ISSN: 2772-283X




animal science proceedings

10th International Sheep Veterinary Congress (ISVC 2023)

6th–10th March 2023
Seville, Spain

animal

March 2023
Volume 14
Issue 1

animal - science proceedings

The international journal for conference proceedings A member of the animal family of journals

Aims and Scope

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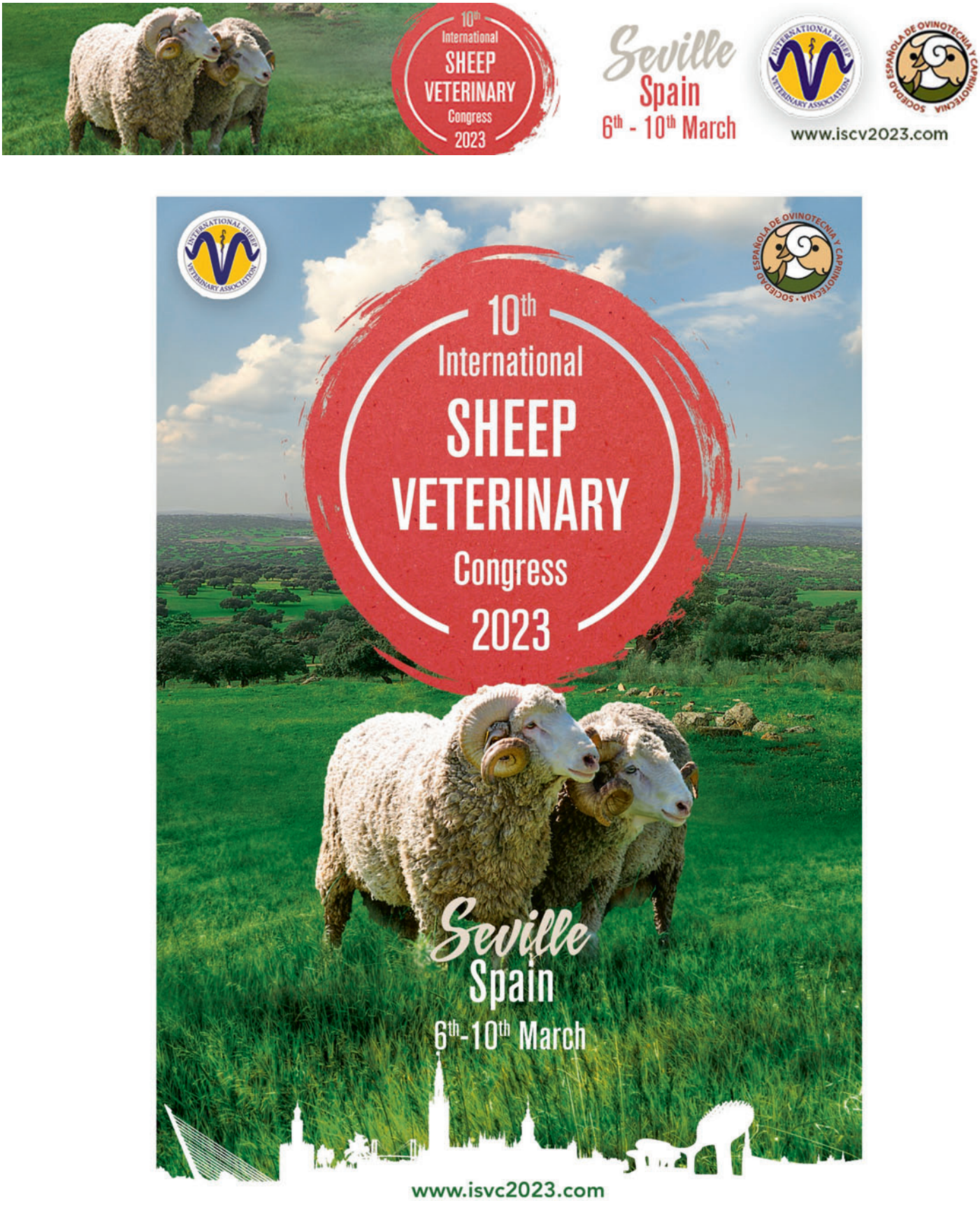
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WELCOME LETTER

Dear Colleagues,

The Spanish Association for Sheep and Goat Production (SEOC), as member of the International Sheep Veterinary Association (ISVA), in representation of Spanish Sheep Veterinarians, was elected to organize the 10th International Sheep Veterinary Congress (ISVC) in 2023 from 6th - 10th march, in Seville. We are enthusiastically organizing the Congress to which we would kindly like to invite you to attend.

There are several reasons for attending this event:

Spain is the third country in Europe with a census of 16 million sheep, behind the Russian Federation and the United Kingdom. Third country also in terms of meat and milk production, with just over one hundred thousand tons of meat and half a million tons of milk. The high productions in these species give an idea of the diversification of management and production systems that attendees will be able to see in the pre-tour and post-tour that we are organizing. This high specialization will also be reflected in the contents of the scientific program.

The geographical position of Spain in the South of Europe, with excellent communications with all over the world, will facilitate the attendance of participants from the five continents, especially from South American countries because there is no language barrier.

Our experience with the organization of the International Sheep and Goat Medicine conferences since 1975, managing more than 400 attendees and around 30 commercial sponsors yearly.

The good infrastructures of the city of Seville, its extraordinary communications and the stable political situation of Spain within the European Union, as well as the fantastic facilities where the Congress will be held, are some factors that will strongly facilitate a wide international participation.

Seville has been chosen as the world's best tourist destination in 2018, according to the Lonely Planet travel guide, being considered a very suggestive city for its rich historical and artistic heritage. This bi-millenary city has the largest historic center in Spain, with a rich gastronomy, welcoming people and mild climate, which invite you to get lost in its streets and squares.

The venue of the Congress offers all kind of technical facilities as a guarantee for successfully develop a solid and attractive scientific programme. Moreover, the venue and the city offer the most appropriate conditions and the best environment for the social events of the Congress.

The help and support of the Seville University, the Conference of the Deans of the Spanish Veterinary Faculties, the Mayor of Seville, the General Council of Veterinary Associations of Spain, the Andalusian Minister of Agriculture, Livestock, Fisheries, Food and the Natural Environment, in addition to a significant number of sponsoring companies, who have supported the organization of this event.

Come and enjoy our ISVC-2023 in Seville!!!

Mrs María J. Alcalde & Mr Jesús Barandika Iza
Presidents of the Organising Committee

All the research reported in this issue complied with the ethical and welfare regulations of the relevant countries.

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Information about the Local Organizing Committee:

The Spanish Society for Sheep and Goat Production (SEOC) is a non-profit association, open to all professionals interested in these sectors, both meat production and dairy. It was created in 1975 by a group of lecturers, researchers and technicians specialist in animal production. It was born from the concern of these professionals on exchanging knowledge, promoting research, and above all, transfer the latest developments on these species to rural areas and the productive sector through its technicians. In the IX Conference (1984), the field of action of the Society was expanded into the study of Caprine species, the Conference held in Granada and Malaga being the first that had the name with which we know it today: Spanish Society for Sheep and Goat Production (SEOC).

The SEOC annually celebrates its scientific conference with an itinerant character, so throughout the years of its existence it has traveled through the country and even once the conference was based in a Portuguese town. Scientific sessions have always had a very wide national echo and since the XXII conference, this event gained also an international scope and character. The SEOC currently has more than 400 members. Over 150 communications are presented in the annual Conference, in which more than 400 people are involved. Besides, SEOC organizes seminars and courses at the highest level. SEOC also publishes its own magazine focused in the dissemination of the latest scientific advances to the sheep and goat sectors. In 2015 the European College of Small Ruminant Health and Management (ECSRHM) held its annual general meeting in Castellón de la Plana, coinciding with the XL National and XVI International Congress of the SEOC. The Spanish Society honored their guests by implemented simultaneous translation in the main hall for the entire Conference.

The SEOC is a founding member of the Union of Spanish Institutions of Animal Production (Unión de Entidades Españolas de Ciencia Animal, (UEECA) and the Vet+i Foundation (Spanish Technology Platform for Animal Health). Moreover, the SEOC upholds collaborative relations with the Spanish General Council of Veterinary Associations, other Veterinary Schools and their Student Associations. Within de framework of its XLI National and XVII Internacional Conference, held in September 2016, the General Assembly decided to put the SEOC forward as the candidate organizer to hold the 2021 International Sheep Veterinary Congress in Spain.

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Main tasks at SEOC:

SEOC participates actively in the technical coordinating group of ‘‘Strategic and action plan to reduce the risk of selection and dissemination of antibiotic resistance’’, while being represented in six other groups coordinating the same plan. These groups deal with issues related to the consumption of antibiotics in livestock farms, causes of the high use of antibiotics, plans to reduce their use, establishment of rapid diagnostic tests aimed to reduce their use, prescription of antibiotics and the development of guidelines for their correct use addressed to veterinarians as well as to cattle ranchers. All these aspects are presented by our representatives from the perspective of keeping the real situation visible and possible improvements that can be carried out in the sheep sector. (The second edition of this plan can be downloaded in this link)

Given the recent outbreak of foot-and-mouth disease in Spain, due to recent outbreaks in Morocco, MAGRAMA (Minsiterio de Agricultura y Pesca, Alimentación y Medio Ambiente), in collaboration with EuFMD (European Commission for the Control of Foot-and-Mouth Disease), organized a training course for veterinarians in the fight against this disease. These technicians would be in charge in case it would be necessary to spread the information between the dierent sectors. In this sense, SEOC oered to MAGRAMA the possibility of forming partners that covered a wide geographic distribution to act as messengers of the information if necessary, Due to the limited nature of the course only a few members were admitted by MAGRAMA to attend the event. The admitted members participated actively in the course providing the vision of the sheep and goat sector.

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Alberto Bernués
Chris Buschbeck
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Animal - Science Proceedings 14 (2023) 1–12

Contents lists available at ScienceDirect

Animal - Science Proceedings

journal homepage: www.elsevier.com/locate/anscip

10th International Sheep Veterinary Congress (ISVC 2023) – Plenary Talks

PL-1
The Merino sheep and its spread throughout Europe

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Keywords: Merino; Mesta; Trashumance; Fine wool; Universalization

Much has been written and speculated since ancient times about the origin of the Spanish Merino and when its first appearance came about, with very different and at times unfounded theories being offered about its origin and the animals that were involved in its breeding. And although to this day this eternal riddle has not yet been fully solved, it is a generally accepted fact that the formative process of the Spanish Merino happened on Iberian Peninsula soil.

Some of the oldest historical references to the eminently pastoral and livestock farming character of many communities in pre-Roman Spain are provided to us by classical authors. A fairly common feature that was often used to describe the sheep of Hispania was the black or dark colour of their wool.

The Turdetani were the inhabitants that the Romans met upon their arrival in the southwest peninsular in 3th century BC, in what was called Turdetania. The customs of Turdetani included dressing in fine black wool and trading materials from said wool. These intensely black wools from Turdetania were highly valued and sought-after by the Romans. Like the Romans, the native inhabitants of that land showed great appreciation for their sheep and the quality and fineness of the wool.

The dark tone of the Hispanian sheep fibre pushed the Romans into cross-breeding the black sheep to achieve fleece whitening. It is not known for sure the degree of expansion and influence that the results of those crosses could have had amongst the sheep population in Hispania.

In Muslim Spain there are reports from the middle of the 10th century that refer to the quality of the Andalusian wool. The existence of black wool garments and garments made of dyed wool cloths would therefore indicate the presence of black wool sheep and white wool sheep.

In Christian Spain and as the Reconquest was making its way southwards, especially from the eleventh and twelfth centuries onwards, it meant that the livestock of the Christian kingdoms could use the lands recovered from Islam. This must have encouraged the farmers from the mountainous areas in the northern half to move with their livestock and keep them there during winter. In spring they made the trip back to the northern areas to enjoy the summer pastures that grew in their mountains.

With these complementary movements, an intricate network of livestock trails spread that connected the grazing pastures of the centre and north peninsular with the fertile winter pastures of the south in a continuous cycle that for centuries involved legions of mountain shepherds and their herds of transhumant sheep.

Without passing judgement on the basis of the theories about the formation of the Merino breed, the fact is that it would be in the 14th century that we can reliably establish the existence of a breed of sheep producing a particularly fine wool, called *merina*. This was the word used exclusively to designate such a singular type of wool. Secondarily, this would provide the name given to the sheep producers of the same, even though the breed could have existed previously.

We can therefore assure that the sheep that the Castilian mountain herdsmen and shepherds had been selecting and rearing on a transhumant basis for several centuries was definitely the Merino breed.

For geographical, historical and ethnological reasons, the parallel presence of Merino in Portugal is worth noting, a country that shares the history of this breed with Spain and the peninsular transhumance.

An external episode gave a second impulse to transhumant Merino at the beginning of the 15th century. And it was the trade dispute between England and the Netherlands that resulted in the suspension of exports of English wool to the Netherlands. Due to the lack of raw material the Flemish textile industry turned to fine Castilian wool, whose class and fineness was perfectly adapted to the characteristics of the new cloths and light fabrics.

This strong external demand greatly increased the price of fine wool from Merino that migrated long distances, which resulted in a substantial improvement in the profitability of this type of traditional livestock. As a result, the Merino population increased from an estimated 1.5 million at the beginning of the 15th century to three million head approximately a century later.

The existence in Castilla of white wool Merino coincided with an important presence of black wool Merino. Its ethnological relevance should be highlighted, being considered the sheep from which the white wool Merino came. However, to this day the black variety is in danger of extinction, having been so consequential in the history of the Merino breed.
The Merino bequeathed by La Mesta was, on the whole, a selected sheep type that was highly specialized in the production of fine wool, making it the world's first industrially oriented breed, whose wool production supplied the European luxury textile industry for centuries. As a result of this process, a very substantial reduction in the diameter of the wool fibre, the increase in the weight of the fleece and improvement in other parameters of the quality of the wool were achieved.
It was during the eighteenth and early nineteenth centuries that an unrestrained ambition was unleashed among the various European courts and states to have their own Merino farms. So, a race began to get the Merino into the states, who implemented strategies of all kinds, legal or otherwise, which together with the willing attitude of the Spanish Crown itself and certain historical events, all led to the effective procurement of Merino livestock from Spanish soil.
Some of the most significant operations that allowed for the departure of Merino from Spain and the subsequent loss of the wool monopoly occurred then. These were in the form of gifts or concessions of Merino livestock from Spanish Crown to other royal courts in Europe, despite the prohibition for its departure from the Kingdom.
In 1864, Carlos III determined to authorize a consignment of Merino livestock destined for Saxony in response to a request of his brother-in-law, the Regent Elector of Saxony. On July 30th 1765 a Merino herd, composing of some 220 or 230 head arrived to Stolpen, near Dresden. The Merino core quickly adapted to its new conditions, multiplied, served for the improvement of indigenous livestock and gave rise to the so-called Electoral Merino of Saxony, which was very high-quality wool that was respected internationally.
Although there were other Merino livestock shipments to Holland, the personal gift that the King of Spain made to William V is worth mentioning due to its later implications, which consisted of two rams and four sheep chosen from his own *El Escorial* farm. This reduced core would later give rise to the South African Merino.
George III had asked Carlos IV's permission to take a consignment of Merino to England, to which the Spanish king agreed. The officially authorised shipment in 1791 was complemented by a personal gift from the Countess of Campo Alange to the English monarch consisting of 4 rams and 36 sheep from her own farm. By legal means or otherwise, the English Crown had gathered a herd of 192 Merinos, 27 rams and 165 ewes, and thereby the so-called His Majesty's Spanish Herd was formed.
But the largest Merino contingent was yet to come, and it was the result of the War of Independence, in which England lent military support to Spain against France. In total, several thousand Merino heads were shipped to England and the United States of America where the Vermont Merino would be formed.
The French King Louis XVI personally requested his cousin, Carlos III, his approval to select a lot of Merino livestock in Spain and to incorporate it into the Royal Farm of Rambouillet, a request to which the Spanish monarch fully agreed.
On June 15th 1786, a flock Merino departed from Villacastín, Segovia province, destined for Rambouillet. The herd was tended by five shepherds. Finally, in mid-October, after four months and with more than 1,400 kilometres travelled, the five shepherds and herd arrived at the Royal Farm of Rambouillet, near Paris, delivering 318 ewes, 41 rams and the 7 wethers, as they had lost 16 ewes and a ram along the way. This initial herd, together with other later additions, represented the founding core that would give rise to the famous Rambouillet Merino.
The Basel Peace Treaty, signed definitively between Revolutionary France and Spain on July 22nd 1795, contained three secret clauses, one of which empowered the French Republic to extract sheep and Merino rams for five years up to a maximum of 1,000 sheep and 100 rams from Spain per year, totalling 5,000 sheep and 500 rams.
Despite the completion of the quota that had been pledged in the Basel Peace Treaty, extractions to France continued plentifully during the early years of the 19th century, contributing to the expansion of Merino.
The French invasion of Spain in 1808 and the War of Independence proved disastrous for transhumant activity. The Merino population was seriously affected by the troops' consumption and their being taken to France and England, from which it would not recover.
In the rest of Europe from the last decades of the 18th century and the beginning of the 19th century onwards, the spread of the breed and the increase of the Merino population had indeed materialised in practically all the countries of the continent. But it was in Saxony and France that the greatest development and the most careful selection of the breed was achieved by using technical and scientific criteria. From the end of the 18th century the Merino was taken from Europe to the other corners of the world, where it managed to settle and prosper in most parts, thus achieving the globalisation of the breed.
Finally and as epilogue, the development of the Spanish indigenous Merino, the central character of this extraordinary adventure, far from being a one-off event, represents the culmination of a continuous process of selection and improvement of wool applied to sheep. This has been a process that reached its zenith moment with the creation of the Mesta and the age-old practice of long-distance sheep transhumance throughout the Iberian Peninsula by Spanish livestock farmers and shepherds. And it is to them that the credit must first be given for this unequalled animal husbandry and ethnological milestone in the sheep species and in livestock breeding in general. Quite simply, this led to the development of a unique breed, the Merino, and from it all its universal derivatives, because of its unique animal husbandry characteristics and its historical, social, economic, cultural and environmental importance, it deserves consideration and to be recognised as a World Zooethnography Heritage of Humanity.

doi: 10.1016/j.anscip.2023.01.002

PL-2
History of the Merino in Australia

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Keywords: Wool; Merino; History; Australia

The Merino sheep that first arrived in Australia were from a flock originally given by King Carlos III of Spain to Prince William of Orange in the Netherlands. In 1789, the Prince had sent two rams and four ewes to the Dutch colony at the Cape of Good Hope. Here they were to be cared for by Colonel Robert Jacob Gordon, who had in 1791, returned the original breeding animals when ordered to do so by the Dutch government, retaining their offspring. It was these offspring that provided the first Merino sheep for Australia, when in 1797, Captain Henry Waterhouse and Lieutenant William Kent brought a flock of 26 merinos from the Cape of Good Hope to Port Jackson in Sydney Harbour. Gordon's wife had inherited the sheep after his death, and sold them for £4 per head to Waterhouse and Kent. For the journey to Australia, the flock of 26 was divided between the HMS *Reliance* and the store-ship *Supply*. However, inclement weather nearly doubled their expected time at sea, and more than half the sheep died, despite the efforts made to accomodate them in the officers cabins.
Captain John Macarthur, an officer in the NSW Corps, offered Captain Waterhouse 15 guineas a head for the surviving sheep on the condition he could buy them all. Waterhouse refused the offer and grazed his sheep at 'The Vineyard', a 140-acre property on the Parramatta River he had bought on his return from the Cape. He kept his merino flock segregated, allowing them to breed only with one another. As his flock increased, Waterhouse distributed a few sheep between Macarthur, the Reverend Samuel Marsden, Lieutenant Kent and Captain Thomas Rowley. When Waterhouse returned to England in 1800, William Cox bought most of the flock from him, including several of the original sheep from the Cape. The remainder went to Macarthur who with his wife Elizabeth, had established 'Elizabeth Farm' at Parramatta after the Governor granted him 100 acres there in 1793. Appointed Paymaster of the NSW Corps and Inspector of Public Works, Macarthur controlled much of the resources in the colony and had unrestricted access to convict labour to enable the clearing of timber from his land grant. The Macarthurs expanded their pure merino flock, breeding more than 4000 by 1803, although John had been sent back from Australia to England in 1801 to face court martial following a duel with Colonel Patterson.
Whilst in England, John Macarthur bought 7 rams and one ewe from the first dispersal sale of King George III stud in 1804; the King had been able to obtain these sheep from Spain in exchange for some Flemish horses. Macarthur also promoted the colonial wool industry to the British government and received a commission from Lord Camden to develop the wool industry in NSW, so in mid-1805, Macarthur and the sheep returned to Australia to reunite with his wife Elizabeth who had been developing their flock in his absence. The increasing wealth of the Macarthur family enabled them to seek further land. Many in the colony were aware that soon after arrival of the First Fleet, cattle had escaped from Sydney Cove in 1788. These escapees had developed into a herd that was found to the south on lush pastures by the Nepean River in 1795; an area was promptly named "Cowpastures". The area remained unoccupied for a period due to an official decree that reserved the land for the wild cattle to increase in numbers, until John MacArthur received permission to settle by the Nepean River to graze merino sheep. In 1805, the MacArthur family established 'Belgenny Farm' and then 'Camden Park Estate' on the Cowpastures. Much of Camden Park is now held in the care of the NSW Department of Primary Industry, with their state veterinary laboratories moving from the Glenfield Veterinary Research Station (VRS) to the Elizabeth Macarthur Agricultural Institute (EMAI) in 1990, named in honour of the contribution of Elizabeth to the Australian Merino industry. She was supported by nephew Hannibal Macarthur who established 'Arthursleigh Farm' in 1822 near Marulan in the Great Dividing Range. This 7000ha holding still retains the original historical homestead and a granite and timber wool shed constructed by convicts in 1830. It was bequeathed to the University of Sydney in 1979 for research purposes, with a flock of up to 15,000 fine-wool Merino sheep and 1,000 head of Angus cattle currently run commercially and used for teaching.
It is understood that the first wool export from Australia was shipped in barrels by Macarthur in 1807 and sold in Garraways Coffee House just off Cornhill in London, for 10 shillings four pence per pound. Macarthur was then also absent from the colony from 1809 until 1817 to defend charges of misconduct in England and avoid arrest in Sydney. Elizabeth and Hannibal developed and managed the flock and the production of wool and in 1813, Australia's first commercial shipment of wool from Elizabeth Farm, arrived in England valued at more than £8000. While John was exiled in England from 1809 to 1817, Elizabeth took control of sheep breeding and in 1822, exported 7,000 kg of wool to England. By 1810, Australia had 33,818 sheep. Macarthur then pioneered the introduction of Saxon Merinos in 1812 and the first Australian wool boom occurred in 1813, with the crossing of the Great Dividing Range enabling the vast pastoral areas of NSW to be used for grazing merinos. NSW still remains the state with the most sheep. Interest in merino sheep continued through the 1820s, with another 5000 sheep imported from Europe and South Africa greatly increasing the flock.
In 1841, at Mount Crawford in South Australia, John Murray established a flock of Camden-blood ewes mated to Tasmanian rams. To broaden the wool and give the animals some size, it is thought English Leicester blood was introduced and these sheep became the foundation of many South Australian strong wool studs. Using Merinos and other breeds from Europe, North America and New Zealand, Australian pioneer breeders, including Thomas Shaw, George Peppin and others in South Australia, between 1850 and 1880 re-created the famous short-stapled Spanish fine-wool sheep into completely new domestic sheep strains that were larger, with longer but fine to medium wool. The Peppin brothers purchase Wanganella Station in the Riverina and selected 200 station-bred ewes that thrived under local conditions, then purchased 100 South Australian ewes bred at Cannally that were sired by an imported Rambouillet ram. They mainly used Saxon and Rambouillet rams after importing rams of the latter breed in 1860. One of these, Emperor, cut an 11.4 lb (5.1 kg clean) wool clip. They also ran Lincoln ewes, but their introduction into the flock is undocumented.
Then in 1865, George Merriman founded the fine wool Merino Ravensworth Stud. This enterprise also included the influential Merryville Stud at Boroowa near Yass NSW, a source of many of the fine-wool sheep now occupying the tablelands of NSW and beyond. These breed-

ing efforts produced larger, more robust sheep that could yield up to 10 times more fleece than the original Spanish variety, with wool finer, more densely crimped, cleaner, more elastic and stronger, and thus better suited to the expanding woollen textile industry in Europe. Unfortunately, in the 1880s, Vermont rams were imported into Australia from the USA. These sheep had an abundance of 'skin wrinkle' and their use spread rapidly. Unfortunately, whilst the fleece weight was high, they had lower yield and uneven wool quality, lower lambing percentages, and were at great risk of sheep blowfly strike from *Lucilia cuprina* following the later inadvertent introduction of the fly from South Africa. The Federation Drought (1901–1903) reduced the number of Australian sheep from 72 to 53 million, ending the Vermont era.

The wool industry in Australia has been a 'bumpy ride on the sheep's back', with numerous cycles of 'boom and bust' leading to volatility in sheep numbers, increasing rapidly when wool was able to be combed on the emerging industrial machines of Europe. Within four decades of the arrival of the Merino, Australia had become the world's largest producer of wool with production aligned with the industrialisation of leading European nations and the USA. Then numbers decreased by almost half to 54 million during the devastating Federation Drought (1895–1902), with sheep numbers not returning to their pre-drought levels until 1926. The First World War boosted demand for Merino wool when the British Government bought Australian wool at favourable fixed rates. The unit price for wool again improved dramatically during the Second World War as demand increased for uniforms, blankets and other garments. By the 1950s, the industry was booming and it was commonly said that 'Australia was riding on the sheep's back, with over 6 sheep present for every person living then in Australia. In 1950–51 the gross value of wool production made up 56 per cent of the total value of all agricultural industry production. The mass introduction of synthetic fibres in the second half of the 20th century led to wool representing only 15 per cent of Australia's total agricultural production by 1970. The federal government introduced a minimum reserve price scheme that subsidised the industry through the volatility of wool prices and by the end of the 1980s, the Australian 'peak sheep' flock numbered 172 million head. The world record price for a ram was AUD450,000 for JC&S Lustre 53, which sold at the 1988 Merino ram sale in Adelaide, South Australia (SA).

However, supply was now exceeding demand for wool and by 1990, the reserve price scheme was economically unviable, the industry stalled, and numbers declined as many grazing farms switched their sheep enterprise to cross-breeding or beef cattle. The prolonged severity of both the Millenium Drought from 1996 to 2010 (the most severe drought on record) plus the emerging ovine paratuberculosis epidemic in the 1990s that was unresolved until the 2002 registration of Gudair vaccine from Spain, saw the Australian wool industry continue to decline, with sheep numbers falling to less than 70 million head currently. The strong prices for sheep meat led many graziers into fattening lambs by cross-breeding their merino ewes with British breed rams. Yet, for over 200 years, Merino sheep grazing has been one of the most important forms of land use. As the Australian pastoral industry flourished on Merino wool, a rich 'outback' culture developed, with stories, songs and poems of the travails of the sheep industry, capturing the profound impacts and landscape changes that Merino sheep contributed to Australian rural folklore.

doi: 10.1016/j.anscip.2023.01.003

PL-3
Pass, present and future of Merino in Argentina and Uruguay

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Keywords: Animal breeding; Australian Merino; Wool; Valorisation

History

Merino breed in Argentina: De Arrascaeta (1998) cited that three Merino entrances took place between 1825 and 1827 been Bernardino Rivadavia Government Minister, those of which identified the beginning of a new era in the Argentine wool history. At this moment the number of sheep in the country was around three million. Once Merinos were introduced into de the country, it was still necessary to assure its capacity to improve offspring by crossbreeding the flocks. In 1826, Peter Sheridan jointly with Thomas Whitfield and John Harrat formed a model stud known as *Los Sajones*. The stud grew by having pure merinos and applying zootechnics standards. They were the only ones who had pure Merinos until 1930, the date where German Merinos were imported. It was the only stud of the country which produced Merino rams and ewes and it was the only place which had been promoting the genetic improvement of Argentine livestock. Since 1834 new Merino breeders appeared on scene. The effort made by the pioneers slowly showed wool production was getting a relevant place in the exports of the Buenos Aires province. The increase on demand and the several benefits Sheridan and Harrat obtained from Merinos called the attention of the breeders who became interested in buying breed rams. So, this originated a period named as MERINOMANIA, from 1836 to 1838, in which 3,802 Merinos was imported. At the beginning of the Wool Boom (1840) an excellent wool quality was only the aim and at the middle of the century the Ramboullet biotype was the favourite (with thicker fleece and meat producer). Europe still show the tendencies but the local differences in selection would form a new local breed named the *Argentine Merino*.

After Independence disputes, just in 1860, under National State organization, the economic, legal-political and management demands became stronger and little by little wool production found the ways to be de main exported product of the Argentine Republic.

A new Merino period began in 1912 when *Sociedad Rural Argentina* opened the Flock Book of Argentine Merino and the animal's registration started. The change was observed in the full list of studs: the relocation of breeders from the south of Buenos Aires to the Patagonia area and the supremacy of Patagonian studs in the National Rural Shows. According to 1937 census, 54% of the existing stock in the country, equivalent to near 44 million sheep, corresponded mostly to this breed. The Merino breed (in general) an its descendants (the Argentine and the Australian Merino, in the last century) could occupy a very prominent position in the development of the wool production from Patagonia and the country thanks to their different features. The prominence was not only the result of the international reputation their fine wool (quality, uniformity, and price) had but also of all the crosses made with Merinos by stud breeders. In this sense, the Merino is and has been a corrective wool breed and this is evidenced during its history. As the time has gone wool quality has been kept and animals was improved adapting itself to different breeding environments. Finally, the current challenge is to continue seeking for quality in the fine wool production in a world which turns to be more competitive and complex every day.

Merino breed in Uruguay: The Merino breed was introduced to Uruguay in the 19th century (1875) when a family of Basque-French immigrants arrived in the country with their flock. In 1901, the first pedigree imports were recorded in the Rural Association of Uruguay (ARU, 2021). Imports of pedigree animals from Argentina began in 1903, in 1911 from the USA and in 1924 the first rams were imported from Australia. The Australian variety was imported to Uruguay through two English companies based in Argentine Patagonia. In its beginnings, the Merino breed was used to cross with animals of thick wool breeds such as Lincoln and Romney Marsh, producing the renowned "Río de la Plata wool". In 1943, the SCMAU was founded, its first president being Dr. Domingo Bordaberry. Since that date, it has had uninterrupted growth, going from 4% to more than 38% of the national stock today (ARU, 2021).

During the early 1990s, the Uruguayan sheep industry was focused on wool production, with less emphasis on lamb meat (Cardellino at al., 1994). At this time, revenue from wool accounted for approximately 70% of total sheep farmer income, therefore the wool price was the main factor influencing sheep farmer decisionmaking (Cardellino at al., 1994). The Corriedale breed represented 70.5% of the national flock, followed by Polwarth (11.6%), Australian Merino (8.4%), Merilin (3.2%), Romney (1.0%) and crossbreeds (5.3%) (Cardellino at al., 1994). Due to the national sheep breed composition, mid-micron wool (25.0–30.0 μm) was the most abundant wool type (approximately 70%) (Cardellino at al., 1994). During the late 1990s, the mean fibre diameter of Uruguayan Merino wool was approximately 22 μm, with insignificant amounts of fine and superfine wool (Montossi et al., 2007). A decrease in demand for this wool type led to a reduction in the overall number of sheep in Uruguay, but at the same time an increase in the number of fine micron Merinos. This scenario influenced sheep numbers in Uruguay, where the national flock decreased substantially from 25.2 to 13.2 to 8.3 million total sheep for the years 1990, 2000, and 2010, respectively (Montossi et al., 2013). Therefore, most of the sheep population was concentrated mainly in northern and eastern regions of Uruguay, where extensive and semi-extensive production systems are predominant (Montossi et al., 2013).

In 1998, to face this challenge, the Uruguayan Wool Secretariat (SUL), Association of the Uruguayan Merino Breeders of Uruguay (SCMAU), National Institute for Agriculture Research (INIA) and 36 Merino sheep farmers developed the fine Merino Project (FMP, 1999–2010) (Montossi et al., 2007). The main objective of the FMP was to develop a fine Merino genetic nucleus, located at Glencoe Experimental Unit of INIA, specialized in producing fine wool (less than 19.5 μm), generating genetically superior rams to be distributed to commercial farms throughout Uruguay. In response to those wool price trends and market scenarios (favoured the ultrafine wool 15.5 μm or finer), the Merino nucleus continued as part of a new project entitled Uruguayan Regional Consortium for Innovation in Ultrafine Wool (CRILU, 2011-2021). This consortium has been run by an increased number of farmers (42), INIA, and wool top makers of Uruguay. In 2022, a new stage of the CRILU began for another six years incorporating new famers (85 in total).

Present

Genetic evaluation in Argentina: Argentina has the national sheep genetic evaluation service called PROVINO (Giovannini et al., 2015). This service is conducted by the National Institute of Agriculture Technology (INTA) with the aim of estimate the genetic merit of breeding animals. This genetic merit is expressed in terms of Expected Progeny Difference (EPD) and Indexes for the most economically important traits. For Merino, around 1,750 young animals of Polled, Horned and Dohne Merino biotypes are yearly evaluated. PROVINO has two options: *Basic PROVINO*, for individual flocks or contemporary groups, not requires pedigree information and all group animals must have the same characteristics as sex, management group, year and season of lambing. This option is generally taken by multipliers breeders that used to buy rams to commercial flock's breeders. On the other hand, *Advanced PROVINO*, usually used by studs, requires Pedigree and lambing information like sex, birth date and weight, dam age, type of birth (single, twin) and management group. PROVINO is in continuous update and evolution. Current research is focused in analysing the possibilities and cost-benefits of Genomic Evaluation implementation.

Genetic evaluation in Uruguay: Between 1995 and 2000, the Association of the Uruguayan Merino Breeders of Uruguay (SCMAU) with the support of the SUL developed Central Progeny Centers (CPC). In these CPC, Uruguayan and Australian rams were genetically evaluated. Further, during 2001, in conjunction with the Merino nucleus of Glencoe (at INIA) and CPC, seven key Merino Studs started with a pilot across flock genetic evaluation system, connected by reference rams. This was the seed for the implementation of the Merino National Genetic Evaluation (similar to the *Advanced PROVINO).* In the 2002, other ten studs were incorporated to the genetic evaluation. In last years, approximately 20 studs have been evaluated, incorporating more than 5,000 lambs per year with records of production and quality of wool, growth and (8 flocks) resistance to gastrointestinal parasites. Ten traits are routinely evaluated, and three selection indexes were developed by and collaborative work between the SCMAU, INIA and SUL. In the last 20 years a notice genetic trend for fibre diameter, fleece weight, staple length a body weight was observed (www.geneticaovina.com.uy).

Similarities between the Merinos of Australia, Argentina and Uruguay: In recent works (International collaboration) the relationships between populations from Australia, Argentina and, Uruguay were compared using a genomic data and several approaches (e.g. PCA, Reynolds genetic distances, pairwise F_{ST} values). The main conclusion is that the three populations are very close with low genetic differentiation between these populations ($F_{st} < 0.05$) and lower Reynolds' distances observed in the Australian than to Argentina breeds in comparison with the Uruguayan Merino breed. This closeness is reasonable first because they are the same breed of Merino (Australian type) and the direct import from Australia to both countries.

Future developments

Certainly, the valorisation of sheep production will follow the path of valorising animals, people (breeders and social environment) and the environment. This valorisation is accentuated in the products of the Merino breed from Argentina and Uruguay due to the high value of their products that reach the most demanding consumers worldwide. Although these issues have been worked on in isolation for years, the future challenge is to be able to integrate these three aspects. Today there are already various international certifications that someway value several of these aspects (e.g. Responsible Wool Standard, GOTS Certified Organic Wool, Origen – Engraw, Nativa – Chargeurs, Nativa Regen – Chargeurs and LTSA).

From the point of view of animal breeding, in recent years an agroecological vision has been incorporated into the selection objectives. These new approaches include traits related to health, robustness, reproduction, production and efficiency, environmental impact, original and adapted genetics, and product quality.

Several of these traits are being evaluated in both countries aiming to develop solid databases and reference populations that, enhanced with genomics with different strategies, can expand their improvement to the commercial population. Some of these developments (e.g. predicting the genetic level for methane emissions in commercial farms using predictomics) are already being implemented in international brand certification processes.

Given the complexity of this approach, collective action is needed from the various actors in the chain: farmers and breeders' societies, companies, government, science and technology institutions, and society. National and international coordination will play a key role in achieving the objective.

doi: 10.1016/j.anscip.2023.01.004

PL-4
Merinos in South Africa

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Keywords: Sheep; Merino; South Africa; Sheep farms

Domestic animals reached southern Africa about 2000 years ago, with the migration of baNtu peoples from the north. Sheep were the fat-tailed, hair type and natural selection made them well adapted to local conditions. As European trade routes to Asia grew, ships exchanged goods for livestock with the local inhabitants. In 1652 the Dutch East Indies Company established a permanent refreshment station at Table Bay. The first European sheep were introduced in 1657, and after 1695 the Company officials farmed for their own account, and for the next century their trade was with passing ships in the form of meat.

The colony expanded when natural pastures deteriorated because of continuous and excessive grazing; farmers drifted away from Cape Town and became pastoralists. Their sheep provided a staple food, their clothing and bedding, fat for cooking, candles, a form of butter and soap. Monarchs in Europe were accustomed to giving and receiving expensive, rare gifts and some of the Spanish sheep, famed for superior wool, were given to the Dutch Prince William V of Orange-Nassau with far-reaching consequences for the Cape. The Military Commander Colonel Gordon saw the potential of these sheep and suggested in 1779 that they be tried at the Cape. They flourished and multiplied and this was the beginning of the saga of Merinos in southern Africa, the first to be found outside Europe. In 1789 the Dutch authorities sent another consignment to Colonel Gordon but in 1791, ordered their return. Gordon complied, returning what was sent but none of their progeny.

Gordon sold some Spanish rams to progressive Cape farmers, who used the sheep as purebreds or for repeatedly back-crossing with the indigenous Cape Sheep. In 1795 Britain sent a military expedition to take possession of the Cape, announcing that Prince William had authorised the surrender of the Dutch garrison. In good faith, Gordon complied but came under severe criticism that drove him to suicide. In 1797 his embittered widow sold most of his Spanish sheep, and 26 animals were sold to captains of ships on their way to Australia. The British Governors encouraged wool farming by waiving the duties and taxes on Spanish sheep. Large-scale adoption of wool farming only occurred because the market for quality wool in Europe seemed insatiable and there were good, reliable profits to be made from wool sheep. The Merinos spread from the west of the Colony to the east where conditions were highly favourable. By 1840 wool was the major export of the Colony by value and has remained a major livestock agricultural export of South Africa ever since.

Merino numbers in South Africa reached nearly 50 million in the 1930s and 1950s, then were reduced to sustainable levels. Of about 22–25 million sheep in 2022, 16 million are wool sheep. The value of meat from Merinos is estimated at twice that of wool, since sheep meat is prized at a consistent premium. Several breeds originate from the Merino, augmented over the years by importations from many countries. In the past emphasis was placed on evaluations based on looks rather than performance, spreading the genes of sheep ill-suited to their environment. Breeding is increasingly based on objective, measurable performance under practical circumstances, in proportion with relative financial value, combined into an Estimated Breeding Value Index. Because of the crucial role of meat in financial viability, selection and genetic progress is based on the fecundity and mothering abilities of ewes. Large numbers of breeding animals required for significant genetic progress to be made led to the formation of Group Breeding Schemes that combine genetics from many farms, with agreed breeding objectives. Measuring ram performance under practical conditions with minimal supplementation is a way of evaluating the genetic suitability of breeding stock. The groups doing this are known as Veld Ram Clubs. Direct genetic identification using Best Linear Unbiased Prediction enables estimates of direct genomic value and breeding value indices. Estimated breeding values are increasingly available along with relative economic values and indices for rams offered for sale.

Organisations to promote agriculture in South Africa began in the 1790s, and by the 1830s there were several farmer-led societies promoting livestock. In 1906 a Woolgrowers' Association was created followed by local wool sheep associations, culminating in the National Wool Growers' Association (NWGA) in 1929. In 1930, an advisory Wool Council was formed, becoming the statutory South African Wool Board in 1946. These two bodies continued to deliver complementary services to the wool industry until 1998 when Cape Wools, the Wool Trust and the Wool Forum took over some of the Board's functions. The NWGA continues to provide dynamic leadership and unique services to its membership that includes over 2700 commercial and 30,000 small-scale communal wool farmers.

Concurrently there was the creation and development of breed societies to promote breeds, the Merino Breeders Association being formed in 1937. Marketing of wool is done through a variety of brokers and a compulsory wool levy financed operations between 1929 and 1998. South Africa joined other countries in the formation of the International Wool Secretariat in 1937 but withdrew in the 1990s. Legislation relating to sheep dates back to the Dutch era (1652–1795), regulating the movement, taxation and disease control of livestock. In the British era (1795–1910), this legislation included animal welfare, starting in 1856. Parliamentary Acts are supported by Regulations in many cases. There are also official Standards relating to the transportation of livestock and conduct of sales yards. Sectoral organisations like the NWGA and Cape Wools have drawn up Codes of Best Practice for farmers, recently strengthened by Standards. Degradation of the natural indigenous vegetation (veld), followed by reduced carrying capacity for productive livestock and soil erosion has been an enduring problem for over 300 years, the causes of which were hotly debated. The original system of transhumance most closely resembled the natural grazing system of wildlife grazers and browsers, based on movement from nutritionally exhausted to fresh, rested pastures. Overstocking played a role but the consensus of evidence available from research conducted by pasture scientists is that the most important determinant of veld condition and change is how the grazing of the veld is managed. Veld management requires the separation of veld into paddocks (or 'camps') and this requires effective fencing which is expensive especially in arid areas with large camps, and only began when predator control, stock theft and disease management made fencing essential.

That in turn necessitates separate water supplies and other facilities, so the central question became the number of camps needed. The most successful management systems apply short duration, high intensity grazing followed by an effective growing season rest period. Multispecies grazing and veld burning may be used, and farmers must be ready to change stocking rates. This needs systematic assessment of veld condition. These principles result in veld improvement, higher carrying capacities and higher profitability. Predation has been a problem facing livestock owners from earliest times. Originally the solutions used were to kraal (corral) livestock overnight and keep them under the close protection of herders during the day. Firearms led to the progressive elimination of large predators from most areas of livestock farming, but this transferred the problem to smaller carnivores, particularly the black-backed Jackal and the Caracal. These proved much more wily, adaptive and resilient and they have survived decades of predator control. Some farmers have now adopted non-lethal predator management measures that preserve the balance of ecology. Theft is another intractable long-standing problem of livestock farming. Currently, besides legislation and stock theft police units, farmers are encouraged to report all cases, permanently identify their animals as required by law, take extra precautions, and invest in stock movement sensors to detect untoward activity that may indicate theft. Drones are also being used for this purpose. In some circumstances, farmers have been forced to return to nightly kraaling and daily shepherds. The marketing of wool can be problematic, especially when embargoes are imposed on wool imports as a result of disease outbreaks, even when wool poses no disease threat to the importing country. Another potential trading obstacle is the perception amongst consumers of unsatisfactory sheep welfare practices. This is counteracted by strict guidelines set out by Cape Wools in their Sustainable Cape Wool Standard, and by mandatory Mules-free Certification. Sheep diseases in South Africa include those encountered elsewhere in the world, as well as important diseases and problems that are largely or totally confined to Africa, including an array of toxic plants. In the majority of cases, these plants become a problem as a result of faulty grazing management practices. Good veld management is the key to limiting losses from toxic plants. Apart from the globally widespread problem of sheep scab, several tick species cause health problems including direct damage, disease transmission and toxicity. These are best controlled by holistic integrated programmes and not exclusive reliance on ectoparasiticides. Blowfly strikes constitute a major challenge but breeding for plain-bodied animals (that have very little skin pleating) and that are not susceptible to strike has allowed South Africa to discontinue and prohibit the controversial Mules Operation. Haemonchus contortus is by far the most dangerous internal parasite and misuse of anthelmintics resulted in severe and widespread drug resistance. The situation has been counter-balanced by implementing integrated management that includes pasture management, breeding resistant and resilient sheep, monitoring of worm infection, and using targeted selective treatment. Three unique infectious diseases are encountered: the most important is Blue Tongue which can cause severe losses. The availability of a tri-valent vaccine containing the most virulent and important strains renders Blue Tongue a minor problem, provided the vaccine is used correctly. Rift Valley Fever only becomes a widespread and severe problem during years of higher rainfall suited to the proliferation of the vector, mosquitoes. Since these years are irregular and unpredictable, farmers often fail to vaccinate. The vaccine is very effective if used correctly. Heartwater affects cattle and goats as well as sheep. This complicates control measures that may include the control of the vector tick as well as vaccination. A promising new vaccine is under development, while the existing 'vaccine' has many limitations. Very few sheep farms are based on intensive artificial pastures and whole mixed rations, while the great majority of wool sheep are either part of mixed farming that may include crops and cattle or based almost exclusively on natural pastures. Since over 65% of South Africa is regarded as arid or semi-arid, and 85% unsuited to arable farming, these areas are best suited to utilisation by ruminants. Wool farming in South Africa created stable incomes and started a commercial farming economy. Wool exports were a turning point in South Africa's economic history, influencing the growth of trade and the development of harbours and railways. Wool sheep farming based on the Spanish Merino continues to form a cornerstone of the livestock industry in South African agriculture.

doi: 10.1016/j.anscip.2023.01.005

PL-5
Induction of immune responses by vaccine platform technologies

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Keywords: Immunology; Vaccinology; Infection; Disease

The induction of immunological memory is an underlying principle of vaccinology, a concept recognised by Edward Jenner when he used cowpox to vaccinate against smallpox over 200 years ago. Jenner's experiments laid the foundations for modern vaccinology and are especially notable for the fact that they were conducted without detailed knowledge of either the pathogen or the host immune response. It was a further 100 years before the ability to identify, isolate and grow pathogens and reproduce disease in challenge models (based on Koch's postulates) that led to Louis Pasteur deliberately attenuating organisms for the purposes of vaccination. The fractionation and inactivation of pathogen components subsequently led to the first subunit vaccines, which included the clostridial vaccines for sheep. The advent of tissue culture in the 1950s then led to a rapid expansion of viral vaccines and advances in molecular biology and DNA cloning created a base for synthetic vaccine antigen production in the 1980s.
These major step-changes in vaccinology were due to major technological advances in antigen production and were important for improved vaccine safety. However, as antigen production became more refined, it also became clear that antigens alone were not effective at stimulating vaccine-induced immunity and required adjuvants for 'help'. Alum was first widely-used adjuvant and was developed almost 100 years ago. It has an excellent safety profile and is particularly effective at stimulating humoral (antibody) immune responses. Until relatively recently, a major challenge for vaccinology was the induction of cellular immune responses to killed or sub-unit antigens. The answer lay in advances made in immunology and understanding the fundamental mechanisms leading to activation of the innate and adaptive (effector) arms of the immune system. Vaccine platform technologies exploit this knowledge in a generic way to elicit the desired immune responses to vaccine target antigens and can be broadly divided into adjuvant-based, pathogen-based and nucleic acid-based platforms (Entrican and Francis, 2022).
A key advancement of modern vaccine platform technologies is their ability to induce both cellular and humoral immunity to the target antigens. Nanoparticles, replication-deficient adenoviruses and mRNA formulations can all stimulate antigen-specific CD4+ and CD8+ T cells. These platforms have been used for commercial veterinary vaccine development in a range of species, with many future opportunities (Aida et al., 2021). This presentation will discuss vaccine platform technologies in the context of practical factors (cost, frequency of delivery, multivalency, stability) for the design of safe and effective sheep vaccines.

References

Aida, V. et al., 2021. Novel vaccine technologies in veterinary medicine: a herald to human medicine vaccines. Front. Veterin. Sci. https://doi.org/10.3389/fvets.2021.654289.
Entrican, G., Francis, M.J., 2022. Applications of vaccine technologies in veterinary vaccinology and the benefits for One Health. Vaccine 40, 2833–2840.

doi: 10.1016/j.anscip.2023.01.006

PL-6
miRNA signalling and stress resilience, and its implications for disease resistance

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Keywords: Stress responsiveness; Lipopolysaccharide (LPS); Sheep; miRNA

When livestock are reared using intensive farming practices, they experience increased stress that can adversely affect animal health and production, and climate change is predicted to be an amplifying factor. Producers have become reliant on antimicrobials to prevent and treat diseases caused by microbial stressors, but this global practise is being curtailed because it has contributed to the development of antimicrobial resistant pathogens, some of which are zoonotic. Selective breeding based on health traits such as stress responsiveness may be a strategy to improve population level stress resilience, and this would help to mitigate adverse outcomes attributed to stress. Stress responsiveness is a moderately heritable trait, but estimates vary with phenotyping methods.
Bacterial lipopolysaccharide (LPS) endotoxin has been widely used across species as a microbial stressor. When LPS is administered to sheep, it elicits a classical acute-phase response (APR) that manifests as fever, anorexia and temporal increases in serum cytokine and stress hormone (cortisol) levels that model an acute bacterial infection. Bacterial LPS is a biologically relevant stressor implicated in numerous disorders including mastitis, sepsis, acidosis and leaky gut syndrome, which are all exacerbated by heat stress.
Our group has been using LPS to stress phenotype sheep for several years. We have demonstrated that the peak cortisol response to LPS is correlated with immune responsiveness, and telomere length, which is a predictive marker of ageing. This phenotype is moderately her-

itable ($h^2 \cong 0.3$), and we have identified several genetic markers associated with stress responsiveness. Interestingly, LPS stress phenotyping during pregnancy alters ovine fetal neuroendocrine-immune programming, and this is retained into adulthood. The mechanisms by which this occurs are currently unknown, however, epigenetic mechanisms that include microRNA (miRNA) have been implicated in fetal reprogramming.
Recently, we identified 45 ovine miRNAs, 35 upregulated and 10 downregulated, out of a panel of 91 miRNAs that were differentially expressed (DE) during the peak stress response to LPS challenge, most of which are found on ovine chromosome 18. Further analysis of high (HSR), middle (MSR) and low (LSR) stress responders from a population of 112 sheep revealed 3 upregulated and 7 downregulated DE miRNA (HSR versus MSR and LSR). Functional analysis of these DE miRNAs revealed roles in Ras and MAPK signaling, cytokine signaling, adaptive immune system and transcriptional pathways in the HSR sheep. In contrast, metabolic pathways were enriched in the LSR sheep. Collectively, these studies reveal roles for miRNAs in the ovine stress response that should be investigated further to elucidate their contribution to regulating mRNA expression during LPS-induced stress, and their genetic and epigenetic association with variation in stress responsiveness.

doi: 10.1016/j.anscip.2023.01.007

PL-7
The ovine microbiome

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Keywords: Microbiota; Microbioma; Rumen; Milk

The field of microbiome research has evolved rapidly over the past few decades, becoming a topic of great scientific and public interest. Research on the human and animal microbiome has advanced from a fledgling field to a flourishing area of research and has boosted, for good or bad, the whole "microbiome market". The advancement of DNA/RNA, proteins, and metabolite analytical platforms, combined with increased computing technologies, has transformed the field of microbial community analysis. As a result, we have assisted to an exponential increase in the number of publications describing the composition and structure and, sometimes, function of the microbial communities inhabiting almost any habitat, including different parts of the bodies of several animal species.
This rapid evolution of the field has been accompanied by confusion in the vocabulary used to describe different aspects of these communities and their environments. The misuse of terms such as microbiota, microbiome, metagenome, metataxonomic analysis or metagenomics analysis, among others, has contributed to misunderstanding of many study results by the scientific community and the general public alike. Microbiota is a term used to define the assemblage of live microorganisms present in a defined environment. There is a general agreement in relation to the microbiota concept. However, the definition of the term "microbiome" is still a matter of debate and controversy. Some authors define microbiome as the collection of genes and genomes of members of a microbiota. However, others use this term to refer to the entire habitat, including the microorganisms, their genomes, and the surrounding environmental conditions.
The terms microbiota and microbiome include all kind of microorganisms (bacteria, archaea, algae, fungi, and small protists, and viruses. The division of microorganisms into beneficial, pathogenic, and neutral according to microbial interactions with their hosts is based on an anthropocentric view. Indeed, the physiology of the host and the whole microbiome substantially influence the outcome of the interaction. The different members of a microbiome are not a random collection of microorganisms. They form microbial networks and consortia, with hub species and core members. Microbes interact with one another, and these symbiotic interactions have diverse consequences for microbial fitness, population dynamics, and functional capacities within the microbiome. At the end of the day, such interactions have key consequences for the host fitness. Additionally, the microbes that characterize a specific location in a specific host species are the result of coevolution. In fact, host-microbe interactions shape the reciprocal fitness, phenotype, and metabolisms, giving raise to the theory of coevolution of microbiota and their host. Disease state of the holobiont is characterized by dysbiosis (pathobiome), while eubiosis refers to a balanced host-microbe interaction ("healthy" microbiome). In other words, a body's location has a microbiota/microbiome only if (a) microbes are present in such a place in all/most healthy individuals, (b) they have a defined structure (which may have some variations: enterotypes, vaginotypes, lactotypes. . .), (c) its presence is associated to specific functions for its host, and (d) its alteration (dysbiosis) is usually associated to a loss or an alteration of such functions The question of temporal and spatial structures in microbiomes is also important for understanding microbiome functioning. It is also of great significance for the understanding of specific processes, such as outbreaks of pathogens, adaptations during different life stages, adaptation to the ecosystem or productivity (e.g., food conversion rates, production of meat, milk or wool, etc.), as well as for predicting and controlling microbiomes outcomes that may be relevant for the host.
The composition of the microbiota/microbiome of a biological sample and its potential functions are investigated by the application of a combination of several technical procedures, including classic and molecular microbiology, culturomics, metagenomics, biochemistry, metabolomics, metatranscriptomics, metaproteomics, statistics and bioinformatics, among others, combined with clinical or environmental metadata. Most microbiome-related studies performed so far have been based in metataxonomic analysis targeting the 16S rRNA gene and, therefore, they are limited to the bacterial and archaeal side of the microbiota. In addition, such approaches are not suitable for analysis at the species or strain level, which are the taxonomic levels that provide the highest diversity in a given ecosystem. Incorporation or generalization of techniques enabling the study of all the components of the microbiota/microbiome at species/strain level are, therefore, required for a better understanding of the microbiota/microbiome, their functions and for the development of strategies for their manipulation. In fact, despite of the substantial popularity of microbiome research across diverse fields, this extremely fast-growing discipline

faces a variety of challenges. The lack of data standardization as a matter of continuous development of new techniques and equipment, as well as the urgent need for better coordination and collaboration across the field of microbiome research, was recently listed as the most important challenges facing microbiome researchers. Microbiome research is strongly driven by methodological advances. Despite all progress in this area, there is no perfect and universal method.

Robert Koch's explanation of the origin of human and animal diseases as a consequence of microbial infection and development of the concept of pathogenicity was an important milestone in microbiology. These findings shifted the focus of the research community and the public on the role of microorganisms as disease-forming agents that needed to be eliminated. However, comprehensive research over the past century has shown that only a small proportion of microorganisms are associated with disease or pathogenicity; the overwhelming majority of microbes are essential for ecosystem functioning and known for beneficial interactions with other microbes as well as macroorganisms. Another major paradigm shift was initiated at the beginning of this century and continues through today, as new sequencing technologies and accumulated sequence data have highlighted both the ubiquity of microbial communities in association within higher organisms and the critical roles of microbes in human, animal, and plant health. These new possibilities have revolutionized microbial ecology, because the analysis of genomes and metagenomes in a high-throughput manner provides efficient methods for addressing the functional potential of individual microorganisms as well as of whole communities in their natural habitats.

The skin and any mucosal surface of an ovine host harbor a site-specific microbiota, with frequent interactions between the microbiotas of distant organs. In fact, the microbiota seems relevant for any organ or tissue (even those are considered as sterile under physiological conditions) of an ovine host since it play a key role in the host metabolism and, in addition, interacts with all the local and systemic axes (rumen-gut-brain; rumen-gut-mammary; rumen-gut-liver...) through metabolic, immunological and neuroendocrine pathways. As a consequence, any ovine system or organ deserves to be included in microbiome studies. Most of the studies performed up to the present, have been descriptive (composition) and have assessed the impact of several factors (age, mode of birth, breed/genetics, geographical location, season, diet, intensive/extensive regime, diseases, treatments, gestation, milk production...) on the composition. In addition, the microbiota composition in a specific place may have a paramount importance in determining why some animals respond and other do not respond to treatments against some diseases. Anyway, future works must be directed to discover the microbiome-associated functions and how to modulate them. Although the microbiotas of the ovine skin (including that of the feet) or that of the reproductive tract are very promising for understanding ovine health, disease and productivity, most ovine-related microbiome studies have been focused on the rumen and the mammary gland because of their sanitary, economical and/or environmental impact.

Ruminants have evolved a complex digestive tract (a multi-compartmentalized stomach divided into four chambers) that sets them apart from other mammals. The rumen is the first and largest of these chambers and, also, the most important one since the fermentation of the diet consumed by the ruminant occurs there. In contrast to monogastric mammals, feed degradation is not carried out by the animal's own enzymes, but rather is due to the activity of the symbiotic and commensal microbiota present in the rumen. This digestive evolution allows ruminants to take advantage of fibrous foods, and even non-protein nitrogen, such as urea, thus giving ruminants the competitive advantage of a greater diversity of food resources. Specifically, the ruminal microbiota is responsible for the degradation of food through anaerobic fermentation into different products. The degradation of carbohydrates by the rumen microbiota generates volatile fatty acids, which represent the main source of energy for the ruminant; however, during this process, by-products such as carbon dioxide or methane, which are greenhouse gases, are also generated. The rumen microbiota also participates in nitrogen metabolism. For all these reasons, the rumen microbiota plays an essential role in ovine metabolism and health. A better knowledge of the role played by each of the different microbial groups is necessary for developing nutritional strategies that may allow the modulation of the rumen microbiota with the aim of improving health and productivity, as well as reducing the environmental impact of ruminant farming.

The health of mammary glands in dairy ruminants is essential for the production of high-quality milk, so it has strong economic and social effects in rural settings where the production of milk, cheese, and other dairy products is important for the local economy. Mastitis is broadly defined as an inflammation of the mammary gland, and usually results from bacterial infection. Mastitis is highly prevalent and has a strong effect on milk production and quality, and animal welfare. As a consequence, it is generally considered an important threat to the dairy industry. Interestingly, some animals may be mastitis susceptible and some mastitis resistant, even in the same herd. Research has contributed to our understanding of risk factors, including animals' genetic susceptibility to infections. In fact, many microbial, host, and environmental factors can protect against, predispose to, or influence the development of mastitis. In addition, some studies have revealed that the mammary gland harbours a site-specific microbiota and that alterations of this mammary-related microbiota can predispose or lead to mastitis. The bacterial microbiota in the mammary gland of cows has repeatedly been reported to have a protective effect against mastitis. Similarly, the bacterial microbiota in the teat ducts of ewes can protect against mastitis but, under certain circumstances, some of those bacteria can behave as opportunistic pathogens and cause mastitis. Interestingly, it has been suggested that selected bacteria may physiologically translocate from the digestive tract to the mammary gland during pregnancy and lactation. This opens new opportunities for developing novel tools for the prevention or treatment of this condition.

In conclusion, it is expected that microbiome-derived knowledge may contribute to a better understanding of ovine health and production and to develop strategies aimed to preventing or treat diseases, reducing medication, increasing productivity (or to make it more sustainable) or reducing the environmental impact of ovine production.

doi: 10.1016/j.anscip.2023.01.008

PL-8
A review of sheep resilience

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Keywords: Robustness; Climate change; Adaptative capacities; Animal breeding

Introduction

Resilience can be defined as the animal's ability to maintain an adequate production performance under challenging conditions or as the ability to return to its state prior exposure to stress, without permanent consequences, and adapting quickly to environmental fluctuations (de Goede et al., 2013). This concept was integrated in the definition of robust animals by Knap (2005), as being those that combine high production potential with resilience to stressors in different environmental conditions.

Sheep production is present worldwide under diverse environmental conditions in different production systems. Therefore, it is affected by several types of stressors, which are also changing. To mention some, stressors can be associated with climate, feed resources, incidence of parasites and pests, wildlife, and husbandry. Firstly, in relation to climate stressors, extreme events of rain, droughts and heat waves can directly and unfavourably affect outdoor and indoor sheep production. Furthermore, as climate is changing livestock production will be differentially affected at regional and local levels. Secondly, climate change will also affect the availably and quality of feed resources. Under pastoral conditions, sheep production is often characterised as extensive, low-input systems on rangelands and marginal areas. Therefore, pasture availability and nutritional value between and within years may limit the expression of sheep production potential. On the other hand, more intensive and high-input systems, can probably cope better with climate change and feed supply variation, assuming increased costs and competing for human-edible food, or land potentially used with this purpose. Thirdly, diseases like internal and external parasites are significant challenges for sheep and given the growing evidence of drug resistance it is crucial to implement alternatives to enhance sheep resilience to parasites. Finally, finding ways in which wildlife and livestock can co-exist appears to be relevant, particularly in regions where predators cause sheep and lamb losses and in the light of recent significant pressure in some European countries for the 're-wilding' of farmland.

Improving sheep resilience could be a strategy to increase production, adaptability, and sustainability (social, economic, and environmental) under an agroecological transition. The objective of this paper is to discuss how animal breeding can contribute towards improving sheep resilience.

Animal breeding

For many decades, characteristics related to productivity and, for some species, to resilience have been included in breeding programs. More recently, feed efficiency and greenhouse gas emission traits have been investigated, and genetic parameters for both group of traits developed. It is important to consider the potential antagonisms that may exist between productivity and resilience or health traits, which could be important when selecting for more efficient animals. To evaluate and quantify the potential antagonisms it is necessary to define resilience traits and estimate the genetic parameters amongst the traits in the breeding programme. Adding resilience traits, if possible, to current breeding programs would allow for traits to be monitored the consequences quantified so that any potential trade-off could be minimised. In parallel with selection for high productive animals, several countries have imported foreign sheep breeds to improve production (breed substitution). Although successful performance of introduced breeds in the new environment has been reported, the adaptation of those high productivity foreign breeds may not be as resilient as indigenous breeds.

Some suggested indicators of resilience are traits associated with growth, fatness, feed intake, tolerance to weather, reproduction, and health. In terms of growth and fatness, body weight (BW), body condition score (BCS), fat cover and their variation have been investigated as accretion and mobilization of body reserves are an important process for animals to cope over periods of feed shortage during high nutritional requirements such as during lactation. Wilkes (2017) indicated that the best indicator for sheep resilience under a low-quality diet, which is common in pastoral conditions in rangelands, is BW variation which is a response to changes in feed quality, availability and intake. On the other hand, Vialoux (2020) reported a relationship between BCS change and reproduction, in which animals that mobilized and accrete more body reserves had improved performance and stayability in the flock. Although the heritabilities of BW and BCS are medium to low respectively, the estimates for the change of both traits have been reported to be low (Vialoux, 2020). Despite this, these traits can generate a positive economic impact when they are measured and included in selection indexes (Walkom and Brown, 2014).

Infestation by gastrointestinal nematodes is one of the most important challenges for sheep pastoral production systems. Host animal genetic resistance to nematodes has been reported worldwide, with low to moderate heritability (Walkom and Brown, 2014), and co-selection of sheep for resistance against different parasites would be possible. No unfavourable genetic correlations with BW or negligible with fat, muscle or reproduction have been reported. Nevertheless, genetic resistance to parasites can be a cost for the host (Douhard et al., 2022), indicating that a trade-off between resilience and production exists which may affect productive performance in restrictive environments.

Foot rot is another endemic disease, which has been found differences in susceptibility to the disease among breeds and animals in different environments. The heritability for susceptibility to foot rot ranged from 0.12 to 0.30 (Nieuwhof et al., 2008), being possible to select less susceptible ewes. As well, the infestation of the skin by a blowfly larva is an important stressor in Australia. Selecting animals against

breech wrinkle has the potential of improving animal resistance to fly strike. It is highly heritable trait and presented favourable (fleece weight, reproduction, BW and BCS) and unfavourable (fibre diameter) genetic correlations with production traits (Walkom and Brown, 2014). Another relevant disease is mastitis, which is under genetic control in several breeds and production systems (Oget et al., 2019). The heritabilities for the most frequently used proxy traits are low to moderate (0.04–0.30), with positive to negative genetic correlations with milk production, or close to zero with body, conformation, and meat production traits. Finally, immune competence has been studied as a proxy for sheep resilience (Hine et al., 2022). It has a moderate heritable (0.49) and shows favourable genetic correlations with traits associated with fitness and resistance to diseases.

Thornton et al. (2021) predicted an increase in the number of days per year of extreme heat stress for sheep by the end of this century. New alternatives to identify more adapted animals to heat stress are needed, as the impacts of climate change may evolve faster than the modifications achievable by traditional genetic selection within breeds (Sánchez-Molano et al., 2020). One of the challenges in detecting resilient animals to an environmental challenge is the lack of precise recorded data about the environmental events. Garcia-Baccino et al. (2021) reported a method to detect unrecorded events and study animal differential responses to environmental challenges. Furthermore, the method allows estimating breeding values for environmental sensitivity of the genetic potential for feed intake and linked to high production potential of the animals.

Reproduction can be an indicator of animal fitness or well-being. Ewe reproduction traits usually have low heritability and are favourably correlated with BW, fat, eye muscle area, from favourable to unfavourable with wool fibre diameter and from negligible to unfavourable with fleece weight. Finally, the trait 'stayability' is defined as the probability of an animal to stay in the flock has been suggested as a proxy for resilience, presenting a low to moderate heritability (Conington et al., 2004). It may indicate the resilience of a sheep over time, but accurate culling information is needed to fairly evaluate the presence or absence of an ewe in the flock through the years.

Conclusions

Sheep resilience combined with high potential production is receiving growing attention, with the potential of improving animal and flock adaptation to current and future production and environmental scenarios and consumers' needs. From an animal breeding point of view, several traits associated with resilience have been identified. In many cases heritabilities tend to be low to moderate, and some trade-offs with productive traits have been found. The best way to address such trade-offs is within the context of a structured selection index and weighted accordingly with appropriate economic values for each trait in the breeding goal.

Acknowledgments

Authors acknowledge the contribution of the projects RUMIAR (CL38 financed by INIA), Smarter (financed by H2020, n°772787), and GrasstoGas (ERA-NET SusAn, ERA-NET FACCE ERA-GAS and ERA-NET ICT-AGRI 2) to generate this manuscript.

References

Conington, J., Bishop, S.C., Waterhouse, A., Simm, G., 2004. A bio-economic approach to derive economic values for pasture-based sheep genetic improvement programmes. J. Anim. Sci. 82, 1290–1304.
de Goede, D.M., Gremmen, B., Blom-Zandstra, M., 2013. Robust agriculture: Balancing between vulnerability and stability. NJAS – Wageningen J. Life Sci. 64, 1–7.
Douhard, F., Doeschl-Wilson, A.B., Corbishley, A., Hayward, A.D., Marcon, D., Weisbecker, J.-L., Aguerre, S., Bordes, L., Jacquiet, P., McNeilly, T.N., Sallé, G., Moreno-Romieux, C., 2022. The cost of host genetic resistance on body condition: Evidence from divergently selected sheep. Evolut. Appl. 00, 1–16.
Garcia-Baccino, C.A., Marie-Etancelin, C., Tortereau, F., Marcon, D., Weisbecker, J.L., Legarra, A., 2021. Detection of unrecorded environmental challenges in high-frequency recorded traits, and genetic determinism of resilience to challenge, with an application on feed intake in lambs. Genet. Select. Evolut. 53, 1–14.
Hine, B.C., Acton, G.A., Elks, D.J., Niemeyer, D.D.O., Bell, A.M., Colditz, I.G., Ingham, A.B., Smith, J.L., 2022. Targeting improved resilience in Merino sheep – Correlations between immune competence and health and fitness traits. Animal 16, 100544.
Knap, P.W., 2005. Breeding robust pigs. Aust. J. Exp. Agric. 45, 763.
Nieuwhof, G.J., Conington, J., Bunger, L., Haresign, W., Bishop, S.C., 2008. Genetic and phenotypic aspects of foot lesion scores in sheep of different breeds and ages. Animal 2, 1289–1296.
Oget, C., Tosser-Klopp, G., Rupp, R., 2019. Genetic and genomic studies in ovine mastitis. Small Ruminant Res. 176, 55–64.
Sánchez-Molano, E., Kapsona, V., Oikonomou, S., McLaren, A., Lambe, N., Conington, J., Banos, G., 2020. Breeding strategies for animal resilience to weather variation in meat sheep. BMC Genet. 21, 116.
Thornton, P., Nelson, G., Mayberry, D., Herrero, M., 2021. Increases in extreme heat stress in domesticated livestock species during the twenty-first century. Global Change Biol. 27, 5762–5772.
Vialoux, I.M., 2020. Genetic parameters of body condition score and effects of BCS and BCS change on ewe performance PhD Thesis. Massey University, Palmerston North, New Zealand, p. 191 p.
Walkom, S.F., Brown, D.J., 2014. Breeding for resilience and resistance in Merino sheep. In: Hermesch, S., Dominik, S. (Eds.), Breeding Focus 2014 – Improving Resilience, pp. 141–156.
Wilkes, M.J., 2017. Understanding physiological drivers of resilience in sheep (Issue May) PhD Thesis. The University of Adelaide, Australia, p. 283 p.

doi: 10.1016/j.anscip.2023.01.009

Animal - Science Proceedings 14 (2023) 13–46

Contents lists available at ScienceDirect

Animal - Science Proceedings

journal homepage: www.elsevier.com/locate/anscip

10th International Sheep Veterinary Congress (ISVC 2023) – Keynotes

ISVA: Sustainability

K-01
FAO's work for the development of the sheep subsector

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Keywords: Sheep; Breeds; Pastoralist; Diseases

According to the Domestic Animal Diversity Information System, there are currently 1384 sheep breeds reported by 171 countries, accounting for 24% of total livestock breeds reported worldwide. Those breeds are reported to be related to providing a large diversity of regulation and maintenance of ecosystem services. Small-scale farmers keep small ruminants for subsistence and economic reasons, and in either role, they generally improve household livelihoods, but they can do much more. Women are significant actors in the small-ruminant sector, particularly in processing activities and managing small livestock. Farmer field schools (FFS) have helped small-scale sheep producers in many countries across developing regions to achieve sustainable food production and to improve their livelihoods. The global small ruminant sector uses about one billion ha of land, 95% being pastures and rangelands. Planned herding of livestock is a central common practice vital for the sustainable management of rangelands. The technical guide on *Improving the governance of pastoral lands* provides solutions to securing pastoral governance and tenure without undermining the inherent, necessary complexity of customary arrangements. It also provides solutions within a rapidly changing context in which traditional practices and crucial patterns of livestock mobility are transforming, including for small ruminant pastoralists. Small ruminants only contribute about 7% of total GHG emissions from livestock (GLEAM-i) and have a significant potential to reduce their emissions by applying best practices on the land. For example, small ruminants in West Africa could reduce their emissions by 27–41% with modest improvements in feed and fodder quality, animal health and grazing management.
Peste des Petits Ruminants (PPR) is a highly contagious disease infecting wild and domestic small ruminants. This disease is particularly prevalent in Africa, Asia and the Middle East. The PPR secretariat (FAO and World Health for Animal Health (OIE)) are responsible for the overall coordination and management of the PPR Global Control and Eradication Strategy (GCES), which was launched in 2015 with the global eradication of PPR conceptualized as a 15-year process to be completed by 2030.
The FAO Pastoralist Knowledge Hub (PKH) established eight regional partnerships of pastoralist organizations, including pastoral sheep networks. Within the partnerships, pastoralists can share information and participate on platforms to advocate for pastoralism; for instance, the PKH supported the establishment of the regional European Shepherds Network and supported them in their advocacy initiatives. The PKH also supported the FAO-CIHEAM (International Centre for Advanced Mediterranean Agronomic Studies) network on Mediterranean pastoralism and supported the advocacy of the Common Agricultural Policy.

doi: 10.1016/j.anscip.2023.01.011

K-02
New opportunities of using sensors in small ruminantsa

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Keywords: Small ruminants; Precision livestock farming; Welfare; Sensors

The small ruminants (SR), sheep and goats, are the most numerous livestock species (excluded poultry) in the world. In the case of the EU, most of them are electronically identified (e-ID), which suppose a great opportunity for the implementation of precision livestock farming by sensors. Compared to e-ID transponders, which send fix outputs, the sensors send variable signals according to the type and intensity of the input. In practice, sensors are classified as non-wearable (fixed) and wearable (attached to the animal). Among them, their use in SR will be analyzed for ambient monitoring, electric fences and grazing, automated weighing and growth recording, milk recording and health and behavior problems detection, with special attention on early warning systems. The study of sensor applications for the evaluation of SR welfare is the main aim of the Project TechCare (https://techcare-project.eu/), currently in progress. Its results showed that, prioritization of welfare problems vary according to countries, productive purpose and production systems. Thus, meat sheep (1, nutrition and water; 2, stoking-rate; 3, gastrointestinal parasites and lameness), dairy sheep (1, nutrition and water; 2, mastitis and milking management; 3, shelter ambient) and dairy goats (1, mastitis and milking management; 2, nutrition and water; 3, agonistic behavior and feeding competence). Moreover, the technologies of greater interest for the detection of welfare problems were selected and prioritized, resulting: meat sheep (1, meteorological station; 2, automated scale; 3, high frequency ear tags and readers), dairy sheep (1, meteorological station; 2, milk meters; 3, automated scale), dairy goats (1 y 2, idem to dairy sheep; 3, high frequency ear tags and readers). In conclusion, all indicates that there is a wide market for sensors in SR and that wearable systems seems to be the ideal solution for animal-based indicators, although those non-wearable may be an option of interest due to their cost-benefit. In any case, further research is needed to support the current results and limits of using sensors in SR.

doi: 10.1016/j.anscip.2023.01.012

K-03
Reduction of greenhouse gas emissions and carbon footprint on sheep production in Spain

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Keywords: Emissions; Footprint; Sustainability; Management

Small ruminants generate greenhouse gas (GHG) emissions (methane, nitrous oxide, carbon dioxide) accounting for 7.4% of global GHG emissions (FAO, 2017), and the particularities of the species and farming systems imply that the carbon footprint of sheep milk and meat is more than the double per kg of product compared with that from cattle (Batalla et al., 2015). In Spain, livestock accounts for around 7.6% of total GEI emissions (MITECO, 2020), being sheep and goats responsible for around 16% and 4% of livestock emissions (less than 1.5% of total emissions) respectively (the remaining emissions correspond to beef cattle with 40%, pigs with 24% and dairy cattle with 15%) (Del Prado et al. 2021). However, in the search of sustainable development, it is crucial to consider the diversity of farming systems and functions that many of these systems perform (food, fire prevention, etc.) and the benefits generated or ecosystem services. In addition, it seems evident that knowledge gaps exist amongst sheep farmers about the use of different innovative best practices to reduce GHG emissions. And according to all this, it is necessary to design policies more aligned with sustainability objectives from a three-dimensional perspective (environmental, economic and sociocultural) and the transfer and implementation of management practices and measures aimed at reducing emissions, improving the adaptation and resilience of the systems to the new scenarios and enhancing the ecosystem services linked to livestock systems linked to the territory and pastoralism. In this context, the LIFE GREEN SHEEP project was created to improve sheep production systems towards lower carbon emissions and management practices that contribute to improve flock sustainability. Starting from a carbon footprint (CF) calculation approach, sustainability indicators will also be applied in a large number of demonstrative and innovative flocks in the participating countries (Spain, France, Ireland, Italy and Romania). A quantitative and qualitative comparison of several tools (ARDICARBON from Spain, CAP'2ER from France, CARBONSHEEP from Italy and SHEEPLCA from Ireland) has been carried out, and several changes were proposed to improve the comparability of the results. Technicians have also been trained in the use of these tools, and a sample of demonstrative and innovative flocks have been identified. Specific action plans will be developed for a sample of innovative flocks from all these countries with the specific objective of reducing the carbon footprint of sheep meat and milk production by 12%, while trying to improve the sustainability of the flocks from a three-dimensional point of view (social, economic and environmental). An update of the current state of the project, regarding the dairy and sheep farming systems assessed in Spain, will be presented.

doi: 10.1016/j.anscip.2023.01.013

K-04
Organic production

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Keywords: History; Regulations; Healthcare; Chances and challenges

While sheep and goats are still frequently being kept in traditional husbandry systems worldwide, which in many ways resemble organic approaches, intensification of farming has not passed by these small ruminant species in many countries. In Europe, the organic movement dates back to the 1920s, when the idea of biodynamic farming was born. The organic movement developed alongside advances in modern agriculture, highlighting and opposing its negative side-effects on soil and environment. Other countries and associations followed suit, but certified organic farming remained more of a niche approach until around the 1970s, when it gained traction and found wider consumer demand. To date, certified organic products have entered mainstream supermarkets and are widely seen by the general public as a more environmentally and animal welfare friendly way of food production, or a more healthy food option. Production and demand are often based on either a concern for the environment or improved animal husbandry, the desire to eat healthily, or spiritual beliefs. The sustainability of certified organic production systems however also depends on a society's spending power, since they usually incur a higher cost of production compared to conventional farming methods. Modern certified organic farming is regulated by European and national legislation, and additional rules are implied by the various organic associations. Amongst other aspects, these rules cover husbandry, nutrition, access to pasture and the use of veterinary treatments. The presentation will inform the audience of some of these rules and provide examples from the author's experience of working with organic farms of chances and challenges to farmers and veterinarians in providing best possible healthcare to organically farmed sheep and goats within this framework.

doi: 10.1016/j.anscip.2023.01.014

K-05
Nutrition disorders in grazing lambs: Deficiencies

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Keywords: Lambs; Nutrients; Disorders; Grazing

The fundamental role of nutrition in immunocompetence and growth in grazing lambs highlights the importance of preventing nutritional disorders before they impact health and productivity. Nutritional disorders may be the result of insufficient dietary energy and/or protein, maternal undernutrition, infectious disease, environmental stress, poor genetics, or mineral and/or vitamin deficiencies. The consequence will depend on the relative importance and duration of the nutrient disorder before diagnosis and correction.

There are many factors which determine nutrient availability to grazing livestock including soil type, fertilizer history, soil health, climate, stage of plant growth, mineral form/bioavailability, plant species/biodiversity and grazing management. Most of these can be manipulated to minimise the risk of nutritional disorders occurring but the process may not be cost effective. For example, soil type and health can be amended with application of lime, dolomite, gypsum, compost, and liquid supplements but the cost may be prohibitive. Similarly, climatic effects at the farm level can be manipulated through the provision of irrigation, drainage, and shade but these strategies may not be an option or too costly to install. In addition, the development of synthetic fertilisers, mechanisation and chemical farming over the last 150 years have substantially altered nutrient and topsoil availability especially in more developed farming systems. The consequences include loss of biodiversity and increasing soil acidification limiting nutrient density in the diet of grazing livestock.

Deficiency of macro and trace elements and/or vitamins is a relatively common cause of reduced health and productivity in grazing lambs depending on geographical location and prevailing conditions. These impact growth, bone and muscle development, metabolism, immunity, and health in grazing lambs as well as fertility, ease of parturition, and milk production in their dams. The quantities and balance of nutrients required at each stage of lamb development is well established but the ability to ensure that these requirements are met year round can be a constant challenge. Changing seasonal conditions further complicate this and so lamb producers need to be constantly aware of the risk of nutrient deficiencies and utilise preventative strategies to optimise lamb health and growth. Every mob and every paddock present a unique set of circumstances and so there is no one solution fits all. Supplementation can be expensive and so it is better to optimise nutrient availability through soil and pasture management where possible.

The opportunity to monitor all aspects of animal production through soil, plant, feed, water, blood, liver, urine, milk, and faecal tests as well as keen observation and using abattoir feedback at a fraction of the cost of supplementation is a vital strategy in preventing nutritional disorders before they occur. Sufficient availability of these services and encouraging lamb producers to avail themselves to these services is the key.

doi: 10.1016/j.anscip.2023.01.015

K-06
Nutrition disorders in grazing sheep: Intoxications

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Keywords: Toxic plants; Heavy metals; Biologically active elements; Mycotoxins

During grazing sheep can have access to a wide variety of poisonous plants, mycotoxins, heavy metals and/or biologically active elements responsible for an ample range of deleterious effects and significant economic losses in flocks worldwide, especially those reared in extensive o semi-intensive conditions. *Sola dosis facit venenum* the classic toxicology maxim credited to Paracelsus, illustrates well the fact that the some of compounds mentioned above can cause intoxication if consumed acutely or chronically in excess.
Some plants, of spontaneous growth, decorative purpose or cultivated, have developed chemical strategies to adapt to the environment and to avoid herbivory, which can cause harmful effects on animals that consume them. Thereupon, several compounds such as pyrrolizidine alkaloids, calcinogenic glycosides, oxalates, tannins, coumarins, nitrate-containing plants, anti-nutritional factors, among others, have been associated with plant poisoning in sheep. Due to the nonspecific nature of the clinical signs it is usually particularly difficult to establish cause-effect relationships between the consumption of plants and clinical disease, leading to plant poisoning is an underdiagnosed condition. Additionally, factors linked to the plant, animal and management system, can condition the toxicity of a plant and the occurrence or not of poisoning. It is necessary for the veterinary practitioner to consider these etiologic agents and factors in the differential diagnosis in sheep.
Mycotoxicoses are clinically responsible for a variety of disorders in sheep: liver damage (e.g. facial eczema, lupinosis, aflatoxins), digestive and immunosuppression (e.g. trichothecene poisoning), vascular (e.g. fescue poisoning, ergotism), reproductive (e.g. abortion, estrogenism) and locomotion/neurological (e.g. ryegrass tetany, ataxia-tremor syndrome, Paspalum poisoning) problems. Nonetheless, the clinical course is often subclinical and accompanied by production losses.
A varied set of inorganic or organic substances can be potentially toxic to sheep too (e.g. arsenic, copper, fluoride/fluorine, lead, nonprotein nitrogen, selenium, zinc, etc.). A classic example is a high susceptible to chronic cooper intoxication due to predisposition to accumulate cooper in the liver along time and limited ability to excrete this compound. Despite is generally associated a chronic dietary exposure to doses above those recommended, tree treatments with copper-based fungicides is at the origin of some poisoning in flocks. Accidental or occasional poisoning during grazing with other heavy metals, organochlorines, organophosphates, and carbamates may also occur.
Diagnosis of all these intoxications may be challenging. Acute clinical forms may present specific signs and progress to death. In such circumstances, symptoms and lesions can lead to a presumptive diagnosis. However, subacute to chronic forms, related to permanent or long-term availability and intake of a toxic compound, may course as an unspecific condition (e.g. emaciation, poor external aspect, ill-thrift, etc.).
Confirmation of the diagnosis must be always made based on the history of exposure, pathological findings (macroscopic and microscopic) and ancillary tests, if available.

doi: 10.1016/j.anscip.2023.01.016

K-07
Balancing fibre, sugars, and starch of the diet to have high milk production and healthy ewes

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Keywords: Sheep; Diet carbohydrates; Milk production; Milk fat

This review will highlight the knowledge accumulated on the utilization of dietary carbohydrates, and their productive and health effects in lactating ewes.
Milk production is heavily dependent on nutrition during pregnancy. In this stage, fibre has a critical role, due to the limited ability of the rumen, especially when carrying multiples foetuses, to accumulate it. When the intake of energy is low, body reserve mobilisation is fast, with increased risks of subclinical or clinical ketosis (pregnancy toxaemia). To maximize DM and energy intake, the data available suggest using highly degradable NDF sources, limiting the NDF intake from 0.9% of BW or 35% of dietary NDF (multiple births), to 1.1% of BW or 45% of dietary NDF (single births). Sugars and starch are also important nutrients in this stage, especially in the last weeks of pregnancy. While their supplementation is crucial, no clear indications are available in terms of amounts, concentrations, and sources. In cases of ketosis, gluconeogenesis is partially impaired. This suggests using low-degradable starch sources, to maximise glucose digestion at the intestine level. Starchy diets in late pregnancy have also a positive impact on the glucose metabolism of the offspring and its milk yield persistency in the first lactation.

During early lactation, the energy deficit can be large and needs to be limited by supplying high-quality forages and frequent monitoring of the ewes. During this stage, clinical ketosis is less common than in other species, since sheep, being less selected for milk production, quickly reduce milk yield when high energy deficits occur. Reference values of maximum NDF intake and concentration have been proposed, with values varying based on the body size and on the milk production level. Fat metabolism and milk fat are highly sensitive to energy balance and the utilization of dietary carbohydrates. A common problem in highly productive dairy ewes is the low concentration of milk fat. Besides genetic factors, milk fat depression in indoor-fed ewes can be due to the improper supply and utilization of high doses of sugars and starch, leading to rumen sub-acute ruminal acidosis. In pasture-based systems, milk fat depression is often observed when the ewes graze plants in their early phenological stages, during which they have a limited ability to stimulate rumination and, often, are very rich in sugars (>20% of DM). While grasses with high sugar content in the past were limited to northern regions, now they are common even in the Mediterranean region, due to the utilization of new grass varieties and, possibly, the modified climatic conditions during winter and early spring.
Overall, dietary carbohydrates largely affect the performances and health status of lactating ewes, especially when their milk production is high, as often occurs in modern flocks.

doi: 10.1016/j.anscip.2023.01.017

K-08
Housing conditions and biosafety on lamb-feedlots

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Keywords: Housing; Biosafety; Lambs feedlots; Fattening

The environmental conditions and the lamb management influence in an important way the outcome of different pathologies in the feedlots of "multiorigin" lambs (from different ewe farms), being the respiratory processes the most prevalent one and with a major impact on mortality. In an antibiotic reduction scenario, it is necessary to set up healthy goals for animals and to define a work planning to monitor the feedlot health with the aim of a continuous improvement.
The conclusions of several studies carried out in lamb feedlots regarding the welfare of animals housed in intensive conditions, point out that the most relevant environmental parameters related to the respiratory diseases are temperature, relative humidity, and ammonia concentration. Concerning the factors related to management, animal load and bed quality may have also a significant impact. This research work proposes some indicators to evaluate the conditions of housing and management of animals, reference values of these indicators, as well as an approach for forecasting mortality from the assessments carried out.
In relation to environmental conditions, the adequacy of the facilities to meet the objectives of ventilation and air renewal in the different seasons of the year is a key point. The installation of ammonia, temperature, humidity and CO_2 sensors and the use of PLC (Programmable Logic Controller) devices to regulate mechanical ventilation are already being used in some feedlots.
It is also necessary to evaluate welfare aspects related to animal management, such as animal load, bed quality, stressors (with special attention to the transition period), cleaning of animals, dimensioning and management of feeders, watering, handling of forages (straw in the case of feedlots), body condition and consistency of feces. The evaluation and monitoring of all these indicators is necessary to ensure good operating conditions.
Another key pillar to preserve the good health in a feedlot is the implementation of biosafety measures. To achieve this, it is necessary, first of all, to define biosafety objectives. Subsequently, the risk factors that may hamper the biosafety of the farm should be identified. Then, it will be necessary to create a health planning adapted to the farm and establish appropriate prophylaxis measures.
As a conclusion, the monitoring of environmental and management conditions, the definition of objectives for the housing improvement and the establishment of a biosafety plan adapted to the farm, are key points to preserve the feedlot health in the current scenarios, as demonstrated in the assessments carried out in several farms under practical conditions.

doi: 10.1016/j.anscip.2023.01.018

K-09
Male effect and social factors in the management of sexual cycle of small ruminants: *Is the seasonal sexual activity of males a contagious disease?*

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Keywords: Male effect; Sheep; Goats; Seasonality of reproduction

The male effect which allows to synchronize ovulations and fertilizations, is known since the 19th century and perhaps practiced for millennia by breeders. The "short-term" male effect (ovulations 2–3 days after the introduction of males) is typically used during seasonal anoestrus. It is simple, inexpensive, free of exogenous hormones and effective in achieving high fertility (≥70%) in the spring. However, to be efficient, males must be sexually active.
A particularly effective way to have sexually active bucks and rams is to pre-treat them with two months of additional light during the winter preceding their use. They show a short "sexual season" during the 45–90 days following the end of the artificial light, while the control males are inactive. Females placed in contact with these treated males see their fertility very significantly increased compared to females in contact with untreated control males. In "doble proposito" goats of northern Mexico, a significant increase in the income of small breeders was observed because of the shift in the birth season, lower kid mortality, increase in the duration and quantity of milk produced and better milk and kids prices.
More recently, the demonstration of a "long-term" male effect (i.e. 2–3 weeks) in goats and then in ewes, has made possible to reconsider the respective roles of photoperiod and socio-sexual relationships in seasonal breeding. The start of a small light-induced artificial sexual season while the bucks have been present among the females for several weeks, leads to a gradual triggering of ovulations in the females in the middle of the seasonal anoestrus. Very surprisingly in a seasonal species, the maintenance among the females, for two consecutive years, of bucks made sexually active by light treatments allows continuous cyclic activity of the goats during two seasons of anestrus. Their withdrawal leads to an immediate stop of cyclicity. The same observation of a "long-term" ram effect is made in the Rasa Aragonesa ewe. These very powerful active males also act on other males and "transmitted" their sexual activity to other males: male goats made sexually active by an exogenous light treatment during winter, stimulate the sexual activity of untreated control males, who then exhibit sexual activity of the same intensity as the inducer males. These induced bucks, in turn, are able to induce a short-term male effect in females suggesting a certain "contagiousness" of seasonal sexual activity.
These results suggest reconsidering the respective place of photoperiod and socio-sexual relationships in the induction and control of seasonal sexual activity in small ruminants. They also make it possible to better take into account, on the farm, the importance of the sexual activity of the male in the success of the male effect.

doi: 10.1016/j.anscip.2023.01.019

K-10
Reproductive management in small ruminants

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Keywords: Sheep; Goats; Reproduction; Management

Sheep and goat show different annual patterns of reproductive activity: females alternate periods of ovulatory activity -breeding season-, with periods of behavioral quiescence and anovulation -anestrus. The main environmental signal responsible for the timing of this alternation is the photoperiod: short days in autumn/winter are stimulatory to the reproductive axis, and long days in spring/summer are inhibitory. This situation leads to a clear seasonality of meat and milk production, since lambs and kids usually are born during a limited period of the year. The small ruminant industry faces important variations in production and prices throughout the year, and in consequence, the income received by farmers is limited by this seasonality. Thus, the control of reproduction in small ruminants is crucial because the farmer

can choose the best timing of parturition. Moreover, it provides a very strong acceleration in the rate of genetic progress, especially using artificial insemination. Hormonal treatments developed in the 1960–70' use artificial analogs or progesterone itself on a vaginal device (sponges or CIDR), combined with an injection of equine chorionic gonadotrophin (eCG/PMSG). These treatments can be followed by artificial insemination. More natural (melatonin) or synthetic (prostaglandin analogues) hormones have been incorporated. Melatonin implants induce ovulatory activity in spring, facilitating out-of-season mating to obtain parturition when milk and meat prices are high. Prostaglandin-F2α analogs have been incorporated into the reproductive management of these species thanks to their luteolytic effect, combining either with progestative treatment or with melatonin implants.
The use of these hormonal treatments has led to raising doubts about animal and consumer health and welfare, so a more sustainable control of reproduction in small ruminants is required. The ''male effect", probably used by farmers for ages, becomes more and more relevant in that direction. It is especially interesting because of its low-cost management strategy in comparison to the hormonal methods. When rams or bucks are joined with anovulatory ewes or does (respectively) that have previously been isolated from males during the season of reproductive inactivity (anestrus), a proportion of the flock will ovulate, display estrus and become pregnant. We have also demonstrated that using males rendered sexually active during the rest season by an artificial photoperiodic treatment is a promising practice to improve the effectiveness of this technique.
These techniques are complemented with an annual management of the mating calendar, such as 3 lambing/kidding in 2 years, 4 lambing/kidding in 3 years, or the STAR system, with 5 lambing/kidding in 3 years. Each system will achieve a different distribution of the parturition periods, leading to the implementation of adequate management that harmonizes the characteristics of each flock.

doi: 10.1016/j.anscip.2023.01.020

ISVA: General diagnosis to reduce Antibiotic usage

K-11
Reduction in antibiotic use in sheep in Spain

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Keywords: Antibiotics; Reduction programs; Antimicrobial resistance; One health

The development of antimicrobial resistance (hereafter AMR), especially the appearance and dissemination of multiresistant bacteria, and the lack of alternative treatments, are two of the biggest public and animal health problems that must be faced at the present time.
Although there are many factors that facilitate the selection and dissemination of antibiotic resistance, the inappropriate or indiscriminate use of antibiotics is one of the main factors that contribute to this phenomenon, together with deficient control of the bacterial infection. Not only is AMR a serious health problem in Europe but also at a global level, given that it affects different sectors such as human health, animal health, agriculture, the environment and trade.
Because there are many factors involved, a global and multidisciplinary approach is required, given that it affects different sectors.
The Spanish Agency of Medicines and Medical Devices performed a Strategic Action Plan to reduce the risk of selection and dissemination of antimicrobial resistance (hereafter PRAN). The first plan was launched in 2014. After it, two more strategies (2019–2021 and 2022–2024) has been adopt. One health approach was adopted since the beginning for the PRAN.
In 2016, due to colistin was classify as a last resort antimicrobial for the treatment of severe human infections caused by highly resistant Gram-negative bacteria, it was agreed to reduce the veterinary consumption of colistin until 5 mg/kg. In order to achieve this target, it was developed the first ''Reduce Colistin Program". It is a voluntary agreement between the public and private pig sector to reduce the consumption of colistin to achieve the target set up by the AMEG group.
After 6 years from the beginning of the Reduce Colistin program, the balance is summarized in more than 230 voluntary adhesions of producing companies in the swine sector and a reduction from 52 mg/PCU to 0.4mg/PCU (almost 100%). This has set an example throughout Europe, having gone from the first positions in consumption of critically important antibiotics (category B) to the countries with the lowest consumption.
The success of the Reduce Colistin program has been a model to follow and has paved the way for a new phase that includes: the new Pig Sector Reduce Antibiotics Program; In addition, the Reduce Programs for rabbit farming, beef cattle, dairy cattle and sheep and meat goats continue, and the poultry group is expanded to include laying birds and turkeys. Specifically for sheep and goats, the objectives included in the program are reduction of the global consumption of antibiotics, definition and implementing management and treatment guidelines and improve therapeutic tools. The results of this program and the next steps to go forward will be presenting at the congress.

doi: 10.1016/j.anscip.2023.01.021

K-12
Antibiotic susceptibility tests. How to use them?

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Keywords: Prudent use; Antimicrobials; European legislation; Antimicrobial susceptibility test

A new legislation has been recently approved for veterinary medicinal products in Europe (EU/2019/6) where a special attention has been addressed to antimicrobials because the great worldwide concern about one-health issues in the treatment of bacterial diseases in humans. There are many recommendations about prudent use of antimicrobials in Europe coming from official sources (2015/C299/04) or from federations of veterinarians in Europe (https://www.fve.org/publications/fve-guidelines-responsible-use-of-antibiotics/). The problem arise how to tackle these recommendations with the daily practice.
Antimicrobials should not be used for prophylactic purposes, except in specific cases where they are administered to a particular animal or to a limited number of animals when the risk of infection is very high, or its consequences can be serious. On the other hand, antimicrobial drugs should be used for metaphylactic purposes only when the risk of spreading an infection or an infectious disease in a group of animals is high and adequate alternatives are not available. These restrictions should allow the reduction of prophylactic and metaphylactic use in animals, so that they represent a smaller proportion of the total use of antimicrobials in animals. However, the prescription of antimicrobials for therapeutic purposes (to cure an animal suffering from a bacterial infection) is a mandatory clinical act for a veterinarian to ensure the welfare of the animals and comply with their code of ethics. It seems that today there is a pressure to avoid the use of antimicrobials under any circumstances. This point is a serious conceptual error. The use of antimicrobials to cure sick animals due to bacterial diseases is mandatory and unquestionable. The differential point appears when used for metaphylactic or prophylactic purposes.
Another point on the table is not only the use of antimicrobials but also how to prioritize or categorize the families of antimicrobials used in animal production because the different antimicrobial families do not carry the same risk of generating antimicrobial resistance. This recommendation imply that veterinarians must justify not only the use of antimicrobials but also the selection of the antimicrobial to treat one bacterial disease following prudent use of antimicrobials. Moreover, there is clinical urgency to begin treatment that does not allow us to "wait" for the laboratory result. This "irresolvable" problem has a solution if the concept of epidemiological information is applied. That is, the microbiological diagnosis and the determination of antimicrobial sensitivity can be useful for all clinical cases caused by a certain bacterium within the same production system. Nowadays the determination of antimicrobial susceptibility is technically possible to carry out for a large volume of samples as it is done in hospitals of human medicine. This approach will be thoroughly discussed in the keynote lecture with a focus for ovine medicine.

doi: 10.1016/j.anscip.2023.01.022

K-13
Coprology: Interpretation and clinical application

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Keywords: Coprology; Sheep; Flotation Methods; McKenna Method

In veterinary medicine, the classic methods of diagnosing parasites rub shoulders with the most modern techniques and still play a predominent role everyday diagnostic activities. Coprology includes all the techniques wich enable a macroscopic search for parasitic elements in faecal matter.
These techniques are easy to carry out at a vet's surgery because they require little, inexpensive equipment. However, reading and interpreting the result has to be based on a thorough knowledge of the elements found, the sensitivity of the technique and the conclusions that can be drawn.
Having a wide spectrum of anthelmintics at one's disposal does not mean that a vet acan disregard the requirement for a diagnosis to aetiology of the disease, or infection. No antiparasitic drugis active against all respiratory or intestinal parasites, whether they be nematods, cestods, trematodes or protozoa.
Despite the existence of a number of drugs and implementation of tretament, intestinal parasites are still frequent in small ruminants. In his everyday practice, the vet is called upon to make an individual diagnosis, or to offer an overall coverage of parasitic infections. In both cases, follow up and decisions concerning treatment need to be based on a detailed knowledge of the parasite in question and therefore means faecal anaysis needs to be carried out.

The purpose of this keynote is to indicate clearly the main methods used in small ruminants faecal analysis (flotation concentrations of eggs and cysyts, Baermann technique, Mc Kenna method, quantitative MacMaster method. . .), to offer interpretation of results be they positive or negative.
All flotation techniques take advantage of a diffrence in the buoyancy of parasites relative to food residues. The principle of these methods is to dilute the specimen in a high-density solution (the flotation liquid) so as to concentrate the parasite elements, which are lower in density, in the surface of the liquid. The Baermann technique is based on the hygrotropism and positive geotropism of living nematode larvae. These propreties enable their extraction from faecal matter. They will migrate from the faeces towards a funnel filled with water. The tube from the funnel will concentrate and collect them. This technique can only be carried out with faeces which are fresh at the time of analysis. The other techniques will be discussed in detail during the communication.
Diagnostic trees will also be provided during the presentation in order to correctly interpret the coprological results in sheep and therefore make the right decisions.

doi: 10.1016/j.anscip.2023.01.023

K-14
Monitoring and surveillance of small ruminant health in the Netherlands

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Keywords: Monitoring; Surveillance; Sheep; Goats

In addition to compulsory monitoring and surveillance systems for notifiable diseases, the Netherlands developed a voluntary system for four major livestock production systems, including small ruminants, in 2003. Monitoring in this system is defined as the ongoing efforts directed at assessing animal health by a systematic collection and aggregation of information, and surveillance as the action based on a signal or a deviation from a norm, following the interpretation of collected monitoring information. The development of this system was triggered by severe disease problems in cattle in 1999 related to the use of contaminated infectious bovine rhinotracheitis vaccine with bovine viral diarrhoea virus. The latter outbreak led to the realisation that attention for notifiable diseases alone does not provide sufficient information about the health status of livestock farming, and is lacking a broad overview of trends in time, including insight into the occurrence and prevalence of new and emerging non-notifiable diseases and disorders. Furthermore, stakeholders have an interest in animal health and welfare at a high level, and public health protection.
This monitoring and surveillance system, financed by the Ministry of Agriculture, Nature and Food Quality (LNV) and the farming industry, aims for (1) early detection of outbreaks of designated animal diseases that are not endemic in the Netherlands, (2) early detection of yet unknown disease conditions, and (3) insight into trends and developments in small ruminant health. This system is built on a consultancy helpdesk, diagnostic testing including post-mortem examination, farm visits, veterinary networks, and, since 2006, an annual analysis of routine census data from four nationally operating organizations. Data analysis provides key monitoring indicators such as animal and farm density, mortality, animal movements, and numbers and origin of imported small ruminants.
Results are anonymously reported to stakeholders, and subsequently communicated to the industry and other interested parties, in such a way that information is never publicly traceable to individual farmers or veterinarians. In case clinical signs are indicative for a notifiable disease, contacts are referred to the Netherlands Food and Consumer Product Safety Authority, an independent agency of LNV, responsible for the supervision of notifiable diseases.
During the presentation, this system will be described, and an overview of key findings will be reported. Because we live in a challenging and changing world in which globalization and climate change require an increased awareness that diseases can suddenly emerge worldwide, monitoring and surveillance systems should continuously be adapted and improved according to changing requirements and circumstances, using new techniques and insights.

doi: 10.1016/j.anscip.2023.01.024

K-15
Diagnostic sampling in small ruminant disease investigation

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Keywords: Small ruminants; Diagnostics; Point-of-care; Sampling

Diagnostic sampling in small ruminant disease investigation is a challenging, although very rewarding component of the veterinary medicine domain, which, if carried out correctly, can really enhance the clinician ability to confidently reach a final diagnosis, apply the appropriate changes and/or control measures and, in the end, provide cost-effective benefits to the overall health and management of the animals under their care.
First, why do we need diagnostic tests? It is important to remember that diagnostic tests should be considered ancillary measures, meaning they should complement a thorough investigation, proper data collection and, where necessary, clinical examination. These underlying steps will allow to formulate a comprehensive, yet relevant, list of differential diagnosis. Diagnostic testing is then applied in a systematic, logical method to assess the list of differential diagnosis and confirm or exclude each hypothesis. Diagnostic tests should not be used as a way to stumble upon a diagnosis.
In the case of small ruminants, a further important consideration is the cost of the diagnostic tests. The value of the animal(s), the impact of the disease on the flock/herd and/or its zoonotic potential, the final aim of the disease investigation (e.g. control vs eradication) will all have an impact on the selection of the diagnostic tests.
The other fundamental points to consider are the selection of the correct biological material (e.g. blood, milk, urine, saliva, faeces), properly collected (e.g. serum vs heparin or ETDA tubes) and packaged (e.g. use of viral transport medium, formalin or dried ice) and, for flock/herd investigations, from the right animals (those fitting the case definition) and in representative numbers (e.g. convenience vs probability sampling). There are also a wide variety of diagnostic tests available in small ruminant medicine, from serology for antibody detection (mainly ELISA), molecular techniques (mainly PCR), coprology, biochemistry and haematology, culture and post-mortem examination. Based on all discussed so far, the most appropriate diagnostic test(s) for each case under investigation should be chosen.
One last point worth considering is the use of point-of-care (POC) testing, which is a fast-growing field in veterinary diagnostics and it is particularly suited for situations where facilities and funds are limited. POC will have considerable advantages over laboratory-based or centralised testing, which usually involves laborious and expensive laboratory techniques, trained personnel and possibly transport of animals to dedicated facilities. Especially in the case of small ruminants, this can translate into more affordable veterinary care, reduced handling of animals, targeted treatments and rapid testing in more remote geographic areas.

doi: 10.1016/j.anscip.2023.01.025

K-16
Hematology in small ruminants

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Keywords: Hematology; Sheep; Goat; Erythrocytes

Routine haematology in small ruminants must be performed on whole blood sample collected in EDTA tube. Samples are preferably processed immediately; alternatively, they can be refrigerated within 1 hour from collection and stored for up to 24 hours. The delayed sample processing results in artefactual increased MCV and haematocrit.
In addition to the instrumental count, blood smear evaluation is useful to assess some haematological alterations (e.g., hemic parasites, polychromasia, nucleated erythrocytes).
Small ruminants have smaller erythrocytes and platelets compared with other domestic species. Erythrocytes may be incorrectly classified by impedance-based analysers, which frequently mistake them for platelets. On the blood smear, minimal polychromasia is noted in health. Also, anisocytosis and poikilocytosis can be seen in healthy juvenile and adult goats (mostly Angora goat and some English sheep). Alterations in the erythrogram are the mostly evident haematological abnormalities in small ruminants.
Erythrocytosis (policytemia) indicates an increase in haematocrit, haemoglobin, and erythrocytes count above the reference intervals. Relative polycythaemia due to dehydration and decreased plasma water is the most common condition. Secondary erythrocytosis is rarer, and this can be triggered by tissue hypoxia (e.g., animals living at high altitude, chronic cardiopulmonary disease) or can be unrelated (e.g., renal neoplasia).
In case of **anaemia**, the erythrocyte mass within the body is decreased. Causes are categorized as regenerative and nonregenerative. The regenerative response starts 2–3 days after the onset of haemorrhage and haemolysis. Major changes that can be observed both on instrumental count and blood smears are: polychromasia, increased reticulocytes count, possible macrocytosis and hypochromasia, presence of nucleated erythrocytes, basophilic stippling, and Howell-Jolly bodies.
Regenerative anaemia is secondary to a haemorrhagic or haemolytic event. Internal (e.g., gastrointestinal) and external parasites are among the most common causes of blood loss in small ruminants. Causes of haemolytic anaemia include haemic parasites (e.g., *Anaplasma ovis, Mycoplasma ovis, Theileria spp),* bacteria (e.g., *Leptospira interrogans*,*Clostridium haemolyticum*, *C. perfringens* type A infection), oxidative damage (e.g., copper and selenium deficiency in lambs, copper intoxication in sheep, sulphur compounds in brassicas (e.g., cabbage, kale), onions and garlic, fresh oak acorns or leaves rich in tannic acid), and water toxicity.
Nonregenerative anaemia is associated with the decreased/inappropriate erythropoiesis or the preregenerative phase of a haemolytic/blood loss anaemia. Major causes include inflammation, renal failure, and chronic lead poisoning. If concurrent pancytopenia is present, toxicity of bracken fern, myelotoxicity due to fungal toxins of *Stachybotrys chartarum,* myelophthisis secondary to neoplastic disorder, myelofibrosis, and *Anaplasma phagocytophilum* infection should be considered.

Iron deficiency anaemia is characterized by mild regenerative response associated with microcytosis and hypochromasia due to chronic gastrointestinal haemorrhages and nutritional iron deficiency.

doi: 10.1016/j.anscip.2023.01.026

K-17
Application of nanotechnology on the development of vaccines, diagnostic tests and disease treatments

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Keywords: Nanomedicine; Therapeutic encapsulation; Nanovaccines; Diagnostics

Nanotechnology, the science that investigates matter on an almost atomic scale, is already part of our lives, it is applied to many technological components, smart fabrics, stronger, lighter, and more durable materials, food, creams, etc.
Nanotechnology applied to medicine is known as nanomedicine. This science studies new diagnostic, therapeutic, or treatment systems based on nanoscale components that offer a new approach to treating disease, at the cellular, subcellular and molecular levels. Nanomedicine raises high expectations. Among its advantages is its enormous potential to achieve greater efficiency in disease diagnosis systems, with greater speed and new targeted treatments; a new way of developing vaccines, and the potential of delivering promising solutions to many illnesses for better, more efficient, and affordable healthcare. From diagnosis to disease monitoring, going through surgery and chemotherapy, or regenerative medicine, nanotechnologies virtually impact all fields of current medicine. Currently, there are hundreds of nanomedical products under clinical trials, covering all major diseases including cardiovascular, neurodegenerative, musculoskeletal, and inflammatory. Enabling technologies in all healthcare areas, Nanomedicine is already accounting for approximately 80 marketed products, ranging from nano-delivery and pharmaceutical to medical imaging, diagnostics, and biomaterials.
Recently, a wide range of potential applications of nanotechnology has been envisaged also in veterinary medicine and agriculture. In the veterinary sector, they increasingly invade animal therapeutics, diagnostics, the production of veterinary vaccines, farm disinfectants, for animal breeding and reproduction, and even the field of animal nutrition. Many reports have shown evidence that nanoparticles may be good candidates for animal growth promotion and antimicrobials merging roles of nanoparticles for nutrient delivery. Their replacement of commonly used antibiotics directly reflects on public health. By so doing, they minimize the problem of drug resistance in both human and veterinary medicine, and the problem of drug residues in milk and meat. Finally, in agriculture, nanomaterials are used to increase productivity as nanopesticides and nanofertilizers, improve the quality of the soil eg., using nanozeolites and hydrogels, stimulate plant growth using nanomaterials (SiO_2, TiO_2, and carbon nanotubes) or as smart nanosensors to monitor the environment.
In short, nanotechnology is already part of our lives, let's see how we can get the most out of its use.

doi: 10.1016/j.anscip.2023.01.027

K-18
Diagnostic imaging techniques applied on farms

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Keywords: B-mode; Doppler; Small ruminant; Ultrasound

Diagnostic imaging techniques, mainly the ultrasound (US) scan, can be easily applied in small ruminant farms. B-mode US is a practical and non-invasive imaging modality offering real-time results. Compared to other advanced imaging techniques, such as Magnetic Resonance Imaging (MRI) or Computed Tomography (CT), it is cheaper, more portable and widely available. Within the diagnostic support tools, US provide information that was previously only obtained through laparoscopy or exploratory laparotomy. It is also possible to carry out serial US scans to monitor the progression of an abnormality, response to treatments or even viscera functionality (e.g. reticular contractions and intestinal peristalsis). It can be valuable in assessing the content of abdominal injuries, cysts, encapsulated abscesses and other fluid-filled lesions. Moreover, the US can evaluate parenchymal organs including the kidneys, adrenal glands, liver and spleen that are difficult to clinically examine. Lastly, fluid collections and biopsies guided by US scan can be performed in body cavities and organs such as liver, kidneys and lymph nodes. Examples from the B-mode US scan in clinical practice include the diagnosis and prognosis of several gastrointestinal, thoracic, splenic, udder, laryngeal, urogenital, ocular, locomotor and neurological diseases. Once the patient's prognosis is established, recurrent economic losses from treatments that would be ineffective (e.g. large lung abscess) can be avoided. In addition, time can be saved for a diagnosis that previously could only be conceived through laboratory tests (e.g. kidney and liver function) or surgical procedures. In the last decades, the addition of Doppler technology has further expanded the US utility. It is usually carried out to assess

vascular patency and organ perfusion. Color Doppler, in particular, is useful to investigate organs for the presence or absence of blood flow and areas for turbulent flow. Therefore, Doppler US has also permeated all aspects of clinical medicine offering additional information for a wide range of pathologies. More recently, quantitative pixel evaluation techniques, specialized softwares and neural networks have been proposed to medical image classification and detection of distinctive types of lesions, mainly in kidneys and liver. The applicability ranges from the differentiation of tumor types and evolution of chronic lesions in parenchymal organs. This approach may revolutionize the use of the US technique and add to the refinement of patients' diagnoses and prognoses. In conclusion, ultrasonography is an essential tool for all veterinary practitioners for clinical diagnosis, prognosis and therapeutics reaching a highlight role among the diagnostic support tools for the small ruminant health management.

doi: 10.1016/j.anscip.2023.01.028

K-19
Differential diagnosis of lamb diarrhea

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Keywords: Diarrhea; Lamb; Diagnosis; Sheep

Digestive disorders for which diarrhea is a cardinal clinical sign, are the leading cause of death of lambs during their first 3 weeks of life and significant cause of death in lambs up to 60 days of age. The main predisposing factors include lack of proper colostrum intake, maternal health status, lack of proper vaccination of the dams before lambing, overcrowding, climate and presence of infectious agents in the flock. The most prevalent infectious causes of diarrhea in lambs are *Escherichia coli, Salmonella* spp., *Campylobacter* spp., *Cryptosporidium parvum, Eimeria* spp. and *Giardia* spp. Other less common causes of lamb diarrhea are *Clostridium perfringens* types B and C and rotaviruses. Other causes of undetermined etiology, such as the so-called ‘‘terminal ileitis”, can occasionally occur.
Necropsy of one or more freshly dead animals is critical to establish a diagnosis. While a presumptive diagnosis can be achieved by clinical, gross and microscopic findings, determination of the etiology should be based on laboratory examination of multiple samples from affected animals, with special emphasis in intestinal content and/or feces.
Ancillary tests include aerobic and anaerobic bacterial cultures, PCR, capture ELISA for viruses and clostridial toxins, fecal float for parasite eggs and immunohistochemistry on formalin-fixed tissues. Interpretation of results should be made keeping in mind that some agents of neonatal diarrhea may be commensals of normal animals and their detection alone is therefore not diagnostic. In this regard, it is important to keep in mind the difference between ‘‘detecting and infectious agent” and ‘‘making a diagnosis of disease”, which are not always the same. For instance, *Clostridium perfringens* can be found in the intestine of most normal animals and therefore, detection of this microorganism, by culture or PCR in those samples is not diagnostic.
Diagnosis of *C. perfringens* type B or C enterotoxemia should be based on the detection of the main toxins produced by these microorganisms in intestinal content or feces (i.e. alpha, beta and epsilon toxins for *C. perfringens* type B and alpha and beta toxins for *C. perfringens* type C). Contrary to popular myth, enterotoxemia by *C. perfringens* type D does not cause diarrhea in lambs. A similar situation occurs with coliobacillosis for which, the mere isolation of *E. coli* from intestinal content or feces is not diagnostic; histopathology ad/or antigenic detection of virulence factors are required for the diagnosis of these diseases.
While coccidian oocysts should not be found in the feces of healthy animals, the presence of a few of these parasites in feces without significant intestinal lesions, does not warrant a diagnosis of coccidiosis.

doi: 10.1016/j.anscip.2023.01.029

K-20
Differential diagnosis of high airway respiratory diseases in sheep

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Keywords: Sheep; Upper respiratory tract diseases; Differential diagnsosis; Thermography

The differential diagnosis of upper airways respiratory diseases in adult sheep involves multiple difficulties due to the great variety of diseases that affect sheep and their similar clinical signs.
The diseases that affect the upper respiratory tract in adult sheep vary widely depending on the weather and geographical location of the farm. The main diseases found are:

Oestrosis. It is a nasal-sinus myiasis caused by the larvae of the fly *Oestrus ovis* that affect most of the animals in the flock and it is endemic in hot and dry regions. A few weeks after larviposition, inspiratory dyspnea, nasal discharge and sneezing become evident and frequent.
Enzootic nasal adenocarcinoma (ENA). Enzootic nasal adenocarcinoma of sheep is a contagious tumour of the ethmoid turbinate mucosa that is associated with enzootic nasal tumour virus 1 (ENTV-1), a type of Beta retrovirus. Clinical signs include continuous and copious unilateral serous nasal discharge, inspiratory dyspnea, exophthalmos and skull deformations when the tumour progresses.
Chronic proliferative rhinitis (CPR). It is a slow and progressive disease with a poor prognosis for affected animals if treatment is not applied in time. It causes a proliferative inflammation of the ventral nasal turbinate with uni or bilateral affection that may totally obstruct the nasal cavity causing severe inspiratory dyspnea, snoring and seromucous nasal secretion. *Salmonella enterica* subspecies *diarizonae* serovar 61:k:1,5,(7) has been associated with the disease.
Ovine nasal obliteration syndrome (ONOS). It is a chronic process of slow course that affects a large number of animals in the flock and that can cause total obstruction of the nostrils. It has been associated with sporidesmosis caused by sporidesmin produced by the *Phytomices chartarum* fungus.
Conidiobolomycosis. It is an emerging disease in tropical and subtropical areas when sheep graze around water reservoirs and fields containing decomposing plant material, associated with high humidity and temperature that favour the proliferation of fungi. It is associated with *Conidiobolus incongruus, Conidiobolus lamprauges* o *Conidiobolus coronatus* that cause granulomatous lesions in the nasal cavity.
Ptiosis. It is also a common disease in tropical and subtropical areas that appears in the same environmental conditions as conidiobolomycosis. Caused by the fungus *Pythium insidiosum.*

Diagnosis
Although when the disease is completely established, clinical diagnosis of most of these disorders is straightforward, in many cases, the early detection of the disease will be essential to avoid the dissemination of the pathogen. CT scan offers better images, however, in farm conditions, thermography is the most useful diagnostic imaging technique to lead the diagnosis of upper respiratory tract disorders in sheep. Eventually, a nasal swab will be sampled to carry out the aetiological diagnosis by microbiological or fungal culture or molecular techniques. At necropsy, histopathology and immunohistochemistry also can confirm the disease.

doi: 10.1016/j.anscip.2023.01.030

K-21
Neurological Differential Diagnosis in sheep: The relevance of the neurological examination

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Keywords: Neurological examination; Lesion location; Differential diagnosis; Sheep

Neurological diseases in sheep are associated with diverse causes and a wide range of clinical symptoms.
In this session, I will show the work at the neurology service of the Scrum – the Clinical Ruminant Service of the Faculty of Veterinary Medicine of Zaragoza, where the number of referred cases has notably increased in the last few years.
The presentation of some of the cases attended at the service will illustrate how each one of them is faced. Once the case is referred to the service, and after a thorough history is taken, the protocol to reach a diagnose begins with the performance of a complete neurological examination as its main point (Mayhew and MacKay, 2022).
In sheep, it is necessary to be aware of some adaptations with respect to the examinations performed on the dog or cat. Thus, some conclusions will be discussed to perform a simple but adequate examination.
The examination allows us to confirm the presence of a neurological case and, subsequently, to find the location of the disorder. This neurolocalisation determines a posterior more precise differential diagnosis, the prognosis, and the treatment. To do so, the nervous system is initially divided into intra- and extracranial locations and then subdivided into a total of up to nine regions, each of which has its specific associated symptoms.
Afterwards, to perform the neurologic differential diagnosis, the "VITAMIN D" acronym is used: V (vascular), I (infectious/inflammatory), T (traumatic), A (congenital anomaly), M (metabolic), I (idiopathic), N (neoplastic) and D (degenerative). However, although all these conditions must be considered in the diagnosis, seeing the most common neurologic disorders in sheep, this acronym can be simplified in most cases to "ITAM": infectious/inflammatory, traumatic, congenital anomaly and metabolic (Voigt and Climent, 2022).
Reaching an accurate localisation of the lesion also influences the following steps of the diagnosis, such as the imaging and, if necessary, especially in cases with several affected individuals in the flock, the necropsy. The location of the lesion permits both to limit the region of study, and to specify the samples to be analysed, leading consequently to a faster diagnosis.
Definitely, in our experience, the complete neurological examination in sheep is a very useful procedure to locate the neurological issue. Therefore, despite its low use, it is essential for a good differential and definitive diagnosis.

References

Mayhew, J., MacKay, R., 2022. Large Animal Neurology. John Wiley & Sons, Hoboken, NJ, USA.
Voigt, K., Climent, M., 2022. Chapter: Neurological disease in the sheep. In: Quintas, H., Lacasta, D., Ferrer, L.M. (Eds.), Differential diagnosis in sheep. ISBN 978-84-09-38757-1.

doi: 10.1016/j.anscip.2023.01.031

K-22
The sheep: The basis of a teaching model at the service of farmers

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Keywords: Sheep; Teaching model; Veterinary education; Farmers service

Small ruminant farmers, except in severe cases, do not consider it necessary to move their sick animals to a hospital. Faced with this trend, years ago, the need arose to increase practical teaching with ruminants at the Veterinary Faculty of Zaragoza, that is located in the Northwest of the Iberian Peninsula, in an arid region with an acceptable census of sheep and scarce cattle. This fact led us to seek agreements with veterinarians and sheep farmers in the region to increase the number of animals sent to the Ruminant Clinical Service (SCRUM). These agreements are based on two forms of action: (1) farmers or cooperatives sent culling animals through their veterinarians and, in return, received a detailed report on the diseases of their animals and (2) veterinarians sent sick animals from those clinical cases in which they needed diagnostic support. All this is at no cost to farmers and vets. The financing of the service is obtained from Professional Associations and more than 40 external companies that collaborate with material contributions or through the provision of services.
Four professors are directly involved in the SCRUM, and seven specialists (Pathology, Genetics, Neurology, Diagnostic Imaging, Clinical Analysis...) support the diagnosis. In addition, the SCRUM has 34 internal students who care for sick animals, collect and order all the information generated, and support the pathology and clinical analysis services.
The results have been really satisfactory. The number of animals managed has gone from 45 in the 2006/07 academic year to more than 400 in the 2021/22 academic year. The clinical cases sent in the last year have been 45, and the number of disorders far exceeds the number of animals since each culling animal presents more than one. In the diagnostic process, these animals have served to teach a good number of clinical subjects and have allowed us to obtain casuistry and valuable graphic material for teaching and dissemination, which has materialised in different books, national and international articles, and communications in various forums.
Especially important is the practical training that SCRUM students acquire. In a survey carried out in the 2019/20 academic year on graduate students who had been part of this service, 88.1% had found work within less than three months after completing their studies and 100% in less than one year. In addition, they considered that their time at SCRUM had been very positive not only for their practical training applicable to the different species but also their ability to present in public, work as a team and make decisions. One hundred per cent would recommend to other students to be part of the SCRUM internship.

doi: 10.1016/j.anscip.2023.01.032

ISVA: Global threat to sheep

K-23
Foot-and-mouth disease in small ruminants and global strategies and programmes for control

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Keywords: Foot-and-mouth disease; Sheep and goats; PCP-FMD; Free status

Foot and mouth disease (FMD) is a contagious transboundary animal disease that negatively impacts livestock production, international trade and livelihoods of smallholder farmers in endemic countries. The impact of FMD is minimised through movement restrictions, vaccination, biosecurity, and surveillance. The annual impact of FMD due to production losses and the cost of vaccination has been estimated to be 5.5–21 billion USD in endemic settings, and more than 1.5 billion USD in free countries.
FMD in small ruminants is relatively under-researched with limited published literature and most of the studies focused on sheep and fewer in goats.
The World Animal Health Information System (WAHIS) (2020–2022), shows that 27 out of 51 countries having declared the occurrence of the disease, reported specific quantitative information on small ruminants with around 130,000 cases reported during the period for most of the circulating serotypes (A, O, SAT1, SAT2, SAT3).
The pathogenesis of FMD is similar in both species compared to cattle except for some distinct viraemic phases. The clinical presentation of FMD in sheep and goats has been well defined, however subclinical infections occur more frequently compared to other susceptible domestic species. The severity of FMD in both species is dependent on the host and virus specific factors. Similarly, the incubation period depends on the immune status of hosts, virus strain, dose of FMDV and route of infection with a typical range between 3 and 8 days.
Despite small ruminants' role in the epidemiology of FMD is poorly understood, they have played an important role in the transmission of FMDV in previously reported outbreaks (i.e. Türkiye, Greece and the United Kingdom). FMDV was isolated from goats during outbreaks in some regions of the world. However, limited consideration was devoted to these species, and often excluded from control programmes despite the fact that including sheep and goats in routine vaccinations and during outbreaks in endemic settings might limit the risk of subclinical disease and enhance disease control.
The Progressive Control Pathway for FMD (PCP-FMD) is a tool to support endemic countries to implement the FAO/WOAH Global FMD Control Strategy and progressively minimise the negative impacts of FMD through national and regional control programmes. WOAH international standards for free status and for the prevention and control of FMD are in the *Terrestrial Animal Health Code*. To reach FMD free status recognised by WOAH, countries may follow WOAH procedures for endorsement of their official FMD control programme to effectively control and eradicate FMD, and achieve official recognition of country or zone free status. WOAH free status or endorsed control programmes of some countries and zones have been suspended/withdrawn due to outbreaks of FMD resulting in significant impact on their international trade of commodities.

doi: 10.1016/j.anscip.2023.01.033

K-24
Peste des Petits Ruminants Global Eradication programme (PPR GEP)

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Keywords: PPR; Eradication; Wildlife; Shoat

In April 2015, the Peste des Petits Ruminants Global Control and Eradication strategy (PPR GCES) was approved and officially launched. The overall objective of the strategy is *"PPR and other high-impact infectious diseases constrain the health of small ruminants, trade, and the resilience of small ruminant production systems. This undermines human health and the livelihoods of those who rely on small ruminants, and threatens biodiversity due to potential for devastation of susceptible wildlife species on the brink of extinction*".
The specific objectives are:

- The eradication of PPR by 2030
- Reinforcing veterinary services
- Improving animal health globally by reducing the impact of other major infectious diseases

In 2015, PPR was reported or suspected to be present in 70 countries; 50 countries were at risk of PPR infection while 48 countries in the Americas and Europe were recognised by the World Organisation for Animal Health (WOAH) as historically free from PPR. As of 2022, 67 countries were reporting infection with PPR and 71 countries have no reports on the disease. 59 countries have PPR free status recognition and one country in zonal basis. The PPR GEP phase one thus contributed to the overall progress towards a world free of PPR. However, there is need to accelerate the process of PPR eradication through better identification of the critical target populations of sheep and goats for vaccination for maximum impact within a short timeframe while optimizing the use of available resources.
The next phase includes innovations that broaden the scope to cover multiple diseases of sheep and goats, enhance the marketability of small ruminants/products in urban and export destinations and to improve the veterinary service effectiveness with a sanitary mandate that promotes veterinary private sector engagement in delivering public goods, including the engagement of veterinary supervised community health workers as well as access to animal health markets (including the value chains for medicines and vaccines from the manufacturers to the points of administration in the herds) by all stakeholders. It therefore includes development programme outcomes (e.g., market access, One Health, modernization of veterinary services as a public-private-community partnership through sanitary mandates) which imply the tactical control of broader animal health impediments necessary to reach these outcomes.

The key strategies for its implementation include:

i. Adopt episystems as the primary focus for management of the PPR GEP Blueprint;
ii. Improve access to animal health delivery services;
iii. Development of the Public-Private-Community Partnerships (PPCPs);
iv. Strengthen multi-sectoral and multi-stakeholder partnerships and coordination.

This paper shown the majors achievements during the first phase and majors activities to be implemented toward global freedom by 2030 for a overall budget needed of USD 1.9 billion.

doi: 10.1016/j.anscip.2023.01.034

K-25
Sheeppox

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Keywords: Sheeppox; Poxvirus; Capripoxvirus; Sheep

Sheeppox is a severe systemic disease of sheep caused by infection with the poxvirus sheeppox virus. The disease is characterised by the appearance of classic poxviral skin pathology accompanied by lesions in the respiratory and gastrointestinal tract. Morbidity and case fatality rates associated with outbreaks of sheeppox vary but can be as high as 20% and 40% in epidemic situations.
Sheeppox virus is a member of the capripoxvirus genus. This genus contains three species of poxvirus (sheeppox virus, goatpox virus and lumpy skin disease virus) which all cause severe disease in ruminants. The three species are genetically very closely related but differ in their host range and resultant disease. The mechanisms underpinning these differences are unknown.
Sheeppox virus and goatpox virus are both endemic in regions of Africa and Asia, often causing substantial economic hardship and contributing to rural poverty and food instability. In order to develop effective and proportionate control programmes for sheeppox and goatpox recent research has focused on identifying the risk factors associated with outbreaks of disease, calculating the financial impact of disease outbreaks, and assessing the economic viability of control measures.
In the past two years outbreaks of sheeppox have been reported to the World Organisation for Animal Health from Russia, Bhutan, Israel, Spain and Mongolia. The outbreak in Spain was unexpected, and the first outbreak of sheeppox in this country for many decades. Alongside the current lumpy skin disease epidemic in Asia, this highlights the continued global threat to livestock from this understudied genus of viruses.

doi: 10.1016/j.anscip.2023.01.035

K-26
Sheep pox virus outbreak: Spanish experience

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Keywords: Sheep and goat pox virus; Epidemiology; Clinical presentation; Surveillance and control

After 50 years free from Sheep and goat pox, Spain has experienced an outbreak of sheep pox virus that has affected two different spatial clusters, one in Granada where index case was detected and the other in Cuenca, epidemiologically linked to the cluster in Granada by movement of incubating animals during the high-risk period. The outbreak started on 16th September 2022 and has been active since then. The control of this disease has supposed an important challenge for the OVS given the little information we had in the beginning about its epidemiology at herd and animal level, sampling, transmission, etc. We have learnt from experience and now, after several weeks without new outbreaks, we are optimistic about its prompt eradication, what will allow Spain to regain freedom in the near future, hopefully. In my keynote presentation I will summary the most relevant aspects in relation to the epidemiology, clinical presentation and control based on what we have observed in the Spanish outbreak, what has been different to some extent to what we expected at the moment of first detection based on the available scientific literature and OMSA manual. I hope this information will contribute to maintain a high level of awareness in Spain and will help other countries OVS in its early detection and control in the case SGPV enters their territories.

doi: 10.1016/j.anscip.2023.01.036

K-27
Zoonotic risks from small ruminants

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Keywords: Emerging infectious diseases; Interdisciplinary collaborations; Public Health; Surveillance

In accordance with the WHO, ‘‘A zoonosis is an infectious disease that has jumped from a non-human animal to humans”. Zoonotic pathogens may be bacterial, viral, parasitic, or fungal. The pathogens can spread to humans through direct contact, inhalation, food and water or transmitted by vectors. Zoonoses cause major public health problems around the world due to the close relationship between humans and livestock, companion animals and with wildlife.
The awareness of zoonotic pathogens in small ruminants has increased in recent years. In Europe different zoonotic diseases (re-)emerged in the last two decades. In the Netherlands, *Coxiella burnetii* infected dairy goats caused the world-wide largest human Q fever outbreak from 2007 to 2012. Tremendous efforts have been undertaken to control the disease on goat farms. Moreover, intensive research purposes contributed to a better understanding of *C. burnetii*. In other European countries, human Q fever cases are associated with lambing sheep. New research showed that year-round lambing increases the risk of *C. burnetii* in sheep flocks. Vaccination of female offspring before mating seems to be an effective and cost-efficient way to prevent *C. burnetii* outbreaks in sheep flocks.
Due to the increasing popularity of drinking raw milk, and new marketing channels for raw milk through vending machines and internet sale, it is necessary to raise the awareness of food-borne pathogens in raw milk (products). Apart from the classic foodborne pathogens such as thermophilic Campylobacter, other pathogens are less in focus. For instance, the Tick-borne Encephalitis Virus (TBEV) is also transmitted to humans through the consumption of raw goat milk (products), as has been reported from several countries such as Germany, Slovakia and Croatia. The virus is transmitted by infected ticks to goats, and they are shedding the pathogen with milk up to 23 days post infection. Therefore, milk pasteurization is strongly recommended.
New zoonotic potential of neglected pathogens has been identified with advanced molecular techniques. For example, the classical Borna Disease Virus (BDV) is not transmitted from infected sheep to humans to the current knowledge. The bicolored shrew is supposed to be the reservoir of BDV and the pathogen is transmitted by their excretion to humans, sheep and other susceptible species.
Despite the risk of pathogen spillovers from small ruminants to humans, especially sheep offer the opportunity to act as sentinels to identify the emerge of zoonotic diseases such as TBEV, Rift Valley Fever Virus and Crimean-Congo Hemorrhagic Fever Virus. An interdisciplinary approach is urgently needed to prevent transmission. Close collaborations between human and veterinary medicine and scientists from other fields such as ecologists and meteorologists are desirable. Linking data of passive and active surveillance systems from both disciplines will increase the preparedness for future disease outbreaks.

doi: 10.1016/j.anscip.2023.01.037

K-28
Control of sheep and goat brucellosis

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Keywords: Brucellosis; *B. melitensis*; *B. ovis*; Control strategies

Brucellosis is a zoonosis caused by *Brucella*, a genus of gram-negative bacteria that behave as facultative intracellular pathogens of ruminants, suidae, canids, camelids, marine mammals and wildlife. *Brucella* causes reproductive failure in livestock and undulant fever (among other symptoms) in humans. Worldwide, sheep and goat brucellosis caused by *B. melitensis* is the greatest threat for humans and controlling the infection in livestock does not only improves animal production but iťs the most effective and practical way to prevent human contagion.
Eradication of *B. melitensis* has been achieved in several European Union (EU) countries after many years of effort and heavy investment in official campaings. However, the infection remains prevalent in some regions of the EU and in most resource-limited countries all over the world. The attenuated live *B. melitensis* Rev1 vaccine (the only vaccine available for sheep and goat brucellosis) has been instrumental for the control and eradication of *B. melitensis.* However, Rev 1 causes abortions when administered to pregnant females and may interfere in the serological tests used routinely for *B. melitensis* surveillance. Wherever *B. melitensis* has been eradicated, these drawbacks have been overcome by limiting vaccination to young replacement animals by the conjunctival route, and by applying a combined test-and-slaughter policy. This strategy requires individual identification, strict control of animal movements and a generous budget for logistics and compensation for culling. These requisites are unfeasible in resource-limited areas, where mass vaccination of both young and adult animals (including those pregnant) becomes necessary. In these situations, the vaccine serological interference is irrelevant because culling cannot be

implemented, but the abortifacient effect of Rev 1 is a serious issue when vaccinating pregnant animals. Indeed, to develop a safe *B. melitensis* vaccine providing a good protection but lacking the abortifacient effects is currently the main goal of brucellosis vaccine research.
Although non-zoonotic, *B. ovis* (which affect sheep exclusively) also poses a significant problem as a widespread cause of infertility in rams and abortions or perinatal mortality in sheep. Rev 1 vaccine is also effective against *B. ovis* but due to its safety issues and potential diagnostic interferences, this vaccine is banned in those regions where *B. melitensis* eradication has been achieved. Consequently, *B. ovis* is re-emerging in *B. melitensis* free areas, and causes a grave problem in sheep in those countries where Rev 1 vaccination has been never implemented. Specific surveillance and control programs need to be implemented to avoid the spread of *B. ovis* in these areas. Thus, the development of *B. ovis* specific vaccines not interfering in *B. melitensis* surveillance is worth to be investigated.

doi: 10.1016/j.anscip.2023.01.038

K-29
Q fever in a future pan-European surveillance perspective

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Keywords: Coxiella burnetii; Small ruminants; Vaccination; Pan-European framework

Q fever is an almost ubiquitous zoonosis caused by *Coxiella burnetii*, which is able to infect several animal species, as well as humans. Cattle, sheep and goats are the primary animal reservoirs. In small ruminants, infections are mostly without clinical symptoms, however, abortions and stillbirths can occur, mainly during late pregnancy. Shedding of *C. burnetii* occurs in faeces, milk and, mostly, in placental membranes and birth fluids. During parturition of infected small ruminants, bacteria from birth products become aerosolised. Transmission to humans mainly happens through inhalation of contaminated aerosols. In the last decades, there have been several, sometimes large, human Q fever outbreaks related to sheep and goats, and often originated from a single farm or a single event. At the end of the first decade in this century, the largest recorded outbreak occurred in the Netherlands, with over 4,000 patients, and was related to *C. burnetii* shedding dairy goats. In order to prevent human Q fever outbreaks, several measures were implemented in the Netherlands. Of the implemented measures, mandatory vaccination with inactivated phase I vaccine (Coxevac®, CEVA Santé Animale) has played an important role in the reduction of bacterial shedding. Development of alternative Q fever vaccines has been rather limited, recent advances in methods to identify candidate vaccine antigens have shown considerable promise for the development of next-generation subunit vaccines, and will be discussed in this presentation.
An important role in source tracing can be played by genotyping of the bacterium. Whole genome sequencing (WGS) has revolutionised molecular epidemiology and surveillance of many zoonotic pathogens as it provides comprehensive genetic information and is easily standardised. Recently, a pan-European consortium has been proposed with the aim of collating *C. burnetii* positive samples from a wide range of hosts like livestock, wildlife and humans, with accurate clinical data. Isolated strains, plus available archived strains, will be submitted for WGS to generate a comprehensive database of annotated *C. burnetii* genomes, and phenotypic data from the field and *in-vitro* cellular assays as proxies of *in vivo* virulence. WGS data will be analysed using novel bioinformatics approaches to identify molecular determinants of *C. burnetii* host range and virulence. An important aim of this project is to create a pan-European framework for future molecular surveillance of *C. burnetii.* These opportunities in surveillance and advanced techniques will most likely bring source tracing of *C. burnetii* infections to a next level.

doi: 10.1016/j.anscip.2023.01.039

K-30
Bluetongue

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Keywords: Orbivirus; Animal health; Vaccination; Reference laboratory

Bluetongue (BT) is a non-contagious, viral disease affecting domestic and wild ruminants (primarily sheep and including cattle, goats, buffalo, antelope, deer or elk) that is transmitted by midges of the Culicoides species.
The virus which causes BT is identified as a member of Orbivirus genus of the family Reoviridae. The BT virus species, or serogroup, contains 24 notifiable serotypes, and some other atypical serotypes recently described. Infection with bluetongue virus (BTV) can occur asymptomatically in many animals, but can cause fatal disease in a proportion of infected ruminants. The severity of disease varies among

different animal species and viral strains with symptoms being most severe in sheep resulting in deaths, weight loss and disruption in wool growth. In highly susceptible sheep, morbidity can be as high as 100%. Mortality averages from 2% to 30% but can be as high as 70%. It is not known to affect humans.
The BT virus has been shown to be present in regions where the Culicoides is present (e.g. Africa, the Americas, Australia, the Middle East and some countries of southern Asia). Regarding Europe, until 1998 it was essentially bluetongue-free. Only few sporadic incursions of the disease were described before 1998 (Spain and Portugal between 1956 and 1960; Cyprus in 1977; Greece in 1979). Between 1998 and 2006, BTV strains from five different serotypes (serotypes 1, 2, 4, 9, and 16) emerged in the Mediterranean basin.
In August 2006, Dutch authorities reported the first ever case of bluetongue in Northern Europe. Most of the countries in northern and even southern Europe were affected by this strain. Next years some other BTV strains have affected to different countries in Europe, highlighting BTV1 in the Iberian Peninsula in 2007, affecting also to France; BTV4 in Balkans countries in 2014 reaching central Europe, including Italy where serotypes 1, 2, 9 and 16 have been detected along these years; and the unexpected comeback of BTV8 in France in 2015.
Regulation (EU) 2016/429, "Animal Health Law", has included BT into the list of animal diseases relevant for the Union intervention and categorization of animal diseases. Implementing Regulation lists infection with bluetongue virus (serotypes 1–24) as a category C disease for optional eradication programme. Vaccination can prevent clinical BT and mitigate its course by interrupting the BT virus cycle in the environment; it thus reduces the economic losses due to animal infection and makes transfer and trading of animals from BTV enzootic regions possible.
The Laboratorio Central de Veterinaria (LCV) of the Spanish Ministry of Agriculture is appointed as European Reference Laboratory (EURL) for Bluetongue since 2019. Its main task is to harmonize the laboratory diagnosis as key element for a rapid response to disease alert.

doi: 10.1016/j.anscip.2023.01.040

K-31
Antiparasitic drug resistance

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Keywords: Parasite; Haemoncuhus contortus genome; Genetic crosses; Sustainable helminth control

Parasites have large and complex genomes, extremely high levels of polymorphism, and huge reproductive potential; hence adaptation to drug exposure has been inevitable. Around the world, antiparasitic drug resistance is now commonplace in arthropod, vector borne protozoa and helminth parasites responsible for serious human disease and severe production loss in livestock. This presentation will focus on approaches to anthelmintic resistance research that are needed to inform advances in the control of gastrointestinal roundworms and fluke parasites.
Molecular tools are needed to study the emergence and spread of anthelmintic resistance. The investigation of possible associations between the resistance phenotype and polymorphisms in candidate genes was successful in identifying three SNP mutations in the isotype-1 β-tubulin gene, conferring benzimidazole resistance by preventing drug binding. However, studies of candidate genes have yet to unequivocally identify molecular loci responsible for resistance to other anthelmintic drug classes. We have developed and used alternative genetic crossing approaches, using the *Haemonchus contortus* genome to search for genetic linkage to mutations that might confer heritable anthelmintic resistance. Our first approach involved genetic crosses between populations the ivermectin susceptible reference genome *H. contortus* strain and South African- and Australian-derived resistant parental populations. The progeny were exposed to ivermectin selection before four rounds of backcrossing to the susceptible strain parents. This resulted in the introgression of loci genetically linked to ivermectin resistance mutations into the susceptible parental genomic background. Next, we next undertook a genetic cross between populations of the drug susceptible genome isolate and a North American multi-drug resistant *H. contortus* strain. Extreme quantitative trait locus (x-QTL) analysis of anthelmintic drug selected progeny of this genetic cross showed loci linked to benzimidazole (chromosome II, containing the isotype-1 β-tubulin gene), levamisole (chromosome V, containing a candidate acetylcholine receptor gene) and ivermectin (an approximately 2 Mb locus on chromosome V). The investigation of pairwise genetic diversity throughout ivermectin selected lines derived from the previous genetic backcrosses demonstrated the same single major genomic locus for ivermectin resistance. Our attempts to refine the locus for ivermectin resistance have been hindered by infrequent genetic cross over during meiosis and consequent low recombination rates; nevertheless next-generation re-sequencing and transcriptomic methods have identified novel candidate genes for further investigation.
Our *H. contortus* genetic crosses have also demonstrated important aspects of the parasite's biology, such as polyandry, polyploidy and incipient speciation. Furthermore, the Illumina MiSeq-based 'nemabiome' metabarcoding method developed by researchers at the Calgary Veterinary School, has revolutionised our ability to study anthelmintic resistance in mixed species parasite populations. The level of understanding that we have derived from these approaches is important when considering the translation of population genetics research to the development of practical guidelines for sustainable helminth control.

doi: 10.1016/j.anscip.2023.01.041

K-32
Hemoparasites: Differential diagnosis and treatment

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Keywords: Anaemia; Jaundice; Haemoglobinuria; Emaciation

Haemoparasites cause several diseases in sheep. Diagnosis/differential diagnosis varies according to clinical symptoms (see below).
Anaplasmosis caused by *Anaplasma ovis* may cause haemolytic anaemia. Other clinical signs are fever, anorexia, depression, weakness and dyspnea. Icterus may be present in severe cases, but hemoglobinuria is uncommon. However, anaplasmosis in sheep is normally subclinical, although recent studies indicate that *A. ovis* in some areas may cause severe wasting conditions. Current treatment involves the use of oxytetracycline or tetracycline hydrochloride.
Tick-borne fever (TBF) is caused by *Anaplasma phagocytophilum*. The most characteristic symptom is high fever. Other clinical signs are often absent or mild. However, high mortality, may occur due to immunosuppression and secondary infections. Other complications include abortion, reduced spermatogenesis, and reduced weight gain in lambs. Current treatment is oxytetracycline.
Babesiosis is caused by protozoa, mainly *Babesia ovis* and *Babesia motasi*, where *B. ovis* is most pathogenic. Acute babesiosis (*B. ovis*) is characterized by apathy, fever, anaemia, jaundice and haemoglobinuria, and mortality may occur. Chronic infection includes anaemia and ill-thrift. Imidocarb diproprionate and diminazene aceturate may be used for treatment.*Heartwater* is caused by *Ehrlichia ruminantium*. There are four clinical forms: peracute, acute, subacute and subclinical, where the acute form is most common. The latter form is characterized by sudden onset of high fever, nervous signs, rapid and abdominal breathing. *E. ruminantium* may cause high mortality. Successful therapy depends on early antibiotic treatment using tetracycline.
Eperythrozoonosis is caused by *Mycoplasma ovis* (formerly *Eperythrozoon ovis*). Clinical symptoms include haemolytic anaemia, hemoglobinuria, stiffness and reduced weight gain. Subclinical or latent infections seems to be the rule. However, ill-thrift condition occurs with small, pot-bellied and emaciated lambs, often with a fatal outcome. Neoarsphenamine, antimosan and tetracycline have been recommended for treatment.
Theileriosis is caused by protozoan in genus *Theileria* of which *Theileria lestoquardi*, *Theileria luwenshuni* and *Theileria uilenbergi* are considered pathogenic. *T. lestoquardi* infection may cause high mortality. Clinical signs in the acute form are fever, cessation of rumination, swelling of superficial lymph nodes, diarrhoea, jaundice and haemorrhages (submucosal and subcutaneous tissues). In chronic cases, intermittent fever, inappetence, emaciation, anaemia and jaundice may occur. For treatment, parvaquone or buparvaquone may be used. Halofuginone is also reported to be effective.
Trypanosomosis is caused by haemoflagellates in genus *Trypanosoma*, especially *Trypanosoma congolense*, *Trypanosoma vivax* and *Trypanosoma brucei*. The main clinical symptom is anaemia. *T. vivax* and *T. congolense* cause acute, subacute and chronic disease. Clinical signs may involve depression, anorexia, rumen atony, enlarged lymph nodes and weight loss. Jaunice and hemoglobinuria are uncommon. In chronic cases, emaciation is reported. *T. brucei* may cause CNS-symptoms. Curative and prophylactic use of trypanocidal drugs, such as diminazene aceturate and homidium chloride, are recommended.

doi: 10.1016/j.anscip.2023.01.042

K-33
The landscape of ticks-sheep-wildlife-pathogens habitat overlap in a changing world

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Keywords: Ticks; Pathogens; Climate; Reservoirs

Ticks are prominent vectors of important pathogens of livestock. Both the weather and the interactions of ticks with wild hosts (i.e. red deer, common mice, or birds) are fundamental drivers of the transmission dynamics of these pathogens to sheep. Adequate modelling efforts to evaluate the areas under risk by tick-borne pathogens are still far from adequate. These evaluations should ideally rely on a complete understanding of the epidemiology of these pathogens, plus the local relationships among the partners, greatly influenced by deforestation, increase of crop areas, changes in diversity of wildlife and trends of weather. This presentation is intended to show the basic panorama regarding the main ticks affecting sheep in Europe, together with a general overview of the epidemiology of tick-borne pathogens, like Protozoa of the genera Babesia or Theileria, or bacteria such as Anaplasma. The aim of the presentation is to present the main interactions among the habitat, the landscape, and the ticks, with a focus on epidemiology and prevention, as driven by the changes in climate.

Special attention is intended to show how climate may disrupt some "classic concepts" on the epidemiology of tick-borne pathogens, resulting in new patterns of transmission, at different latitudes in the European continent. These relationships should be ideally redefined, to prepare new protocols of prevention, impact, and adaptation, in an easy way to transmit knowledge to stakeholders and farmers.

doi: 10.1016/j.anscip.2023.01.043

K-34
Mastitis in small ruminants

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Keywords: Mastitis; Staphylococcus; Cell counts; Contrôle

Intra-mammary infections in small ruminants are etiologically diverse: mainly Gram-positive bacteria, but also Gram-negative ones (*Pasteurellaceae*, coliforms, . . .), Mycoplasmas, Lentivirus, etc. The most frequent mastitis causative organisms are *Staphylococcus aureus* for clinical infections and coagulase-negative Staphylococci for subclinical ones. The majority of *S. aureus* strains are of different molecular type from bovine ones and often more pathogenic. The impact of lambs or kids as healthy vectors (upper respiratory tract) of udder pathogens before weaning is important (*Mannheimia haemolytica*, *S. aureus*, . . .). The role of Mycoplasmas and CAEV may be significant from a clinical, diagnostic and control point of view (goats). Milk PCR and ELISA should be used to determine the herd status for these infections.
Significant progress has been made in mastitis diagnosis. Bacteriology has benefited from the contribution of mass spectrometry as some bacteria species identifications were previously uncertain with biochemical tests. On the contrary, in some countries, vets perform simplified bacteriological diagnose at the veterinary office in order to provide basic etiological orientations. The interest of somatic cell counts has been increased by the possible animal-side use, and above all by the diffusion of differential cytometers (promising for goat milk in long-term).
Acute mastitis treatment should be very early and target anti-infectious and anti-inflammatory goals. If dry-off antimicrobial therapy is to be implemented, intra-mammary administration and highly selective treatments should be performed. Females to treat must be subclinically infected ones (after culling of chronic cases), one the basis of milk cellularity: somatic cell counts and/or CMT (potentially bacteriology). At the end of lactation and before antibiotic treatment, an effective culling selection process by simple means (udder clinical examination) is possible.
For control, mechanical milking is one of the most important risk factors. In addition to the classic recommendations and annual control, milking time ("wet", dynamic) tests allow to identify the main milking defaults in the presence of animals. Other risk factors especially include certain parameters of feeding (nutritional balance, micronutrients intake, . . .), and secondarily of livestock management (suckling vs. milking, weaning, duration and mode of dry off, . . .) and sometimes housing.
Vaccination against mastitis has been developed in recent years to control clinical or subclinical mastitis, mainly of staphylococcal origin. The genetic basis for mastitis resistance is better known and may lead to effective selection in some breeds. Several genomic regions controlling SCC were identified in sheep and goats.
Management of a mastitis problem should be based on a comprehensive and thorough diagnosis at the herd level, followed by a reduction of risk factors associated with improved detection and elimination of udder infections. Antibiotics alone, or vaccination alone, are not the correct answer.

doi: 10.1016/j.anscip.2023.01.044

K-35
Vaccination schedule for respiratory diseases

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Keywords: Mannheimia haemolytica; Pasteurella multocida; Bibersteinia trehalosi; Sheep

Respiratory diseases are one of the main causes of death in sheep. However, its importance differs according to the production systems and climatic conditions in which the sheep are raised. Deaths are distributed drip over time although their frequency is higher during heat stress periods. These characteristics make diagnosis difficult and reduce the importance that farmers attach to these diseases.
Lesions associated with respiratory diseases can be observed in animals of all ages, however, the proportion of consolidated pneumonic lesions is higher in lambs from one month of age. A large number of agents such as viruses, fungi and bacteria are isolated from these lesions. We have to take into account that in most cases several agents can be isolated simultaneously from the same animal. *Mannheimia*

haemolytica, *Pasteurella multocida* and *Bibersteinia trehalosi* are the most frequent species isolated among bacteria. These bacteria also have different serotypes or serogroups that have different levels of virulence and several of them can be isolated simultaneously from the same lesion.
There are different types of vaccines licensed for sheep that focus on the control of these bacteria. These vaccines can produce defenses against one or several of the Pasteurellaceas described, but in the EU there are not licensed sheep vaccines that protect against the three agents simultaneously. The most common antigens in the formulation of vaccines are the outer membrane proteins (OMPs) that vary for each species and also for each serotype/serogroup within the same species. We need to know them before selecting this type of vaccine since cross-protection between serotypes is not enough in most of cases. Other antigens used are, in the case of *Mannhemia haemolytica*, leukotoxins, which confer good protection and play a very important role in the development of an effective immune response. The iron regulated outer membrane proteins of *Pasteurella haemolytica* (*Mannehimia haemolytica* + *Bibersteinia trehalosi*) have also been used in the formulation of vaccines and confer a good cross-protection between serotypes. In addition, it is very important to take into account that the antigens used in the vaccines must come from ovine isolates, since antigenic differences have been observed between the antigens presented by isolates from bovine or ovine origen.
When considering vaccination plans against respiratory diseases in sheep, we must take into account the complete protection conferred by the vaccines, initially requiring two doses. This means that the vaccination schedule should start at least four weeks before the time when the risk of these diseases increases. The moments of application of these vaccination plans will differ between production systems, times of the year and age of the animals, taking into account the main isolated agents and the types of vaccines available.

doi: 10.1016/j.anscip.2023.01.045

K-36
Contagious agalactia

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Keywords: Etiology; Epidemiology; Diagnosis; Control

Contagious agalactia (CA) is a worldwide syndrome affecting dairy and meat small ruminants involving 4 mycoplasma species. *Mycoplasma (M.) agalactiae* is considered the agent in sheep and it has also been detected in goats or wild ruminants as the Spanish or the Alpine ibex. Genetic and antigenic variability is common in this bacterium. Diversity has been demonstrated using several techniques, such as VNTR, MLST, PFGE or total genome sequencing, also evidencing a higher diversity level in mycoplasmas isolated from goats.
CA Epidemiology is very complex. About transmission, the lambs mainly become infected while suckling colostrum and milk. The milking machines or direct contact with contaminated aerosols are considered the main routes of transmission for sheep. *M. agalactiae* has also been detected in semen of infected rams, although its transmission during natural service or when semen is used for artificial insemination has not been studied. The presence of males and females asymptomatic carriers is common in sheep infected herds. Young animals can be also asymptomatic carriers. Both of them represent the main source of infection for other herds due to the uncontrolled animal movements. In these animals, *M. agalactiae* is commonly recovered from milk samples in sheep and the bacteria presence in nasal swabs has also be evidenced in rams.
Mastitis, conjunctivitis and arthritis are the classical symptoms in CA outbreaks and subclinical mastitis and the presence of sporadic episodes of mammary gland atrophies are frequent in chronically infected herds located in endemic areas. Abortions or respiratory symptoms can also be observed. All the symptoms are rarely observed in the same animal or even in the same herd.
The diagnosis and control are also complex and always require a laboratorial support. PCR and culture are the most suitable options to detect and characterize the agent in clinical samples. Serology is only valid in unvaccinated animals. Monitoring of bulk tank milk samples, mastitis samples or the presence of carriers are suitable options to clarify the herd health status. Culling of infected animals is always recommended and antibiotics are also used to control outbreaks although bacteriological cure is not possible. Quinolones, tetracyclines, macrolides or lincomycin are commonly used antibiotics. Minimal inhibitory concentration (MIC) test is recommended because of the presence of antibiotic resistances. Current inactivated monovalent vaccines available in sheep cannot prevent new infections and its use sometimes provide a limited protection from clinical disease. Implementation of hygienic measures and pasteurizing colostrum are recommended to reduce the new infections in infected herds.

doi: 10.1016/j.anscip.2023.01.046

K-37
Control of lentivirosis

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Keywords: SRLV; Heterogeneity; Serology; TMEM154

Small Ruminant Lentiviruses display a high biological, genetic and antigenic heterogeneity. They are currently classified into 4 genotypes and more than 20 subtypes. Specific diseases, known in both sheep and goats, are associated to specific subtypes (as Subtype B1 for Caprine arthritis encephalitis), while other subtypes display weak or null pathogenic potential. No vaccines are available to control disease or infection. Control measures have been adopted in many Countries to reduce prevalence or, ultimately, eradicate infection. They are mainly based of detection and culling of seropositive animals (test and slaughter policy), or by generating a free progeny from infected flock. In both cases a sensitive serological test should be applied, taking in mind the antigenic properties of viral strain/s in the field and application of homologous diagnostic test, at least at the genotype level. Main viral structural proteins are employed in different diagnostic test, being the major capsid antigen, transmembrane protein and surface subunit the most frequently used. Three generation of diagnostic antigens (native, recombinant and synthetic) accompanied nearly 40 years of SRLV diagnostic. Eradication campaigns were frequently successful when control measures were addressed towards specific pathogenic subtype (such as B1), while the eradication of SRLV, as a whole, proved to be more difficult, being nor economically or practically advantageous, especially in small ruminant population displaying high SRLV heterogeneity. Molecular testing (such as conventional or real time PCR) has been proposed from time to time but routine adoption is greatly hampered by low sensitivity, genetic heterogeneity of viral strains and cost.
Recently a new approach based on host genetic resistance was proposed in sheep, rising increasing interest in scientific community. A single nucleotide polymorphism (missense mutation E35K) in the ovine transmembrane protein gene 154 (TMEM154) was identified as protective against small ruminant lentivirus infection in different herds worldwide. However, the protective effect was confirmed only for certain subtypes within genotype A clusters. As an example, subtype B2, known to cause a maedi-like disease in sheep in many Mediterranean Countries, escapes from protection effect, suggesting a limited impact of the SRLV genetic control program based on E35K polymorphism of TMEM154. Nevertheless, this approach open a new window in research and can be potentially a successful strategy in sheep population with limited viral genetic variant.

doi: 10.1016/j.anscip.2023.01.047

K-38
Digital dermatitis in small ruminants

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Keywords: CODD; Lameness; Sheep; Goats

Digital dermatitis is an emerging disease of small ruminants, first reported in the UK in 1997. Since then it has become widespread in the national sheep flock with an estimated 50% of sheep farms affected, and several reports of its emergence in dairy goats. There are also reports of the disease occurring in other parts of the world in small ruminants. Clinically, lameness caused by digital dermatitis is severe. In sheep, it presents as an initial proliferative or ulcerative lesion at the coronary band, progressing to separation and eventual avulsion of the hoof capsule. In goats, foot lesions have a more ulcerative appearance and are proposed to occur as secondary infection of other foot lesions. In both species, lesions are consistently associated with infection with one of three *Treponema* species (*Treponema medium/vincentii like*, *Treponema phagedenis like*, *Treponema pedis*). Until recently, there was only a small evidence base for vets and farmers to utilise in their control. This presentation will summarises significant, recent advances in our understanding of digital dermatitis and its control in small ruminants.

doi: 10.1016/j.anscip.2023.01.048

K-39
Current concepts and future developments in surgery, anaesthesia and pain management

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Keywords: Sheep; Goats; Surgery; Anaesthesia

Routine surgical procedures, such as castration, tail docking, dehorning, or mulesing are subject to different levels of regularity in different countries (Bauer et al., 2018). The sense and the necessity of these interventions are increasingly questioned due to animal welfare. More and more it is required to avoid, or replace tail docking and mulesing, e.g. by management or breeding measures. Where this is not possible, as in the case of castration or dehorning, some legislators are endeavouring to permit them only in the case of individual medical indication and under general anaesthesia or at least the greatest possible pain relief. Veterinarians quickly come up against limits here, as in many countries non-steroidal anti-inflammatory drugs (NSAIDs) and analgesics can often only be used off label in small ruminants.
In addition to the use of NSAIDs, general anaesthesia should be combined with xylazine if possible, which is a potent analgesic in sheep, comparable to opioids. Due to a reduced therapeutic range and increased side effects, xylazine should only be used at a significantly reduced dose in goats and some sheep breeds. To reduce pain also local anaesthetics should be used including lumbosacral and sacrococcygeal epidural anaesthesia as well as conductive or retrograde intravenous anaesthesia.
In addition to routine procedures, pet sheep and goat owners are increasingly requesting surgical interventions at the level performed in small animal practice, such as amputation of injured limbs, osteosynthesis, implantation of stents or creation of bladder or urethral fistulas. Small ruminants are as well gaining increasing importance in experimental surgery. In planned abdominal surgery, to prevent regurgitation, bloat or tympany of the rumen, it is advisable to starve the animals for at least 36 hours and house them without straw. Intubation of small ruminants would be optimal, though it is a considerable hurdle and requires not only deep anaesthesia, but also a particularly long laryngoscope blade. A feeding tube should be advanced through the oesophagus to the rumen to prevent increased ruminal gas accumulation. Leaking ruminal fluid should be collected and returned to the animal via the ruminal tube after surgery. If possible, the supine position should be avoided during general anaesthesia, as this causes arteriovenous shunts in the pulmonary circulation of sheep, which can result in hypoxia and hypercapnia (Grimm and Ganter, 2022).

References

Bauer, B., Hannemann, R., Lendl, C., Strobel, H., Ganter, M., 2018. Painful procedures in small ruminants – castration of rams and bucks. An overview. Tierarztl Prax Ausg G 46, 115–127. https://doi.org/10.15653/TPG-180065.
Grimm, L.M., Ganter, M., 2022. Analysis of pH and Electrolytes in Blood and Electrolytes in Ruminal Fluid, including Kidney Function Tests, in Sheep Undergoing General Anaesthesia for Laparotomy. Animals 12 (7), 834. https://doi.org/10.3390/ani12070834.

doi: 10.1016/j.anscip.2023.01.049

K-40
Knowledge transfer and communication with farmers

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Keywords: Knowledge exchange; Communication; Application; Good practice

The UK sheep industry is a significant livestock sector that fits well in the marginal uplands and alongside arable and other agricultural enterprises to the extent that sheep farmers play a key role embedded within UK rural society. With over 15 million breeding ewes grazing extensively, significantly more than either cattle or pigs, this is an industry where welfare standards are consistently on public view.
Significant economic challenges face the sheep industry, as well as issues with the management and control of endemic diseases such as parasites, lameness and chronic production-limiting viruses. Alongside this, there is an increasing need for the responsible and judicious use of both antimicrobials and anti-parasiticides amidst increasing reports of resistance.
Indeed, antimicrobial resistance (AMR) has been identified as a global threat to both human and animal health with the quadripartite (WOAH, UNEP, WHO and FAO) calling for urgent multisectorial action. Challenges in the veterinary arena match that in the human sphere, where funding has been identified as skewed towards technology development rather than investment in the application of strategies within the appropriate cultural context (Charani, 2021).
Livestock veterinary surgeons are both guardians of animal health and welfare and trusted farm advisors. As such they play a pivotal role in the transfer of good livestock health and management knowledge and the application of that knowledge, a role that depends on effective communication.

Since May 2018, 115 veterinary surgeons have reported running an active Flock Health Club for sheep farmer clients, both in the UK and internationally. Significant tangible benefits have been demonstrated, particularly in the control of sheep lameness, in parasite control and in the effective management of colostrum and lambing time procedures (Noble et al., 2020). The Flock Health Club initiative has ongoing contact with over 460 veterinary surgeons via newsletters and training events.
In terms of the responsible stewardship of medicines, the UK sheep sector led the way via industry application of Sustainable Control of Parasites in Sheep (SCOPS) principles in flocks. Subsequently it made substantial voluntary changes in medicine use decisions, based on the principles of Plan-Prevent-Protect (Lovatt, 2018) and documented through Responsible Use of Medicines (RUMA) annual target reports. Additionally, the Farm Vet Champions initiative (https://rcvsknowledge.org/fvc) has empowered and mobilised 800 farm animal veterinary surgeons to undertake training in good farm management practices and veterinary-farmer communication skills and to measure their progress by setting SMART (specific, measurable, achievable, realistic and time-bound) goals via the bespoke platform.
"Knowledge is like paint. It does no good unless it is applied"

doi: 10.1016/j.anscip.2023.01.050

ECSRHM (European College of Small Ruminant Health Management)

K-41
Overview of transboundary diseases that are of risk to food security

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Keywords: TADs; Livelihood; Risk; Response

Transboundary animal diseases (TADs) are highly contagious diseases with the potential to spread rapidly across borders and impose severe losses on livestock and livelihoods, staking the food security of countries and significantly damaging the economy of countries with direct and indirect losses.
The livestock sector contributes to the livelihoods of more than one billion people globally, with most livestock keepers being small-scale livestock producers and pastoralists. The sector is constantly threatened by the burden of endemic and emerging transboundary diseases. The continuing threats of foot-and-mouth disease (FMD) and other TADs such as peste des petits ruminants (PPR), avian influenza (AI), African swine fever (ASF), lumpy skin disease (LSD), sheep pox and goat pox (SGP), Rift Valley fever (RVF) are examples of the TADs that are challenging national veterinary services and public health authorities.
The effects of the COVID-19 pandemic have highlighted the complex economic, social, and environmental determinants of both animal and human health. Furthermore, increase in long-distance movements of humans, domestic animals and animal products and environmental challenges such as climate change are significantly influencing the spread of TADs.
A better understanding of the factors contributing to the spread of TADs and the connected drivers can significantly contribute to mitigate their socio-economic impacts. Further works are needed to improve the preparedness to respond with efficacy and effectiveness to TADs outbreaks and improving resilience of the livestock sector to crises. Epidemiological and economic models can help to better understand these complex systems and mitigate disease risks more effectively and to assess the impact of diseases and socio-economic benefits of control programmes, supporting investment decisions.
There is a need for a critical review of the level of preparedness and response capacity to ensure rapid diagnosis, improved surveillance, effective immunization, and efficient coordination among stakeholders. Activities aimed at identifying high-risk areas for introduction and spread of TADs should be further implemented in order to prioritize and optimize resources and better target surveillance, prevention and control measures. Mutual public and private collaborations can improve availability of adaptable critical reserves to overcome shortage of staff, vaccines and reagents in case of emergencies.
FAO's Strategic Framework seeks to support the 2030 Agenda through the transformation to more efficient, inclusive, resilient and sustainable, agri-food systems for better production, better nutrition, a better environment, and a better life, leaving no one behind. Strengthening national and international integrated One Health systems for human, animal, plant and environmental health is one of the programme priority areas that can be achieved through improved pest and disease prevention, early warning and management of national and global health risks. This paper provides an overview of the impact of TADs on livestock sector and discusses possible solutions for improving prevention and control efforts.

doi: 10.1016/j.anscip.2023.01.051

K-42
ECSRHIM Transboundary diseases – Barriers to their control and opportunities for eradication. Engagement of veterinary paraprofessionals in transboundary disease control

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The control and eradication of transboundary animal diseases requires not only technological solutions, enabling infrastructure, supportive policy and control plans, but also an adequate workforce capable of implementing these plans. Adequacy is defined in terms of both the quantity of veterinary workforce and the quality of their skillset. Complementary sets of skills are required with persons capable of developing national strategies, working in laboratories and abattoirs, and working at field level with farmers. This field level veterinary workforce plays a key role in implementing vaccination campaigns, raising awareness about transboundary animal diseases, collecting samples, and reporting suspected outbreaks to veterinary authorities. In Sub-Saharan Africa veterinary paraprofessionals outnumber veterinarians ten to one (The role of Veterinary Paraprofessionals). 18 Sub-Saharan countries have less than 50 veterinarians registered within the country and of those six countries have single digit numbers of veterinarians or none. Thus, veterinary paraprofessionals are key stakeholders in the control of transboundary animal disease control at field level.
However, this segment of the veterinary workforce faces several constraints. In many countries they lack clear legal status and regulation under the veterinary statutory body. There are few to no continuous professional development opportunities after graduating. Furthermore, since structural adjustment programs since the 1990s, many of the veterinary paraprofessional workforce has been pushed into the private sector. The sustainability of service delivery by veterinary paraprofessionals in rural areas is linked to their ability to gain sufficient income for their services. This becomes a real challenge in rural areas of Sub-Saharan Africa where smallholder farmers have less disposable income and have received sporadic free services over past decades decreasing their willingness to pay. Issues of veterinary medicinal supply chain access, circulation of fake products, and unfair competition from projects and providing free services compound these challenges.
The European Commission for the Control of Foot and Mouth Disease of the Food and Agriculture Organization has partnered with the World Veterinary Association and HealthforAnimals in order to address some of these key challenges. Under the project **Sustainable Business in Animal Health Service Delivery through Training for Veterinary Paraprofessionals** private sector veterinary paraprofessionals in Nigeria, Uganda and South Africa are being supported through targeted continuous professional development training grow and increase the sustainability of their animal health businesses whilst pivoting it towards preventive animal healthcare services. In addition, public-private multistakeholder platforms have been established to address some of the root causes of their business instability and develop a more supportive environment.
This talk will present key findings from the veterinary paraprofessional training needs and business environment assessment conducted in Nigeria, South Africa and Uganda and key insights learned from this project.

Reference

The role of Veterinary Paraprofessionals in the control of foot-and-mouth and similar transboundary animal diseases. https://www.fao.org/3/cb8366en/cb8366en.pdf.

doi: 10.1016/j.anscip.2023.01.052

K-43
Gender a crucial variable for livestock transboundary diseases control and management; Lessons based on RVF vaccinations in Nyagatare District of Rwanda

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Keywords: Goat Health; RVF Vaccine; Small Ruminants Health; Gender Analysis

RVF is a zoonotic disease of public health and economic importance that affects ruminants such as goats and sheep. It was first reported in Rwanda in 2013 with the latest episode in 2022. The Government of Rwanda (GoR) controls nearly all vaccination activities, and few private veterinary practitioners are involved. In addition to other control and mitigation measures such as education campaigns and insecticide spraying, the GoR provides annual vaccination services or mass vaccinations in case of outbreaks, of livestock in high-risk areas. In Rwanda, cattle are the priority when allocating public resources to veterinary extension services including vaccination. Therefore, despite existing evidence that goats and sheep are more likely to get infected and then die from RVF, the livestock vaccination activities do not target the goats, which are not considered important enough to save.
The SheVax project analyzed the livestock vaccination landscape from a gender perspective, in Nyagatare District of Rwanda, in 2021. It's goal was to see if women benefited from animal health services as much as men, in Rwanda, Kenya and Uganda, and if not, to understand why, and test interventions to improve the health of women's animals. We documented how women are highly dependent on their goats and poultry to earn income to buy food they cannot grow themselves, as well as family clothing and school fees.
Our research revealed that although women provide much of the farm labor for agricultural and livestock production, most resulting income is controlled by men, who don't understand that women have a longer workday than the men, or even how they manage to put food on the table. Most farmers, both male and female, were not aware that goats could be vaccinated against RVF, and many other infectious diseases. RVF vaccine for goats was not readily available, and veterinary students received very little information on goats. Harmful gender norms, and the invisibility of women's animals, work and priorities, exist in many countries with high levels of transboundary animal disease, and are an underlying obstacle to successful control.
SheVax interventions included technical training on goat health and management for the vets, paravets, Community Animal Health workers (CAHWs), and farmers. Gender awareness programs engaged both male and female farmers, as well as local and national government officials, to identify the gender norms that marginalize women from making decisions that impact their own lives, which holds back the development of the livestock sector, their families, and the whole country. Therefore, any planning for effective animal health policies, campaigns, and eradication strategies must first be aware of the extent of gender inequality, and recognize that households do not share resources, labor, information and benefits such as income equally or fairly. Intentional outreach with technical information for women, and engagement with men to recognize the value of sharing decisions and benefits with wives can improve the health of all livestock, and also the lives of the people who depend on them.

doi: 10.1016/j.anscip.2023.01.053

K-44
The global need for advances in the sustainable control of helminth parasites

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Keywords: Sustainable livestock production; Planned animal health; Principles of helminth control; Post genomic research

Sustainable and economically, environmentally and socially responsible livestock production depends on efficient of conversion of primary herbage resources, or by-products to meat, milk, or fibre. The temperature and rainfall, or irrigation conditions which favour herbage growth are the same as those which favour free-living stages of arthropod, protozoa and helminth parasites; while management aimed at optimising livestock production efficiency also favours contamination with and exposure to infective stages of these parasites. Consequently, parasitic infections, helminths in particular, are the foremost production limiting diseases of farmed ruminant livestock.
The achievement and sustainability of efficient production requires planned animal health management, tailored to individual situations, in which the emphasis is proactive preventive interventions, as opposed to reaction to clinical disease outbreaks. The principles of helminth control are to reduce host exposure to infective stages to a level that will allow for the development of protective immunity, while ensuring that parasitic stage burdens are manageable. This usually involves the integration of evasive management and drug treatments; the timing of which is governed by the seasonal production cycle of the host giving rise to naïve or less immunologically capable animals, and climatic conditions favouring roundworm egg hatching, larval development and infective larval survival, or the availability of fluke metacercarial challenge. Bespoke, sustainable control programmes for groups of animals are based on the common-sense application of knowledge of the farming system and inferences on the relationship between pasture contamination, the availability of infective larvae on pasture and the build-up of infection in animals.
Globally, most livestock keepers administer anthelmintic drugs with the unachievable and naïve single goal of eradicating parasites from their animals, preferring formulaic one-fits-all programmes for their use. However, these approaches don't work because of the parasites' different adaptations to changing climate, human lifestyle, or livestock management, and exposure to anthelmintic drugs. Over recent years, variations have become established in the epidemiology of teladorsagiosis, haemonchosis, nematodirosis and fasciolosis in small ruminants in northern Europe; while resistance to each of the single-active broad spectrum anthelmintics has now emerged and spread in multiple helminth species wherever these drugs have been used. There is, therefore, a need for advances in the sustainable control of helminth parasites; integrating grazing management and anthelmintic drugs for use in specific agricultural contexts. These advances need to be practical, incorporating anthelmintic resistance mitigation and exploring the exploitation of host genetic adaption, use of natural xenobiotics and vaccine development. Advanced genome assemblies and transcriptomes have been developed for *Haemonchus contortus*, human soil transmitted helminths, *Schistosoma mansoni*, *Fasciola hepatica*, *Taenia solium* and *Echinococcus* spp. Post genomic research will

be critical to improve our understanding of helminth parasite genetic adaptations as a basis for the iterative development of sustainable management advice.

doi: 10.1016/j.anscip.2023.01.054

K-45
Back to the future? Advances in control of gastrointestinal roundworms

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Keywords: Sheep; Nematodes; Control; Sustainable

From my perspective, on the chalky, free-draining soils of southern England, a farm utilising the recent advances in gastrointestinal nematode (GIN) control in their sheep flock is breeding sheep that can cope with GIN challenge without recourse to artificial anthelmintics, is moving animals at least weekly in a rotational grazing system with cattle, grows chicory or sainfoin for grazing lambs, creates "clean grazing" through rotation of fields between livestock grazing and arable farming. In short, it looks remarkably like the farms of one hundred years ago. . .

Except today's farm is using EID, electronic weigh scales and flock management software to identify the sheep that require anthelmintic treatment, and those to select for breeding. It is augmenting the development of immunity to *Haemonchus contortus* with a vaccine. It is using estimated breeding values for resistance to GIN infection, based on faecal egg counts or plasma IgA levels, when choosing which rams to purchase. The shepherd is utilising forecasts based on meteorological data to identify high-risk periods for particular parasites and can act accordingly. There is also a greater understanding of the relationship between nutrition and immune response to GIN infection, with the analytical capacity to identify the quality of conserved forage, the presence of trace element deficiencies, and shortfalls in energy and protein intakes and so correct them.

Based on the most recent advances, that may be translated to commercial availability, the shepherd may soon be able to submit faecal samples to a lab for an inexpensive PCR test to identify the species make-up of the GINs infecting their sheep. If this is coupled with identification (by use of SNPs) of the genes for resistance to the anthelmintic classes (some have already been identified), then treatment decisions will be more akin to how a bacterial infection is treated in a hospital – the pathogen and its susceptibility will be known and used for treatment decisions in each case. Equally, real-time meteorological data, grazing history, stocking density and faecal egg count will be the input variables for modelling programmes, which will produce accurate estimates of levels of pasture larval contamination on a field-by-field basis.

In the author's opinion the development of effective synthetic/chemical anthelmintics resulted in over-reliance on these products, and strategies that attempted to "conquer" the parasites. This approach has failed, and a new approach is needed. This new approach requires considerably more humility in the face of the natural world, and greater appreciation of the complex system that we are attempting to steward when we farm sheep. Fortunately for those involved in the sheep industry, this should provide a far more intellectually satisfying, as well as more sustainable, and possibly even more productive, approach to parasite control.

doi: 10.1016/j.anscip.2023.01.055

K-46
Advances in the control of fluke parasites

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Keywords: Fluke; Parasites; Epidemiology; Sheep

Fasciola hepatica infection is very common and highly prevalent mainly in humid areas causing economic losses. Climate influenced the exogenous stages of the life cycles and modify the epidemiology. In NW Spain the prevalence of the infection in sheep has increased during the last decade.

Recent data are related with diagnosis, molecular biology tools being of great value for the early detection and testing anthelmintic efficacy. The inappropriate use of triclabendazole has led to development of fluke strains resistant although the extent of resistance is not known yet.

The immune response after infection makes vaccination an approach of fluke control. Several *F. hepatica* protein antigens are potential vaccines. There is not total protection, but some reduced the number of metacercariae established, the survival to adult stage, the worm burden, and the fluke size.

Several fatty acid binding proteins can be candidates as a vaccine. The new ADAD system protect sheep by reducing fluke burden, number of eggs in the bile and faeces. The size of the flukes is shorter, and some flukes are immature.
Sheep vaccinated with native fluke cathepsins (moderators of virulence) show a suitable reduction of the worm burden.
Another candidate – glutathione S-transferase – confers different levels of resistance against *F. hepatica* depending on the adjuvant. Also, the leucine amino peptidase candidate shows a high protection level.
Cytokines are proteins playing a main role in the immune system. A protein member of the *F. hepatica* saposin-like protein family induces significant anti-pathological and anti-fecundity effects on *F. hepatica* and a fluke burden reduction of 81–83%.
In a recent study using two vaccines (cocktail of antigens and two different adjuvants) sheep had a significant lower fluke burden, a decrease in FECs and marked reduction of hepatic lesions. The IgG levels in sera showed an increase in one of the experimental groups.
The lancet fluke *Dicrocoelium dendriticum* is a less important fluke that can be controlled by management and treatment with albendazole (>15 mg/kg bw) and netobimin (15–20 mg/kg bw) usually before housing in autumn and at the beginning of the spring, when required.
The rumen fluke has attracted attention recently. *Calicophoron daubneyi* have some similarities with *F. hepatica*. Only immatures may cause clinical signs, but adults do not. Usually, drug treatment is not necessary.
To conclude just remember: ‘‘control of sheep diseases is essentially a problem of prevention rather than of treatment.

doi: 10.1016/j.anscip.2023.01.056

K-47
Neonatal survival

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Keywords: Lamb survival; Management; Pregnancy; Physiology

Lamb survival

Lamb mortality is a multifactorial trait, largely influenced by environmental factors. Higher survival rates can, therefore, be achieved through management practices. Nevertheless, new intervention strategies and extension activities to support adoption of new technologies are required, especially to improve the survival of lambs from larger litters. Importantly, there is limited information on the social, cultural, and economic factors which may influence management practices on farms to improve lamb survival.
Newborn lambs have to adjust immediately to their surrounding environment by activating their thermoregulatory system and performing behaviours which will secure colostrum intake and the development of the ewe-lamb bond. Consequently, lambs are most vulnerable during the first three days *postpartum*; and this period is critical for lamb survival. The most prominent causes of mortality immediately *postpartum* are hypothermia, mismothering and starvation in outdoor lambing systems, and dystocia and infectious disease in indoor systems.
It is known that maternal nutrition during the gestational period plays a key role to support fetal growth and development. Undernutrition in ewes in the last third of pregnancy increases the risk of impaired fetal growth and affects neonatal and ewe physiology, with lower birthweights and decreased ability to thermoregulate in lambs. Furthermore, undernutrition negatively affects the development of the mammary gland and production of colostrum in ewes. Low birthweight resulting from undernutrition of the ewe has also been associated with behaviour changes in the lamb such as being slower to stand and fewer suckling attempts. Thus, maternal undernutrition mid-late late gestation can negatively influence traits important for lamb survival and thus increases the risk of neonatal lamb mortality. Conversely, overfeeding ewes during pregnancy has also been found to have negative effects on fetal growth and development. Thus, maternal nutrition during gestation has an important influence on traits important for lamb survival. However, the biology underpinning this knowledge is not well understood; consequently, practical methods to improve lamb survival through maternal nutritional interventions are limited.
Here, we will describe the results of a questionnaire that was offered online to sheep farmers from the United Kingdom, Republic of Ireland and New Zealand. There were substantial differences in farming system, flock size, number of triplet lambs born in the most recent lambing season (2019) and management during pregnancy and around lambing. Differences in attitudes to cost, management and wanting triplets were present between countries, flock sizes, respondent age and gender groups. The results highlight that country of origin, flock size, farmer age and gender may dictate management practices on farm.
Our subsequent studies describe novel effects of maternal nutrition on lamb physiology and placental function that will help to inform future research to improve triplet lamb survival; and ensure welfare and profitability on sheep farms.

doi: 10.1016/j.anscip.2023.01.057

K-48
Welfare aspects of lameness in goats

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Keywords: Goats; Lameness; Welfare; Hoof

Goats are being kept as farm animals throughout the world. Their perceived adaptability to their environment and ability to find food where other animals cannot makes them a popular dairy (and meat) animal in all corners of the world. The systems in which they are being kept range from extensive to intensive and everything in between. Every system has its own difficulties with animal welfare and some issues are shared over all the systems. Lameness is one of those issues that arises, wether it is in a small shepherded herd or a large indoor one. Although lameness is studied much more in depth in cattle or sheep, it is certainly a topic that has gained interest in the last years. Almost all welfare studies that are done in goats also register lameness, hoof conformation or horn overgrowth. These studies are carried out in many different countries and in many different breeds. Although the direct effect on animal production has not been reported as often, milk production loss and prolonged kidding intervals have been reported in lame goats compared to non-lame goats. In herds that require the animals to walk daily for their food, the impaired gait is an obvious reason for progressive weight loss and early culling as they cannot keep up with the herd.
Interestingly, in all systems a wide variety of lameness prevalence is reported, ranging from 0% to 60%. This seems to indicate that individual farm management plays a mayor role in the prevalence of lameness on any given goat farm. One finding that is almost consistent throughout is the presence of horn overgrowth. Although it seems to be reported less on farms where the animals are grazed or shepherded, it is certainly not an exclusive finding to intensive herds. There is a correlation between horn overgrowth and lameness although one can also exist without the other. The amount of overgrowth and even claw deformation might be more indicative of overall welfare standards on the farm than of lameness directly.
Lameness is a painful condition and as such it will adversely affect welfare. It is therefore important to be able to prevent but also treat lameness. Both treatment and prevention are be very different between the goat farming systems. Where the challenge in a large intensive indoors herd might be to identify the right individual animal to treat early on, it might actually be the availability of veterinary treatment itself for small scale herds in low income countries that is the biggest hurdle. Therefore no one answer will be sufficient for all systems and it is very important to address these issues with regards to the system the goats are being kept in.

doi: 10.1016/j.anscip.2023.01.058

K-49
Assessing welfare of small ruminants on-farm

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Keywords: Welfare assessment; AWIN protocols; Welfare certification; Labelling

Several reasons advocate farm animal welfare assessment and certification: It ensures that good practices are in place responding to consumers' demand for high welfare along all the production chain; it guarantees higher performance and better and safer products; eco-schemes from EU Green-Deal will provide stronger incentives for animal welfare improvements.
There are at the moment many certification schemes across several European countries addressing farm animal production. However, there are several weaknesses in the current situation: too many labels so that the consumer is getting baffled; unclear messages such as confusing high welfare with organic or national production; labels that are only recognized in one or a few countries. Thus, a more harmonized and universal farm animal welfare assessment, certification and labelling is needed in the EU.
Welfare is a multidimensional concept, involving biologic and mental wellbeing and the possibility to express natural and positive behaviours. Definitions vary but the main idea is that it is a state that reflects a life worth living. However, assessing and scoring farm animal welfare is not an easy task. Several welfare assessment protocols are nowadays available and most rely on animal-based indicators. Although these may be seen as more subjective there is strong evidence that they reflect better the overall welfare.
At the moment welfare assessment is done mainly by observing the group and a sample of individuals, and by consulting farmers or records (for example, mortality rate). This is done by independent auditors that visit the farm and apply an assessment protocol along a few hours. However, a backstage preparatory work done by internal auditors (e.g. vets and other support technicians) is crucial. This work includes identification of the weaker points and recommending solutions.

Two important EU projects (Welfare Quality and AWIN) proposed a set of protocols for different farm animal species. The AWIN was responsible for the publication of the protocols on sheep and goats. Both projects rely on a list of indicators that work out to score 12 criteria (e.g. absence of prolonged hunger; comfort around resting; absence of injuries). The criteria values are then used to score four Principles (Good Nutrition, Good Housing, Good Health and Adequate Behaviour) and the average of these will classify the farm.
An essential take away message is that no matter what protocol or certification scheme is used, the process has to be transparent, rigorous and scientifically sound. The worse think that can happen to a welfare certification programme is to lose its credibility. All involved (farmers, auditors, researchers. . .) must remember that the greater purpose of all this work is to ensure high life quality and the dignity for our farm animals. Labels should reflect real welfare and retailers and consumers must trust them.

This work was supported by FCT (Project UIDB/00276/2020) and LA/P/00–9/2020—AL4AnimalS (Lisboa, Portugal).

doi: 10.1016/j.anscip.2023.01.059

K-50
How do we improve the decision-making process surrounding small ruminant transportation and euthanasia?

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Keywords: Welfare; Health; Decision-making; End-of-life management

All food animal industries are under greater scrutiny to ensure that animal welfare standards on-farm, during transportation and at slaughter are being met. Small ruminant health and welfare issues are no longer "socially invisible", they have an impact beyond the individual farm boundaries as they influence consumer purchasing, stakeholder support and international trade.
Consumer expectation is for their food to be sourced from a "healthy" animal that was fed well, is free from antibiotic residues, did not experience unnecessary pain or distress, and experienced a quick humane death on-farm or at slaughter. In reality, the spectrum of life is not so black and white. While most of the decision-making for the lives of sheep and goats is under the purview of the producer, they have knowledge gaps about the impact of illness on animal well-being, "timely" euthanasia, and consumer expectations.
Veterinarians play a key role in not just managing small ruminant health, but they are obligated to help producers navigate the shipping to slaughter process, as well as on-farm euthanasia. The responsibilities extend to ensuring sheep and goats are fit for travel, are appropriately watered and fed prior to shipping, they do not undergo long periods of unnecessary travel prior to and after sale, and to assisting producers with the decision-making process of when not to ship at all.
This talk will focus on the role of veterinarians in helping producers to develop decision-making tools for those animals that are not ready, and those that should not go to slaughter and be euthanized on-farm. Many producers do not have formal, specific and/or reliable training in the area of on-farm end-of-life decision-making. This can result in good intentions leading to poor or undesirable outcomes. It is up to us to identify their knowledge gaps by asking difficult questions, observing, and providing feedback, and education. We also need to offer education to veterinarians, "train the trainers", as they are integral in ensuring and improving the welfare of animals under their client's care. Veterinarians will then be in a better position to develop and coach their clients on objective criteria for transportation and end of life decision-making. The goal being to promote timely decision-making and action as opposed to waiting too long or letting "nature take its course". Hands-on training is also a key factor to improving end-of-life welfare. Moreover, research into the barriers to euthanasia in livestock on-farm is needed.
There is no one solution that will work for all situations; we need to work on a multipronged approach to reach both producers and veterinarians to ensure that animals are exiting the farm in a manner that is satisfactory to all and that the welfare of the animals is being prioritized.

doi: 10.1016/j.anscip.2023.01.060

SEOC (Sociedad Española de Ovinotecnia y Caprinotecnia)

K-51
Genomics in sheep selection programs

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Keywords: Sheep; Genomics; Breeding; Novel tools

Genomics is a relatively young science, starting in the late 1980s, which has undergone a very significant qualitative leap at the beginning of the 21st century. At this moment, a series of sequencing techniques, known as Next Generation Sequencing (NGS), have emerged that have made it possible to tackle the sequencing of a de novo animal genome in a relatively short time scale and to reduce the cost of sequencing projects by several orders of magnitude. This has led to the development of projects for the knowledge of the genome of most domestic species. In parallel, there has been a spectacular development of molecular tools derived from the large amount of information produced during genomic sequencing, among the most important of which are SNP chips, which make it possible to explore the genome in search of regions associated with traits of productive interest at an affordable price. These SNP-type markers are minimal changes in the genome sequence, i.e., single nucleotide variations that, in most cases, have no phenotypic effect. This type of marker is numerous, and when sequencing the genome of different animal species, several million positions of this type are detected.
On the other hand, genome annotation or identifying functional elements (protein-coding genes (mRNA), regulatory elements, and other non-coding RNA) is necessary for studying the biological basis of productive and healthy traits in different species. In the case of sheep, a draft genome has been available since 2009 and has been gaining in contiguity and annotation with the further versions developed in the last years. This has allowed the development of SNP chips that have been efficiently used in breeding programs. The most important applications of these tools have been the discovery of an important number of mutations responsible for hereditary diseases in sheep, studies of variability within the species, and the use of molecular information in breeding programs. In this sense, the most critical application of genomic tools in animal breeding is the so-called "Genomic Selection" (GS). GS is based on the prediction of the genomic values of animals using all the information available along the genome based on the thousands of genotypes obtained with SNP chips. In this sense, this keynote aims to review the main results obtained using genomics tools in sheep breeding. We first analyze the identification of mutations of interest (hereditary disease and other phenotypes of interest) as well as how genomic selection is being implemented in breeding programs of the sheep species and the new traits subject to selection due to the use of genomic information.

doi: 10.1016/j.anscip.2023.01.061

K-52
Spanish label 100% autochthonous breed

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Spain has a significant livestock heritage. Its geographic location, diversity of ecosystems, climate, landscapes and cultural traditions have resulted in a huge variety of autochthonous livestock breeds that are well-adapted to their production environments and provide unique products of an unbeatable quality and added-value for the society. Unfortunately, many of these breeds are in danger of extinction and their genetics are being diluted due to cross-breeding.
Therefore, the Spanish Ministry of Agriculture, Fisheries and Food (MAPA) has promoted a number of actions within the National Program for Conservation, Improvement and Promotion of Livestock breeds such as the creation of the **100% Autochthonous breed label**. The label is officially regulated through a Royal Decree published in 2013 to guarantee consumers that labeled products originate exclusively from pure-bred registered animals from autochthonous breeds listed in the National Catalogue.
Breeder societies can get the authorization for its use after voluntarily presenting to the Ministry the terms of conditions document to guarantee the traceability of their breed-related products and the system to control the business operators.
There is a generic label for all the species for common use and specific labels with the specie and the name of each breed underneath for the respective products.The label is compatible with other quality schemes and is used for all types of products: Meat, milk, eggs, wool, leather and derivatives.
The label has been welcomed and so far, 65 societies have adopted the 100% autochthonous breed label, representing about 40% of the autochthonous breeds in Spain with more than 7.000 business operators and this number is increasing year after year.
Adding value by raissing awareness in the society and promotion activities.
Undoubtedly, the promotion of Spain's breeds' sustainability and the realization/support of dissemination activities is always very positive. Among the best ways to conserve breeds is to stimulate the demand and the interest of society and consumers in their specific products by raising awareness about the role that local breeds play for the country and about the unique characteristics of their products. The history of the breed is promoted by using the motto: **"Behind each product 100% autochthonous there is a story 100% ours".**
Therefore, the Government together with the sector started a promotion and communication campaign for animal breeds. The campaign integrated all breed societies and other entities with synergies with the food industry, niche markets, gastronomy and tourism to establish a target audience.

More info about this label is available on the Ministry's official website:
https://www.mapa.gob.es/es/ganaderia/temas/zootecnia/razas-ganaderas/arca/raza-autoctona.aspx

Authors: MAPA Zootechnical Area team.
Sources and photo credit: ARCA and MAPA Register for the National Program for conservation, improvement and promotion of breeds.

doi: 10.1016/j.anscip.2023.01.062

K-53
Animal welfare label for sheep and goat meat

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Keywords: Animal welfare; Certification; Sheep; Goats

The growing interest of society in animal welfare and particularly in the welfare of domestic animals is generating the requeriments to have accreditación systems certified by independent entities. So that the products of animal origin that supply the markets have a guarantee that the conditions in which they have lived the animals from which these products come, have met high welfare standards, even higer tah those established in European legislation, already very demanding.
This requeriment has determined the need to develop protocols that allow accrediting these high levels of animal welfare. Since the conditions in which the animals develop are different according to the regions, the sheep breeds, the climate, and other factrs, it is very difficult to stablish universal criteria. Hence the need to know in depth the specific conditions of the livestock and social reality on which these protocols are going to be applied. On the other hand, it is necessary to have standards that are as objective as possible, whose results are repeteable. For this reasons, the Animal Welfare Commitment protocols ‘‘Interovic Animal Welfare Spain” have been based on scientifics knowledge and knowledge of reality and have contrasted and certified by independent entities. Only in this way is it possible to fully guarantee producers and consumers that the level of certified animal welfare is real and objective.
The Interprofessional for Sheep and Goat meat (INTEROVIC) and through the Spanish Sociaty for Animal Protection and Welfare (SEPROBA) have designed and objective, reliable, repeteable, and effecive protocol. The protocol is based on five sections that holistically contemplate teh animal and the environment that surround it: Health, Food, Facilities, Behaviour and Management. 26 indicators and 79 variables have been defined. Likewise, a series of non-Conformities has been established that can be of a minor, serious or critical nature, with procedures for correcting them, thus preventing a farm in which a fault has been detected from being certified, even if it reaches sufficient quantitative assessment. Finally, an algorithm has been designed that allows numerical quantification of the result. A regulation has been drawn up that establishes the procedure to be applied, the rectification mechanisms in case of detecting the presence of non-Conformities and the periodicity of the audits.

doi: 10.1016/j.anscip.2023.01.063

K-54
Characterization of meat quality in suckling kids

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Keywords: Goat; Carcass weight; Texture; Color

España es el segundo país productor de ganado caprino de la Unión Europea, solo superada por Grecia (MAPA, 2022). En el año 2021 se sacrificaron en España 1.194.536 animales (MAPA, 2022), de los cuales el 73% fueron de la categoría cabrito lechal con un peso medio de 5,21 kg de canal. Además de la leche, el cabrito también supone un ingreso importante, del orden del 20 % de los ingresos totales por cabra de la explotación lechera (Castel et al., 2012). España es un gran exportador a países de la Unión Europea y a terceros países como Francia, Reino Unido o Portugal (MAPA, 2022).
Por esto, la mayoría de la bibliografía sobre calidad instrumental de la carne de cabrito lechal es española, y los factores más estudiados son el sistema de lactancia, el peso de la canal y la raza. Se ha visto que el peso de la canal de estos cabritos se distribuye en dos grandes grupos, con pesos por encima y por debajo de 5 kg. Estos grupos coinciden con lo establecido en la norma española como cabrito lechal y cabrito lechal ligero.
Aunque con diferencias por el peso de canal, la carne de cabrito lechal se confirma como una fuente de proteína baja en grasa. No se puede concluir que exista una relación del sistema de lactancia o del peso canal con el pH. Respecto al color de la carne, el peso de la canal no fue determinante, pero si se observó que hay carne de cabritos alimentados con leche natural con índices de amarillo mucho más altos que los de la carne de cabritos alimentados con lactorremplazantes. Respecto a los valores de tono y luminosidad, existen dos grupos de carne. En uno de ellos, la relación entre estas dos variables es baja y aparecen carnes de cabritos alimentados en los dos sistemas de lactancia. En el

otro, tono y luminosidad están relacionados positivamente y en este grupo solo aparece carne de cabritos de lactancia natural. No hay muchos estudios que aporten información de la textura y ni el peso canal ni el sistema de lactación tienen un efecto importante. Estudiando la fuerza de cizalla Warner-Bratzler se vio que la mediana fue de 35 N demostrando que la carne de cabrito lechal es una carne tierna. En líneas generales, la carne de canales de más de 5 kg tuvo menor porcentaje de ácidos grasos saturados y mayor de insaturados, y una ratio n-6/n-3 mayor que la de carne de canales de menos de 5 kg.
Existe muy poca información científica sobre la calidad de carne instrumental de los cabritos, por lo que existe un amplio campo de investigación para cubrir la laguna de conocimiento encontrada.

doi: 10.1016/j.anscip.2023.01.064

Animal - Science Proceedings 14 (2023) 47–53

Contents lists available at ScienceDirect

Animal - Science Proceedings

journal homepage: www.elsevier.com/locate/anscip

10th International Sheep Veterinary Congress (ISVC 2023) – Round Tables

ROUND TABLE: Challenges for sustainable production around the world

RT-01
Challenges for sustainable production around the world: Latin America

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Keywords: Clinical of small ruminants; Latin America; Sheeps diseases; Verminosis

Sheep must adapt to climatic adversities and food shortages in Latin America. Industrial crossbreeding allows us to improve meat and wool production. It also promotes the rusticity of animals for breeding in extensive and intensive areas. However, Latin America lacks dairy herds for cheese production, which requires more technology and knowledge. In cold climate regions such as Chile, Bolivia, Peru, Argentina, Paraguay, and the southern part of Brazil, garment production still has commercial value due to a solid artisanal wool culture. Several problems are hindering the exponential growth of goat and sheep production in Argentina, Uruguay, Paraguay, and Brazil. Worms and other diseases such as lymphadenitis, lentiviruses, obstetric problems, keratoconjunctivitis, contagious ecthyma, and gestation toxemia are responsible for significant economic losses. In Brazilian market, sheep production is increasing every year, and sustainability is the future of Brazil. In 2021, the number of small ruminants was about 22 million, which is still not enough to supply the domestic market. Our production has differences due to the size and diversity of the country. In Brazil, there are about 525 thousand farms classified as sheep producers, divided into small, medium and large farms. The northeastern region of Brazil includes 94.5% of the national goat herd and 68.54% of the sheep herd. The different national breeds such as Morada Nova, Santa Inês and Cariri and the imported breeds such as Dorper, Merino and Ile de France show that a particular crossbreed should prevail depending on the region and the type of production. It is estimated that worms cause a decrease in weight gain of between 17% and 27% in lambs raised in Brazilian pastures and that losses are in the order of 537.6 million reais per year. The development of technologies and processes to combat them is driven by the knowledge of nanotechnology, biotechnology, genetic engineering, and digital agriculture. Biomarkers from omics technology, for example, enable traceability and quality monitoring throughout the production chain. In this context, agricultural research is playing a leading role in providing technologies that ensure the consolidation of farming systems to meet the increased demand for high-quality food, while reducing the use of mainly chemical and chemically produced inputs. Adopt practices that contribute to the conservation and enrichment of natural resources. In this context, South American governments must invest in the organization of the production chain and the dissemination of knowledge through the transfer of production technologies and the creation of public policies that favor most producers.

doi: 10.1016/j.anscip.2023.01.066

RT-02
Challenges for sustainable production around the world: North America

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Keywords: Efficiency; Locally produced; Renewable energy; Welfare

The sheep industry in Canada and the USA is small in comparison to other regions of the world (sheep and lambs: USA, 5 million; Canada, 1 million). Regardless of the size, as ruminant livestock, sheep here have been targeted as a source of greenhouse gas (GHG) emissions. Meth-

ods of sheep production in North America are extremely diverse and very climate dependent with dry-land grazing in the south-west of the USA, and temperate climate grazing without or without use of mixed crop grazing, in the middle, eastern and northern regions of Canada and the USA. But cold winters, severe predator issues, high value of land, and marketing opportunities have led to the industry adopting intensive housing production techniques including lambing out-of-seasons, which may be viewed by the public as less sustainable. However, sheep production contributes importantly to diversity of agriculture here as well as addressing specific cultural demands from new immigrants.

The Investing in Sustainable Livestock Production Guide (Investing in Sustainable Livestock (ISL) Guide, 2020) provides a framework for the sheep industry to develop strategies to better achieve sustainability. Using its "Principles for the Environment", issues that should be or are being addressed include: "Contribute to a Sustainable Future", e.g., the role of lamb, sheep milk products, and wool as a source of locally produced high quality protein and fibre; "Enhance Carbon Stocks", e.g., moving more arable and marginal lands into improved pasture including silvopastoral systems; "Improved Efficiency at Animal and Herd Levels", e.g., weaning more lambs per ewe and per year; "4. Source Feed Sustainably", e.g., while here it is necessary to feed stored feeds for part of the year, augment diets with crop residues and industry by-products; "Couple Livestock to Land", e.g., manage manure and deadstock by properly composting and returning to the land to contribute to soil nutrient balances but not contaminate surface and ground water; "Minimize Fossil Fuel Use" e.g., use natural ventilation systems for housed sheep, generate renewal energy on the farm (wind turbines, solar panels on buildings), reduce use of synthetic fertilizers; "Foster an Enabling Environment", e.g., improve decision making by applying expert knowledge at a local political, institutional and economic context, when making evidence and consensus-based decisions as an industry.

The guide also provides "Principles for Animal Health". Those unique include prevent and control animal diseases; ensure the welfare of animals; healthy animals for safer food; reduce risk of zoonoses; and prudent and responsible use of antimicrobials. By applying these guiding principles, veterinarians and their clients can significantly contribute to sustainability of the sheep industry in the USA and Canada.

Reference

Investing in Sustainable Livestock (ISL) Guide, The World Bank Group FAO. 2020. https://www.sustainablelivestockguide.org.

doi: 10.1016/j.anscip.2023.01.067

RT-03
Challenges for sustainable production around the world: Europe

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Keywords: Mutifunctionality; Quality; Continuity; Resilience

Sustainability of sheep production in Europe has been a topic of debate in the last years. Previous studies pointed out the main factors that can enhance or limit the sustainable development of the sheep sector according to the different pillars of sustainability and viewpoints of stakeholders. Strengths and opportunities normally relate to the favourable conditions for pasture-based production due to abundant grazing resources, the existence of local breeds adapted to the exploitation of such resources, the high quality of the products, the comparatively lower dependence on external inputs, and their capacity to produce public goods. However, stakeholders also point at many weaknesses and threats such as land use conflicts, difficult working conditions, low labour availability, lack of succession, high dependency of subsidies, low productivity, decreasing consumption of sheep meat, among others.

The number of sheep and specially holdings has decreased across Europe. Authors point at the Common Agricultural Policy as one of the main drivers of this process due to multiple flaws in policy design and targets. In parallel to the abandonment of sheep farming in most Mediterranean and mountain areas, there has been a process of intensification in more favourable areas, with increasing levels of external inputs, lower use of grazing resources and higher productivity levels, which not always rendered higher economic profitability. Few studies assess the negative correlation between intensity and technical efficiency with long term sustainability, explained to a large extent by the use of local renewable natural resources.

What are the prospects for sheep production in Europe? These is no easy answer, but we can point out some key issues that might influence its future evolution. First, sheep farming is multifunctional and contributes to the delivery of important ecosystem services, but public policies need concrete environmental targets (and indicators) and adequately pay for the provision of public goods. Second, sheep systems need to differentiate the products based on their extrinsic quality (characteristics of the production system) and convince consumers of the differential quality attributes of pasture meat vs. industrial meat. Third, succession and the opportunity costs of labour will continue to determine the evolution of sheep farming. Public policies favouring new entries and improving living conditions in rural areas might improve the chances of continuity. Finally, the capacity to deal with unexpected and abrupt changes related to global change (notably climate variability and hazards, and uncertain markets for inputs and outputs) will define the future of agriculture. Sheep systems might be more resilient to climatic disruptions and have comparative advantages due to their higher adaptive capacity to harsh conditions, their temporal and spatial mobility, and the lower dependence of external inputs, but we need to know better the determinants of resilience, both in farms and farmers.

doi: 10.1016/j.anscip.2023.01.068

RT-04
Challenges for sustainable production around the world: Oceania and Asia

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Keywords: Sustainability; Environment; Disease; Labour

Oceania and Asia comprise 36% of the Earth's land surface, and sheep and goats (small ruminants; 'SR') occur throughout: across deserts, mountains, and temperate, sub-tropical and tropical climates. They contain half the world's SR population, produce the majority of global goat and sheep meat, and nearly half the world's wool. Production systems are highly varied, encompassing subsistence smallholder farmers, nomadic herders through to giant private and corporate farms. SR farming is a critical part of the whole regions' culture, and often essential to livelihoods of women, youth, indigenous and ethnic populations. Environmental, labour, trade and socioeconomic sustainability are all critically important, with unique problems and opportunities arising across these diverse areas.
SR farming in Oceania and Asia causes climate/greenhouse gas impacts as in other regions but at a greater level because these regions contain more of the world's SRs. Emissions intensity is often high due to the inefficiency of small-scale farming systems. SR farms may expand into or overgraze marginal landscapes due to increasing herd/flock sizes, inefficient production practices and resource competition with other farms. In Australia and New Zealand, domestic and feral SRs can affect fragile semi-arid, arid and subalpine areas. Elsewhere, domestic sheep and goats may compete for grazing with wildlife or contribute to disease spillover. Improving feed utilisation efficiency, conserving or enhancing biodiversity on farms, and reducing disease transmission with wildlife can all enhance sustainability.
Regional SR production is challenged by disease, and capacity of health and other livestock services. Anthelmintic resistance is widespread in many areas. Conversely, SR farmers in Asia often have disproportionately poor access to health services and products, which increases disease, food safety and zoonosis risks. In Australasia, declining contact between farmers and veterinary services threatens sustainable health management and disease surveillance. Addressing these challenges requires an insightful mix of policy reform, more inclusive service delivery, farmer-focussed education/extension, plus technical solutions.
Animal welfare affects sustainability, with painful procedures (e.g. mulesing) without analgesia threatening farming's 'social licence' and market access. Many farming systems have high mortality in different stock classes, impacting welfare, production efficiency and profitability.
Labour availability is an issue across much of the region. Migration of youth, an important traditional labour source, to cities restricts the viability of small-scale family farms. Australia and New Zealand's shortage of shearers critically affects woolgrowers, and the increasing average age of sheep farmers threatens farm succession, workforce diversity and capacity.
These challenges require technical, political, policy, educational and economic solutions. Few universal solutions exist for such a diverse region, although common themes—production efficiency, land use, farmer education and service delivery—emerge. As with the rest of the world, addressing SR sustainability creates opportunities for pro-poor development, plus regional collaboration in knowledge sharing and implementation strategies.

doi: 10.1016/j.anscip.2023.01.069

RT-05
Challenges for sustainable production around the world: Africa

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Keywords: Adaptation; Characterization; Climate; Indigenous

Livestock production is a critical industry for developing countries, in terms of improved livelihoods and food security. Small stock production plays an important role in this regard, as the animals have superior adaptive traits, low maintenance requirements, and produce a wide range of products. The African continent hosts approximately 400 million heads of sheep. Most of these animals belong to indigenous breeds, which are adapted to harsh environmental conditions and able to thrive despite being exposed to a range of challenges. Sheep can be found dispersed over the mostly arid and semi-arid continent, with the highest numbers of sheep found in Nigeria, Ethiopia, Sudan and Chad. Although the sheep breeds are genetically diverse, with high levels of adaptation, very little to no genetic progress has been made in indigenous ovine genetic resources, and many of the breeds are still regarded as non-descript. The lack of official animal recording of specifically small stock across the continent is one of the first hurdles encountered, as this is necessary for both phenotypic and genetic characterization, the setting of goal driven breeding objectives and a sound genetic improvement strategy. Random mating that contributes to increased inbreeding, as well as indiscriminate crossbreeding with exotic resources, both contribute to the dilution of unique genetic resources and small effective population sizes. The high incidence of ectoparasites, gastrointestinal parasites and disease, together with little to no access to veterinary services and medication, has often been cited as the major constraints to small ruminant production in

Africa. The specific diseases and parasites vary with agro-climatological region, but their impact remains severe. Food shortages, drought and lack of access to land, are contributing factors in an already constrained production system. On the technical side, a lack of infrastructure such as animal handling facilities, laboratories (for both feed and DNA analyses) and computing services also contribute to the absence of progress observed in the small stock industry, specifically in the small holder and communal sectors. Certain commercial breeds and populations (mostly of exotic origin) do participate in animal recording and structured genetic improvement programs. For these breeds, one of the main challenges is the difficulty of obtaining new international genetic material such as embryos or semen, due to bureaucratic constraints. Although the African sheep industry holds great potential in a world faced with climate change, stakeholders across the value chain will have to collaborate to utilize the benefits of this sector.

doi: 10.1016/j.anscip.2023.01.070

ROUND TABLE: Veterinary clinical services for small ruminants: experiences from different countries

RT-06
Veterinary clinical services for small ruminants: The North American Perspective (Canada/US)

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Keywords: Small ruminants; North America; Veterinary service; Drug availability

In Canada and the US cattle and hogs are traditionally the dominant livestock industries. The 2021/2022 census results of Canada (Statistics Canada) and the US (USDA - NASS) respectively report that Canada has 1.05 million sheep, just over half a million are breeding ewes. The average number of sheep per farm is 123. The 253000 Canadian goats are distributed on close to 5000 farms, they are concentrated in Ontario and Quebec and about 35% are dairy goats. The US reports 5.2 million sheep on 88500 farms, 3.7 million are breeding ewes and 2.6 million goats on 128000 farms, the percentage of dairy goats is below 10%.
Veterinary service is mainly provided by private practitioners and spans the range from emergency medicine attending to individual animals to flock heath consultation and specialized services for dairy or reproduction. Larger flocks and herds that derive a substantial part of their income from small ruminants as well as relatively new hobby flock owners tend to have the best relations with their veterinarians. Most farmers will have medicines for the treatment of their animals on hand and part of the veterinary service is to help establish protocols for prudent use.
Canada and the US have national scrapie eradication programs that include mandatory depopulation of susceptible animals in affected sheep and goat herds. Other health programs, e.g. for Maedi/Visna are offered by states, provinces or industry organizations. Genetic evaluation services are available for sheep that generate EPDs for meat, reproduction and milk traits.
Challenges for sheep and goat herds depend on their location and husbandry system, but predators and parasites are continual problems. Grazing small ruminants can be threatened by coyotes, wolves, bears, large cats, eagles and ravens. Many areas have worm populations, especially Haemonchus contortus, resistant to the available anthelmintics, making grazing management challenging.
A particular problem for veterinarians and their clients is the lack of veterinary products licensed for sheep and goats. There are no antibiotics approved for goats in Canada making them reliant on extra label drug use. Only three labelled anthelmintics are currently available, containing Ivermectin, Benzimidazoles or Closantel. The situation in the vaccine sector has improved, although vaccines against Toxoplasmosis, Johne's and Coxiella remain needed.
Small ruminant numbers in the US have been declining while numbers in Canada have risen slowly. Despite the small size of the industry, Canada has a high level of innovation and adoption of new technology. With improving productivity and stable high lamb prices the industry has opportunity to further expand.

doi: 10.1016/j.anscip.2023.01.071

RT-07
Veterinary clinical services for small ruminants: European experience

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Keywords: Veterinary; Clinical; Services; Provision

It is near impossible to consider the European continent as one. Countries vary greatly with numbers and breeds of both sheep & goats, and the ways those are farmed in each country.

From "Transhumance" and common grazing to intensive indoor, zero grazing farms. From meat to milk and cheese production, each farm on the continent is unique and requires a different approach when providing veterinary services.

Some challenges to uptake of veterinary services are shared across the continent:

- Cost of services Vs perceived low individual animal value. This is aggravated further in times of economic downturn
- Availability of veterinary, especially emergency cover, due to distance (rural areas) or lack of expertise. Newly graduated vets are seeking "Work-life balance", opting for shorter working weeks, and less "On Call" duties.
- Large corporates buying farm animal practices potentially leads to less clinical freedom, and more monetary based decisions, shying away from "minor species"
- Farming (and veterinary) traditions can be a barrier to adopting veterinary input. Trust is hard to earn and based on knowledge & hard work. "Vets and farmers cost Money" is a common misperception held by both farmers and vets.

European countries all share common threats such as Climate Change, Public Perception, which is not always favourable or science based, Anthelmintic and Antimicrobial Resistance and the risk from both Endemic and Emerging, "exotic" diseases. Many farms are yet to adopt veterinary advice, and some still accept high losses.

Adoption of veterinary clinical services is enhanced by:

i. Government legislation which requires compulsory veterinary involvement for various procedures, medicines prescription, vaccination programs and "Herd & Flock Health Plans".
ii. Government initiatives such as "Animal Health & Welfare Pathway" aiming to get vets on farms, to improve farm animal health and welfare. Subsidised *Post-mortem* and laboratory diagnostic services help "frontline" vets, and their farmers improve their health, production, and welfare
iii. Industry initiatives, such as "red tractor Farm Assurance" and "Responsible Use of Medicines in Agriculture", require veterinary input and data analysis to enhanced, responsible farm performance and accreditation.
iv. Paraprofessional Veterinary technicians, helping on farms with pregnancy scanning and other veterinary related procedures, under veterinary guidance and supervision.
v. Practice initiatives led by interested vets, including Flock and Herd clubs for interested farmers, Newsletters, workshops and conferences. Practices should be of a size that allows individual vets to develop their 'Visible Expertise" in their areas of interest.

At the heart of successful delivery of sustainable, long term veterinary clinical services is an interested vet who seeks to ever increase and share her/his knowledge.
Understanding farmer's motivation, good communication skills, teamwork, and a sense of community, will also help build trust and relationships and deliver a better service.

doi: 10.1016/j.anscip.2023.01.072

RT-08
Veterinary services for small ruminants in SE Asia

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Keywords: Asia; Veterinary services; Para-veterinarians; Antimicrobials

With 60% of the global goat amd human populationss of over 1 & 8 billion respectively, Asia is often called the 'home of the goat', although it also hosts 44% of the global sheep population exceeding 1.26 billion (China and India being the top 2 countries for all 3). Despite large populations and increasing trade, veterinary services for small ruminants remain undeveloped in much of Asia, reflecting the priority of other livestock species and that most small ruminants are raised by resource-poor smallholder farmers. Goat-raising is often considered a 'poverty entry point' for potential livestock farmers including women, offering nutritional benefits, enhanced livelihoods, better utilisation of family labour, and increased livelihood resilience. Yet sadly, international development agencies frequently distribute goats without veterinary advice where services are lacking and disease knowledge is low. This leads to severe mortality and morbidity incidents that are inadequately investigated by non-veterinarians, with spurious diagnostic conclusions and inappropriate interventions. Asian veterinary services have traditionally focused on large ruminants and the prevention of Haemorrhage Septicaemia (HS), although the role of these species transitioned from draft for rice cultivation and transport, to wealth storage and the regional beef trade as urban incomes improved. Ongoing threats of Highly Pathogenic Avian Influenza in poultry, incursion of African Swine Fever and Porcine Reproductive and Respiratory Syndrome in pigs, and Lumpy Skin Disease in cattle, has contributed to insufficient attention to incursions of Foot-and-Mouth Disease (FMD) and Peste Petits Ruminants (PPR) in the region, reflecting 'informal' transboundary trade and poor biosecurity in the region. In many countries, there is a disconnection between socioeconomic values of the livestock trade and political priorities, with low budgetary allocations for livestock services. Yet, millions of goats from smallholders supply wet markets chains across Indonesia and Brunei for Islamic slaughter, with shipments of small ruminants from Australia to Malaysia, often by air, receiving high prices. Increasing demand in China and Vietnam for goats has also led to rapid increases in the herd in Laos, despite seasonal feed deficiencies, high mortality rates, internal

parasitism, Orf, Pasteurellosis, metabolic disorders and risks of endemic FMD and PPR incursion. Throughout Asia, clinical services for livestock are often provided by government veterinarians, although insufficient vets has led several countries to develop networks of para-veterinarians. These are farmers receiving minimal training to assist in delivery of HS vaccination and advise when disease outbreaks occur. Their lack of antimicrobial stewardship and widespread routine antibiotic use for viral & even parasitic diseases to prevent 'secondary infections' is of concern. Improving Asian veterinary services requires that regulatory councils and professional associations be established in all, countries to ensure livestock production services comply with international standards and can improve the currently poor standards of animal welfare.

doi: 10.1016/j.anscip.2023.01.073

RT-09
Veterinary clinical services for small ruminants: Experiences from different countries: Africa

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Keywords: Sheep; Diseases; Africa; Paraprofessional

The livestock sector plays a major role in the rural economics in Africa and the communities derive a range of financial benefits from livestock keeping, including the provision of credit. The credit benefits of livestock are derived from the ability of livestock owners to 'cash in 'their animals for particular purposes at a time that they choose. Given the growing demand for animal-based foods, the livestock keepers continue to expand their assets while adopting productivity enhancing practices (FAO, 2017).
Despite all the effort to improve productivity, a number of sheep diseases have been reported in Africa. The most common reported diseases are pneumonia, helminthiasis, foot rot, sheep pox, Peste des Petit Ruminants (PPR), Enterotoxaemia, ringworms, Trypanosomiasis, Abortions and heart water. The Sheep farmers and keepers make reports to either the departments of Veterinary services or to the private veterinarians. These diseases can be prevented and controlled easily if there exist a robust system of disease control.
This paper analyses the devastating effects of sheep diseases in Africa. Consideration is made to the existence of large numbers of Veterinary Paraprofessionals who have been subjected to formal training. The author looks at the various categories of veterinary paraprofessionals, competencies, veterinary regulations, and workforce development in Africa. For decades, VPPs have been serving the vast majority of the rural communities in resource-poor countries in Africa, with affordable animal health and welfare service, hence contributing to the work of the Veterinary Services. Today, many diseases control and eradication efforts, such as the current *peste des petits ruminants* (PPR) control and eradication strategy, depend on the availability of competent VPPs to ensure the successful implementation and field delivery of control strategies to achieve regionwide coverage.
However, the position of VPPs is often not defined, with many different categories of VPP existing and with varying levels of training which very often may not deliver the skills and competencies required. OIE PVS Pathway reports have registered that VPP training programmes often lack proper practical training, resulting in professionals not having the necessary hands-on practical skills, limited experience in disease identification and treatment, and a low-level knowledge of specific animal health challenges and solutions (lack of foundational training). In some instances, the VPPs are not legally recognised, their prerogatives are not spelt out and their supervision is unclear. This paper therefore, looks at the existence of various Sheep diseases and critical challenges facing Africa.

Reference

World Organization of Animal Health, 2018, 2019, Minimum competency and curricular Guidelines. Food and Agriculture Organization of the United Nations, Sustainable livestock, 2050, (FAO), 2017.

doi: 10.1016/j.anscip.2023.01.074

RT-10
Veterinary clinical services for small ruminants in Mexico

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Keywords: Family-type; Systems; Diseases; Diagnosis

There are conditions that determine the use of veterinary clinical services, first of all, the predominant production systems in Mexico are family-type which are characterized by few number of animals, scarce application of technology, the obtained products locally consumed, predominantly a low level of organization, and the concentration of flocks of small ruminants are mainly found in marginalized areas and far from cities. On the one hand, this largely explains the type of diseases, prevalence, diagnosis and their importance at the farm level, such

as coccidiosis, gastroenteric nematodiasis, pneumonia, foot disorders, mastitis, and chronic problems including lymphadenitis, paratuberculosis and lentivirus of small ruminants. Such diseases have an economic impact on the production units due to increased mortality rate or reduced productive performance. On the other hand, the production objective, and the form of products consumption mainly encourage the slaughter of animals before making clinical diagnosis; the lack of quality criteria for meat and milk allows many animals with some health problem to have a place in the local consumer market. At the national level, zoonotic diseases such as brucellosis and chlamydiosis do not have the necessary importance for their control and prevention, which limits the movement of animals and their products inside and outside the country. The lack of updates on the sanitary status at the national level limits the allocation of necessary economic resources to establish the prevalence of diseases since there is a lack of infrastructure in diagnostic laboratories. Actually, there are only research institutes or universities that are far from being an option for clinical diagnosis, coupled with the problem of low training of veterinarians to comprehensively address diseases. Another problem with the limited use of veterinary clinical services is the lack of drug regulation such as antibiotics and dewormers, which allows its direct administration by the farmers to treat diseases, leading to indiscriminate use, and supporting the active ingredients resistance. The economic impact that diseases have on flocks forces us to strengthen the use of veterinary clinical services in production units by organizing farmers to be able to acquire and pay for this kind of services, establish the health status at the regional level and so that government institutions invest in training in quality veterinary clinical services and infrastructure for the diagnosis of diseases. Moreover, it is necessary to generate the regulation of sale and drugs usage, and finally it is crucial to define quality criteria in products derived from small ruminants.

doi: 10.1016/j.anscip.2023.01.075

Animal - Science Proceedings 14 (2023) 54–207

Contents lists available at ScienceDirect

Animal - Science Proceedings

journal homepage: www.elsevier.com/locate/anscip

10th International Sheep Veterinary Congress (ISVC 2023) – Oral Communications

ISVA: Sustainability

O-001
Veterinary services for a sustainable sheep industry

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Keywords: Veterinary; Sustainability; Services; Education

Introduction
Whilst Australia has 68 million sheep the number of veterinarians specialising in sheep is declining. A Veterinary Association Workforce survey (n = 3,456) carried out in 2022 reported that of those working in clinical practice, just over 6% worked primarily with livestock (Frawley, 2003) (down from 10% in 2003 Frawley) (Hayes et al., 2022), whilst 17.7% described themselves as mixed practice with "some" large animals, the majority (57.2%) work in small animal practice (Frawley, 2003).

Causes
The causes have been attributed to many factors but amongst them is

- Lower pay for rural compared with small animal work
- An expensive qualification
- Difficulty in engaging with sheep farmers
- Perception that vets only do emergency work
- Veterinary student selection biasing small animal practice
- Rural students are disadvantaged by postgraduate veterinary courses.
- Veterinary course structure
- Poor support for new graduates in rural practice
- Separation from friends and family resulting in feeling cut off
- High attrition rate of new graduates (applies to all fields of veterinary work)

Implications
Australia exports 75% of beef and 65% of sheep meat so the widespread lack of experienced vets available to farmers is problematic on many fronts. Undiagnosed chronic parasite infestations, resistance to anthelmintics, trace mineral deficiency or untreated disease issues will lower production and may also result in animal welfare concerns.
A change of scheduling of pain relief medications to make them available over the counter was attributed to poor availability of veterinary service for farmers but will result in even less engagement.
Australia has many bushfires, floods and droughts, where there is a need for veterinary oversight giving considered advice for treatment or euthanasia for affected animals. Social media and the social licence required by farmers intensifies the need for a rapid and efficient resolution of such issues. Another serious concern is the lack of skilled sheep veterinarians on farms doing passive surveillance for exotic diseases also means less are competent to help when Australia is infected by an exotic disease.

Conclusion
The solution to this problem must start at the Universities and their curricula. Selecting rural students and training them at country campuses is believed to result in more choosing rural practices upon graduation.
Mentoring new graduates and post graduate courses exploring consultancy and the successful business models for sheep vets may well be needed to give them confidence to start their own standalone sheep practices.

References

Frawley, P.T., 2003. Review of Rural Veterinary Services. Department of Agriculture, Fisheries and Forestry. Commonwealth of Australia. 1–109.
Hayes, L., Manyweathers, J., Maru, Y., Davis, E., Woodgate, R., Hernandez-Jover, M., 2022. Australian veterinarians' perspective on the contribution of the veterinary workforce to the Australian animal health surveillance system. Front. Veterinary Sci. 10.3389.

doi: 10.1016/j.anscip.2023.01.077

O-002
The impact of farmer access to livestock weighing trading goats and sheep

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Keywords: Eid weighing activity; Impact weighing on trading; Small ruminants; Pakistan

In Pakistan, small-scale farmers typically sell small ruminants by estimating price based on various physical attributes and a visual assessment of the animal's weight. This study aimed to provide farmers with weighing scales, to test the hypothesis that knowing the weight of their animals would help farmers better determine a desired selling price and strengthen negotiations with livestock traders and other buyers.
The study was conducted with small-scale goat and sheep farmers in typical village farming systems in six villages in Punjab and Sindh province. Simple hanging electronic scales were provided in each village for farmers to weigh animals they intended to sell at the Festival of Eid-ul-Adha in 2021. The farmers' estimate of liveweight and sale price were recorded prior to weighing of animals. Farmers were interviewed after Eid-ul-Adha about the sale process and price.
Sixty-five animals offered for sale by 34 farmers were assessed pre-Eid, and 25 farmers who sold 49 animals had follow-up interviews. Pre-Eid, in three of four villages farmers underestimated the real weight of their animals by an average of 6.7 kg, or 14% of actual liveweight. In the fourth village, farmers overestimated their animals' weight by 10.2 kg or 37% (sample of 6 animals). On average, farmers revised their estimate of the value of the animal upward by 13% after they weighed it. For the 69% of farmers who revised their estimated price upwards after weighing, the median (upward) revision was 26%, suggesting that without accurate weight data most farmers under-estimate the price of their animals by a significant amount.
When the farmers were asked if weighing goats/sheep affected selling of their animals, 64% (n = 16) and 16% (4) said that weighing greatly or somewhat helped their selling, respectively. Twenty percent (n = 5) of farmers, all from Sindh province, said that weighing did not affect the sale and purchase of their animals. Two farmers who offered animals for sale at a price based on measured weights did not sell when these prices could not be obtained.
The provision of a weight scale to the farmers have helped farmers in better negotiation with traders while selling, hence fetching a good price of their animals. Moreover, weighing animals on regular basis will keep farmers informed about the weight gain of animals over a period of time which in terms will help them in better decision-making regarding management and fine-tuning nutrition aspect in a better way.

doi: 10.1016/j.anscip.2023.01.078

O-003 Creep feeding improves goat and sheep production and labour efficiency on small-scale farms in Pakistan

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Keywords: Creep feeding; Mortality; Participatory; Labour

Introduction

Small ruminant production is important for livelihood security of poor, rural households worldwide. It requires successful survival and growth of offspring but is threatened by excessive mortality of young animals, a globally pervasive problem. Improving liveweight

improves survival, and 'creep feeding'—providing feed behind a barrier that excludes adult animals—is one supplementary feeding method that can exploit this relationship efficiently.

Material and methods
We conducted a randomised controlled trial with 121 households from 6 villages in Punjab and Sindh, Pakistan using common local feedstuffs identified in focus group discussions with women and men. Rations comprised 33% 'high-quality' feed (chickpea grain, cottonseed cake or wheat bran) and 67% roughage (straw or rice polish) offered at ~200 g/head/day for 6 months. Farmers were provided bamboo creep barriers with 10 cm gaps between bars to install in animal pens. Control households received the same amount of feed at the end of the trial, so both groups benefited equally.

Results and discussion
Creep feeding produced an extra 1.3 kg/head (95% CI 0.03–2.4) liveweight and 1.5% survival over controls overall. Growth rates from creep feeding were similar or better than controls in four villages, and survival similar or better in three. Many control households started creep feeding independently during the trial, so observed differences are likely conservative compared to traditional management. Despite widespread anaemia, there were few differences in health status between intervention and control animals.
About 40 kg/head of feed was used, costing PKR1, 300–2,300/head over the whole trial. The net benefit after feed cost was +5–10% of animals' value but some farmers reported considerably greater prices of creep-fed animals.
Creep feeding improved labour efficiency, especially for women and girls, reducing labour for 63% of women farmers managing SRs. In households where children helped manage SRs, all girls and 83% of boys had reduced or similar labour requirements. About 90% of both control and intervention households intended to continue the practice.

Conclusion and Implications
This trial adds to the global understanding of the different benefits offered by creep feeding and how it can be implemented with smallholders. It created modest, cost-effective benefits in these Pakistani farms and farmers clearly understood its value. Using a participatory approach increased farmer confidence and insight into creep feeding's practicalities, and allowed issues to be addressed collaboratively as they emerged. The variable results across villages is a reminder that creep feeding is not a panacea for all problems in SR production, and close technical support is important for introducing the practice to smallholders.

Acknowledgements and funding
We thank the participating farming families for their cooperation and enthusiasm. This work was funded by the Australian Government through the Australian Centre for International Agricultural Research.

doi: 10.1016/j.anscip.2023.01.079

O-004
The effect of using a commerical complementary feeding stuff on growth performance in lambs

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Keywords: Lamb; Vitamin; Supplement; Growth performance

Introduction
The weight gain of lambs is of great importance in terms of herd economy and animal health. The aim of the present study is to evaluate the effect of a complementary feeding stuff (Calf Protector®, Biochem mbH Lohne, Germany) containing vitamins, trace minerals and colostrum powder applied after birth on growth performance in lambs.

Material and methods
In the presented study, 20 Merino lambs born in a one-week period in a single farm (BUU Faculty of Veterinary Medicine, Research and Application Farm) were used.Colostrum BRIX values of the sheep were measured after delivery. The lambs were kept separate from their mothers for the first 24 hours as per the management procedures of the herd, and the colostrum of their own mothers with BRIX >21% was given to all lambs with a bottle, in equal amounts. From the second day the lambs were allowed to suckle their mothers. Lambs were randomly divided into two equal groups. After drinking their first colostrum, 20 ml of Calf Protector® was administered orally to the lambs in the CP group (n = 10), and 20 ml of saline was administered orally to the lambs (n = 20) in the control group (group C). The lambs were housed and fed under the same conditions. Body weights were measured 4 times immediately after birth and at 30th, 60th and 90th days of age and average daily weight gains (ADW) were calculated for time periods. At the end of the study, Shapiro-Wilk was used to determine the normality of the change in body weights between the groups and the t-test was used to compare the difference between the groups.

Results and discussion
No mortality occurred in lambs during the study period. The birth weights of the lambs were determined as 3.92 ± 0.35 kg in the CP group and 4.25 ± 0.47 kg in the C group, and there was no significant difference between the birth weights of the groups ($p = 0.56$). The ADW in the 0–30th, 30–60th and 60–90th day periods were determined as 0.26 ± 0.01 kg, 0.32 ± 0.02 kg, 0.34 ± 0.06 kg and 0.21 ± 0.01 kg, 0.24 ± 0.02 kg, 0.27 ± 0.02 kg in the CP and C groups, respectively. It was determined that there was a significant difference between the groups in terms of live weights on all days ($p < 0.05$).

Conclusion and implications
Based on the results of the presented study, it was determined that complementary feeding stuff containing trace elements and vitamins had a positive effect on the live weight gain of lambs and this could contribute to the lambs reaching slaughter weight faster.

Acknowledgements and funding
The research presented was not supported in any way by any institution or organization.

doi: 10.1016/j.anscip.2023.01.080

O-005
Tanin rich tree leaves as feed supplements for Sheep of Reasi district in India

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Keywords: Gastrointestinal parasites; Tannins; FCR; Leaf meal mixture

Introduction
Over the last few years, the dietary role of tannins is receiving increasing interest as they may reduce the number of gastrointestinal parasites in mammals (Athanasiadou et al., 2000; Butter et al., 2002; Min et al., 2005). Present study was carried out to assess the effect of locally avalable agroforestry tree leaves on production potential and parasitic control of sheep. Data was collected on feed intake, weight gain, fecal egg counts and overall body score in 60 sheep during an experimental period of 90 days. The result showed use of guava (*Psidium guajava*): neem (*Azadirachta indica*): jamun (*Syzygium cuminii*): mango (*Magniferra indica*) in 1:1:1:1 proportion at 1.5% level resulted in significant ($P < 0.05$%) increased weight gain, improved feed conversion ratio and improved overall body score and significantly ($P < 0.05$) decreased fecal egg count as compared to rest of treatments.

Material and methods
60 sheep were randomly divided into three groups (T1, T2 and T3) of 20 animals in each group for a period of 3 months. The locally available agroforestry trees like, guava (Psidium guajava), neem (Azadirachta indica), jamun (Syzygium cuminii) and mango (Magniferra indica) found in hilly areas of Jammu and Kashmir were used to prepared leaf meal mixtures in 1:1:1:1 proportion and used at different inclusion levels (T1 = 0%, T2 = 0.5%, T3 = 1.5%). Data regarding daily feed intake, adult body weight, Average body weight gain, FCR, body score and fecal egg count were recorded and results were subjected to one way ANOVA accordingly.

Results and discussion
Study shows there is no significant change in dry matter intake of sheep of T1, T2 and T3 groups. Daily body weight gain, average final body weight, FCR and overall body score were significantly increased in T3 group as compared to T1, T2. Fecal egg count was significantly ($P < 0.001$) decreased in T3 groups as compared to T1 and T2.

Conclusion and implications
The use of agroforestry leaf meal mixtures appear as alternative to the use of antimicrobial growth promoter factors. These natural products do not leave residues. Also, agro forest leaf meal mixtures contain photochemical substances with many bioactive principles that would have fewer chances to induce resistance in microorganisms.

References

Athanasiadou, S., Kyriazakis, I., Jackson, F., Coop, R.L., 2000. Effects of shortterm exposure to condensed tannins on adultTrichostrongylus colubriformis. Veter. Record 146, 728–732. https://doi.org/10.1136/vr.146.25.728.
Butter, N.L., Dawson, J.M., Wakelin, D., Butter, P.J., 2002. Effect of dietary condensed tannins on gastrointestinal nematodes. J. Agric. Sci. 137, 461–469.
Min, B.R., Hart, S.P., Miller, D., Tomita, G.M., Loetz, E., Sahlu, T., 2005. The effect of grazing forage containing condensed tannins on gastro-intestinal parasite infection and milk composition in Angora does. Veter. Parasitol. 130, 105–113. https://doi.org/10.1016/j.vetpar.2005.03.011.

doi: 10.1016/j.anscip.2023.01.081

O-006
Smart grazing – A feasibility study with sheep as sustainable "weed controller" in growing maize cultures

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Keywords: Maize; Sustainability; Weed controll; Grazing

Introduction
In many countries sheep are a part of agricultural crop rotation systems.
Maize cultivation especially in an organic way is a challenge for every farmer as the use of herbicides is not allowed. A high competition of weeds in in early maize stages is a serious problem. Therefore, most important plant protection measure is mechanical weeding. Timing of weed harrowing, row hoeing is important for a successful weeding effect. After row closing (80cm grow height) the use of mechanical weed control in maize is not possible.
At this point sheep were used to continue the weed control in the growing maize culture.

Material and methods
In two consecutive years (2021/2022) sheep were raised in three different maize fields close to Hannover, Germany.
In each field three experimental areas (50 × 50 m) were established. In two areas a low stocking rate (4 and 6 sheep) was chosen to have no feed competition. The third area was a control area without sheep. The breed was German Heath Sheep, a local breed, known for their selective feeding behaviour. Sheep were brought to the areas at the time of row closing (80–140 cm grow height) and stayed there until the forage base was no longer sufficient and/or sheep started to damage the maize. During the "grazing" period the areas were observed weekly and a botanical evaluation documented which plants were taken up and whether and how the maize was damaged by the sheep.

Results and discussion
Sheep behaviour varied in the different fields which showed a very various weed infestation in mass and in diversity.
Main weeds *Echinochloa crus-galli, Chenopodium album, Persicaria maculosa, Datura, Solanum nigrum* and *Fallopia convolvulus*. The sheep especially showed an intake of: *Echinochloa crus-galli, Chenopodium album* and variable *Persicaria maculosa*. But in addition trampling weeds between the rows by claws also reduced the growth of the weed (*Fallopia convolvulus*). Weed control only worked when weed diversity was high. In one field exclusively *Chenopodium album* grew next to the maize. Weed control failed.
The sheep showed interest in the lowest maize leaves, but not in leaves or cobs above their nose level (110 cm). Veterinary issues related to this grazing strategy were considered. The sheep basically avoided poisonous herbs. The sheep showed a good general health status and increasing weight.

Conclusion and implications
It seems that the use of sheep as a "natural weed controller" could be an interesting idea in sustainable farming. First field studies reveal that the effectiveness with regard to weed elimination while sparing the corn crop depends on various factors. More field studies are needed to evaluate this factors.

Acknowledgements and funding
This project was funded by EIP agri (European Innovation Partnership) EU-ELER.

doi: 10.1016/j.anscip.2023.01.082

O-007
Characterization of the *Conquense* transhumance route by geotechnologies

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Keywords: Sheep; Trashumance; GPS; Geotechnologies

Introduction
Transhumance is the most ancient sheep husbandry system that optimizes the grazing resources, adapting the varying environmental and climatic conditions. It is key in arid or semi-arid regions, where transhumance has proven to be traditionally efficient to use the ecosys-

temic primary productivity. An example is the Iberian Peninsula, where different climatic patterns coexist. These traditional practices are performed with a different structure and at a smaller scale than in the past. This is a tendency that should be reversed, but the knowledge about the current status of the transhumant drove roads as well as their real extent are being lost in the last decades. In fact, many of them have been either modified or destroyed, and the traditional knowledge about them has been lost over time. Geotechnologies emerge as potential tools that might provide highly relevant information about these drove roads. Among them, the Global Position System (GPS) allows the precise location of the flock in space and time, since remotely-based maps may provide the topographic and environmental conditions of the route. The aim was to assess the potential of the so-called geotechnologies to characterize the most active Spanish drove road known as the *Conquese* transhumance, which annually is twice-traveled by flocks of *Merino de los Montes Universales* sheep breed.

Material and methods
The transhumant flock comprised 3,000 *Merino de los Montes Universales* sheep (mean body weight (±SD) 56.62 ± 6.06 kg for ewes, 81.50 ± 5.70 kg for rams). These animals traveled the *Conquense* route starting from Guadalaviar (Teruel, Spain) and reaching Vilches (Jaén, Spain) after 23 days, during November. Two GPS (Domodis, Pamplona, Spain) units attached to collars were programmed to record geolocations every 30 minutes, and were placed on two healthy ewes. The datasets were in turn overlapped on a digital elevation model (DEM) and a land uses/land cover (LU/LC) maps retrieved by remote sensing techniques.

Results and discussion
The flock traveled 349.8 km and climbed over a maximum incline of 1,223 m in 23 journeys during 9–10 hours per day. The maximum daily distance traveled was 19.06 km while the minimum was 8.85 km, corresponding the latter with the first day of transhumance. Moreover, the maximum slopes faced by the sheep were mainly found in the first few days of the route, reaching up to 60% elevation gain. The preferred LU/LC was scrublands, followed by rainfed herbaceous crops.

Conclusion and implications
This work aimed to promote a traditional transhumant route by taking advantage of innovative pastoral practices based on geotechnologies. These tools highlight the harsh conditions to which these sheep are subjected during a transhumance and, therefore, indirectly prove the outstanding physiological aptitudes of the *Merino de los Montes Universales* breed to withstand this long journey, even when pregnant.

doi: 10.1016/j.anscip.2023.01.083

O-008
Assessment of changes in lamb activity before and after lamb marking using accelerometers

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Keywords: Pain relief; Lamb marking; Castration; Tail docking

Introduction
Lamb marking for most sheep breeds in Australia includes tail docking and (for male lambs) castration. Good welfare practice includes use of pain relief at lamb marking. This experiment used continuous monitoring of animals to assess the effect on behaviour of providing pain relief to lambs at lamb marking under commercial conditions with the aim to promote uptake of pain relief. The experiment was conducted on cohorts within in two different mobs of sheep.

Material and methods
Composite breed (n = 50) and Merino (n = 50) ram lambs from commercial-sized mobs were tagged and an accelerometer (AX3; Axivity, UK) attached to the inside of the rear leg 5 days prior to lamb marking. Lambs were systematically allocated to treatment (pain relief or control) after blocking for weight. Lambs assigned to the pain relief group received a subcutaneous injection with Metacam®20 mg/ml solution for injection (Boehringer Ingelheim, North Ryde, Australia) prior to marking procedures and Control lambs received no pain relief. Lambs were then tail docked using a gas knife and castrated using an Elastrator® ring. Following marking, ewes and lambs grazed pasture in large paddocks and the accelerometers were removed within 2 weeks of marking.
Mean standard vector magnitude (SVM), which indicates degree of movement intensity, was used to determine activity level for 24-hour intervals over the monitoring period. Data was analysed using linear mixed models with fixed model treatment, day and period of day (interval) and their interactions, and random model lamb.

Results and discussion
A full dataset was available from 29 accelerometers in each mob (18 Control and 11 Metacam-treated Composite lambs; 16 Control and 13 Metacam-treated Merino lambs). For Composite lambs, there was no effect of treatment (p = 0.345). SVM varied between days, being higher pre-marking compared to post-marking with the exception of when sheep were moved between the paddock and laneway. SVM peaked on the day of marking (mean 90) and declined for three days (mean 26). In the Merino lambs, the interaction of day and treatment was significant (p = 0.029) with SVM being greater on some days in the control group post marking. SVM also peaked at lamb marking (53)

and was lowest in the 2 days post-marking (30 and 31 respectively); thereafter activity increased to be similar too or higher than the pre-marking activity levels.

Conclusion and implications
Standard Vector Magnitude summarised in 24-hour time intervals did not identify clear differences in overall activity for lambs that received pain relief compared to those that did not but showed accelerometers can effectively record changes in activity associated with husbandry practices. Data analysis is continuing to identify if there were differences in specific behaviours associated with treatment.

Acknowledgements and funding
This project was funded by Boehringer Ingelheim Animal Health.

doi: 10.1016/j.anscip.2023.01.084

O-009
Early behavioural indicators of gastrointestinal parasitism in extensively farmed sheep for use in a precision livestock approach to welfare management

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Keywords: PLF; Welfare; Behaviour; Technology

Gastrointestinal (GI) parasitic infection is one of the many health and welfare challenges that sheep in extensive management conditions face. An understanding of behavioural changes during the onset of infection could lead to their use as early-warning signs of parasitism in the field. Studies have found changes in grazing behaviour and diet selection in infected sheep. Precision Livestock Farming (PLF) technology could be applied to detect these subtle behavioural changes, allowing farmers to treat sheep early and selectively. Determining which behaviours to monitor, especially at sub-clinical infection levels, is crucial to the development of this PLF technology. The aim of this study was to identify early behavioural indicators of GI parasitism using behavioural observation and to pilot the use of PLF tools for this purpose. Twenty-four Scottish Mule ewes and their 8-week-old twin lambs were observed on pasture over two four-week periods in June and September 2021. Half of the ewes and one lamb from each twin pair were treated with an anthelmintic drench, acting as a ‘‘low parasitism” (LP) group while the other half were not treated and acted as a ‘‘high parasitism” (HP) group facing naturally occurring infection. Nematodirus and strongyle faecal egg counts (FEC) were conducted fortnightly throughout the study period to monitor infection levels. Within each of these two groups, half of the ewes and one twin from each lamb pair wore collars (HP-T/LP-T) containing an accelerometer and a proximity logger. The other half of the sheep did not wear collars (HP-NT/LP-NT). Treatment group allocation was randomized and balanced for ewe weight, mastitis score and FEC as well as lamb sex. Behavioural observations were carried out in person using scan sampling. There was no significant difference in Nematodirus FEC between the HP and LP lambs, or in Nematodirus or strongyle FEC between HP and LP ewes. Modelling was therefore carried out with FEC as a covariate rather than parasitology treatment as a factor, using R package glmmTMB. For strongyle infection in lambs, the raw median FEC was 27 epg (min = 0, max = 1881) and for nematodes, the raw median was 0 epg (min = 0, max = 1188). A significant positive relationship existed between lamb Nematodirus FEC and the likelihood of showing locomotion behaviour (est = 0.003, $z = 2.65$, $p = 0.0006$). Strongyle FEC did not have an effect on grazing, lying, or ruminating in lambs, nor did it influence behaviour in ewes. NT lambs were more likely to graze than T lambs (OR = 1.49, SE = 0.30, 95%CI = 1.00–2.22, $p = 0.05$). In these experimental conditions, sub-clinical Nematodirus parasitism was correlated to increased locomotion in lambs and wearing technology on collars seemed to impact the grazing behaviour of lambs. Further research is required to determine the biological significance of these findings.

doi: 10.1016/j.anscip.2023.01.085

O-010
Long-term climatic changes in small ruminant farms and potential associations with animal health

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Keywords: Climate change; Epg counts; Haemonchus; Neonatal hypothermia

Introduction
The objectives of this work were (a) to present long-term changes in climatic parameters, in 325 locations throughout Greece, where sheep farms are based and (b) to present associations of the changes in the climatic parameters with clinical data related to sheep health.

Material and methods
Climatic variables were derived from 'The POWER Project' (NASA Langley Research Center, USA), which provides meteorological datasets for agricultural needs, for the 31 years from 1989 to 2019. Moreover, data on clinical cases on three disorders, namely (i) pregnancy toxaemia, (ii) clinical mastitis and (iii) neonatal hypothermia, in Central Greece were also considered. Further, results of parasitological examinations on clinical samples, specifically: (i) epg counts in faecal samples from sheep, (ii) proportion of *Haemonchus contortus* larvae in coprocultures of faecal samples from sheep and (iii) frequency of cases of *H. contortus* resistance in sheep. Repeated measures mixed-effect linear regression was used to evaluate the significance of changes regarding the various climatic variables in each location throughout the period 1989–2019. The potential associations of the annual frequency of the three disorders with the various climatic parameters was assessed by using analysis of correlation. The same test was used for assessment of the potential association of the parasitological data with the various climatic parameters

Results and discussion
During this period, significant increases were noted in temperature-related parameters (annually 0.05 °C for average temperature and 0.14 °C for temperature range) and precipitation (annually 0.03 mm). There were significant differences in climatic conditions between locations of farms in accord with the management system applied therein, as well as in accord with the breed of animals on the farms: higher average temperature was seen in locations with Greek breeds than in locations with imported breeds. With regard to the three disorders evaluated, there were significant associations of temperature-related parameters with annual frequency of cases of neonatal hypothermia. With regard to parasitological data, there were significant associations of temperature-related parameters with the average proportion of *H. contortus* larvae in faecal samples and the frequency of cases of *H. contortus* resistance

Conclusion and implications
The work presents examples regarding the potential effects of long-term climatic changes on the health of sheep and also indicates differences between pathological conditions in potential effects of climatic changes. Despite the associations found in selected pathological conditions with some climatic factors, during complex pathophysiological processes, environmental factors may, from time to time, have some effect, but other interactions also play a significant role in disease processes. The findings indicate the need for more in-depth research into the response of animals to challenges from the environment.

Acknowledgements and funding
Eleni I. Katsarou receives a scholarship from Unit of Research, Innovation and Excellence of University of Thessaly.

doi: 10.1016/j.anscip.2023.01.086

O-011
Quantifying the effects of parasitism on lamb methane emissions

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Keywords: Parasitism; Climate change; Methane; *T. circumcincta*

Introduction
A major source of methane production from the agricultural section comes from ruminants. Methane is produced as a by-product in the rumen when ruminants digest food. The impacts of parasitism on lamb methane emissions have only been partially explored. A pilot study found that parasitised lambs had daily methane yields (grams of methane per kilogram of dry matter intake; g CH_4/ kg DMI) 33% higher than in non-parasitised lambs near the peak of a *Teladorsagia circumcincta* (brown stomach worm) infection (Fox et al., 2018). However, the effects of the parasitism on methane emissions in the weeks prior to and after the peak of infection were unknown. Host-parasite dynamics change throughout a parasite challenge, so a longitudinal study is required in order to quantify the effects of parasitism on lamb methane emissions. Our research aimed to quantify the effects of parasitism on lamb methane emissions over the duration of a *T. circumcincta* infection and capture any varying effect on daily methane yields.

Material and methods
Sixty-four commercially-bred, parasite-naïve, Suffolk-cross lambs were used in this trial. Repeat measurements of the lambs' methane emissions, live-weights and faecal egg counts (FECs) were taken every 9–10 days for 58 days of a parasite infection (32 lambs in 8 groups) and compared to repeat measurements from non-parasitised lambs (32 lambs in 8 groups). Parasitised lambs were infected with 7,000 *T. circumcincta* larvae 3-times weekly.

GreenCow respiration chambers were used to measure methane emissions. The modified floatation technique (sensitivity; one egg per gram of faeces) was used to perform FECs. Feed intakes were measured daily and were used to calculate daily methane yield.
All statistical analyses were performed in R (version 3.6.3). Data were analysed using linear mixed-effects models with REML, accounting for the random effects of group ID and respiration chamber where appropriate.

Results and discussion
Methane yields were higher in parasitised lambs compared to non-parasitised lambs between Day 10 and Day 48 of infection, and these higher methane yields were considered statistically significant between Day 20 and Day 38 of infection ($p < 0.05$).

Conclusion and implications
T. circumcincta parasitism causes lambs' daily methane yields to increase for a prolonged period of time during a parasite infection. This parasite is ubiquitous across temperate zones, meaning these results have implications for methane emission calculations on a global scale and for developing methane mitigation strategies worldwide.

Acknowledgements and funding
This work is funded by SRUC, BioSS and RESAS.

Reference

Fox, N.J., Smith, L.A., Houdijk, J.G.M., Athanasiadou, S., Hutchings, M.R., 2018. Int. J. Parasitol. 48 (13), 1017–1021.

doi: 10.1016/j.anscip.2023.01.087

O-012
Influence of lactic acid bacteria fresh basil and basil essential oil on Berrichon du Cher breed meat (*Musculus gluteus*) quality parameters

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Keywords: Lamb; Meat; Quality; Acceptability

Introduction
Red meat is a source of valuable nutrients for human nutrition as it contains high-quality digestible protein, iron, selenium, zinc and vitamins (De Brito et al., 2016). Lamb meat has received increasing consumer attention due to its nutritional and physicochemical attributes, including characteristic taste and odour (Teixeira et al., 2019). *The aim of this study was to evaluate Lactobacillus uvarum (LUHS245), fresh basil and basil essential oil (0.1% v/v) and their combination were used to treat Berrichon du Cher lamb meat.*

Material and methods
State Food and Veterinary Service requirements (''Requirements for the Keeping, Maintenance and Use of Animals Intended for Science and Education Purposes," approved by the order of the Lithuanian Director of the State Food and Veterinary Service, 31/10/2012, No. B1-866). Changes in the microbiological profile and physiochemical parameters of meat were evaluated after 24 h of treatment at 4 °C. The analysis of meat physicochemical parameters was carried out as described by Rozanski et al. (2017) and AOAC (2019). The assessment of biogenic amines and cholesterol was performed according to the method of Ben-Gigirey et al. (1999) by Varian ProStar HPLC system. Fatty acid composition was determined using gas chromatograph GC-2010 Plus (Shimadzu corp.) equipped with Mass Spectrometer GCMS-QP2010 (Shimadzu corp.). MDA was analyzed according to method described by Mendes et al. (2009). All measurements were carried out in triplicate. Statistical analysis was performed using the descriptive statistics and univariate analysis of variance (ANOVA) (statistical program R 3.2.1; R Core Team, 2015).

Results and discussion
Experiment resulted in significantly lower mold/yest ($p < 0.05$), water holding capacity (by 1–11%), cooking loss (by 2–5%) in all experimental groups. Moisture content in all groups had tendency increase from 1.76 to 5.03 %. The highest content of polyunsaturated fatty acid where determined where meat where marinated with LAB + basil essential oil. The content of malondialdehydes and cholesterol decreased in all experimental groups respectively from 1.67 to 4.6 times ($P < 0.05$) and from 17 to 85% ($P < 0.05$) compared to the control group.Treatments significantly affected to some biogenic amines.

Conclusion and implication
In concluded, this treatment showed that it could be used to improve microbiological safety and some quality characteristics, increased PUFA content of lamb meat.

doi: 10.1016/j.anscip.2023.01.088

O-013
Influence of gender on carcass traits and meat quality of Romanov breed

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Keywords: Lamb; Meat quality; Carcass; Romanov

Introduction
Many publications show that nutrition, health, breed and management are key factors, that affect the growth and carcass traits of lambs. However, a relatively important factor that also affects both growth and carcass traits of lambs is their gender (Kuchtik et al., 2020).The present study aims to evaluate the effect of Romanov breed lamb gender on carcass traits and meat quality parameters.

Material and methods
The animals were cared for in accordance with the Lithuanian State Food and Veterinary Service requirements (“Requirements for the Keeping, Maintenance and Use of Animals Intended for Science and Education Purposes,” approved by the order of the Lithuanian Director of the State Food and Veterinary Service, 31/10/2012, No. B1-866). Changes in the microbiological profile and physiochemical parameters of meat were evaluated after 24 h of treatment at 4 °C. The analysis of meat physicochemical parameters was carried out as described by Rozanski et al. (2017) and AOAC (2019). Measurement of muscle pH was done with a pH meter (model Inolab 3, Hanna Instruments, Italy), calibrated to pH 4.0 and 7.0. Meat color ($L*$, $a*$, and $b*$) was measured after a blooming period of 30–40 min and remeasured in the middle of the day, using a Minolta Chroma Meter colorimeter (CR-400, Minolta Camera, Osaka, Japan) with a closed cone, set on the $L*$, $a*$, and $b*$ system. The determination of water holding capacity (WHC), drip loss (DL), cooking loss (CL), and shear force (SF) was performed as described in Klupsaite et al. (2020). All measurements were carried out in triplicate. Statistical analysis was performed using the descriptive statistics and univariate analysis of variance (ANOVA) (statistical program R 3.2.1; R Core Team, 2015).

Results and discussion
Obtained results revealed that lamb gender had a significant influence on sternum/breastbone, ribs, right shoulder, and bones of the back leg. Significantly higher lightness (by 3%) was found for male meat; however, higher redness of female meat was observed (by 7.7%). In all cases, a lower pH was obtained for female meat. Significantly higher cooking loss (by 38%) was found for male meat.

Conclusion and implications
The outcome of this study showed that Romanov lamb gender had a significant influence on several carcass parameters (sternum/breastbone, ribs, right shoulder, and bones (left and right) of the rear foot). Male meat had a significantly higher lightness, lower redness, and higher values of pH and cooking loss.

References

AOAC, 2019. Official Methods of Analysis. Official Methods of Analysis of AOAC International.
Kuchtík, J., Konečná, L., Šeligová, M., Kopec, T., 2020. Effect of gender on growth and carcass traits of Romney Marsh lambs. Acta Universitatis Agric. Silviculturae Mendelianae Brunensis 68, 88–92.

doi: 10.1016/j.anscip.2023.01.089

O-014
Optimization of the performance of Manchega sheep milk and its determining factors in the coagulation process for the manufacture of cheese

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Keywords: Sheep milk; Coagulation efficiency; Curd yield; Optimization models

Introduction
The quantity and quality of cheese obtained per volume unit of milk is directly linked to the benefits of the dairy industry. Therefore, it is essential to know what factors determine technological efficiency of milk and how they act. This would allow, through optimization mod-

els, the determination of the most appropriate milk characteristics for the industry, and their inclusion in pricing systems to guarantee fair prices to producers. The estimation of a value of milk technological traits would enable industry, producers, and regulatory authorities to develop their own production guidelines to guarantee competitiveness and promote sectoral policies that contribute to the global efficiency of a sector of great economic and social interest in Spain. The present study aims to evaluate the efficiency of Manchego sheep milk in the production of cheese, fresh and ripened, and to determine the factors accounted for the inefficiencies. For this purpose, we explore two models to determine technological efficiency of milk.

Material and methods
1,200 Manchega sheep milk samples were collected, and analyses were performed for composition, milk coagulation properties, somatic cell count and milk colour values. Only data from 967 samples were included in the statistical analysis, as the rest corresponded to milk that did not coagulate under standard laboratory conditions and, therefore, no information on curd yield could be obtained. A first model was built based on fresh curd yield and a second one based on dry curd yield, and efficiency indexes were calculated for fresh (CE) and dry curd yield (DCE). GLM and MANCOVA analyses were subsequently used to identify the factors that determine curd yield efficiency, considering the two dependent variables (CE and DCE) both simultaneously and independently.

Results and discussion
Factors that determine curd yield efficiency mainly depended on pH, casein, and lactose concentration and, to a lesser extent, on the speed of coagulation and curd firmness. Differences between models were linked to the water retention capacity of the curd. Firmer curds worsen fresh curd yield efficiency, as they retain less water. Contrastingly, milks with a slower coagulation improve dry curd yield efficiency because it is not conditioned by the moisture captured within the curd. Based on this, the CE model could be used to measure efficiency in fresh cheese, but in cured cheeses such as Manchego, the DCE model adjusts better.

Conclusion and implications
The DCE model was considered much more accurate for prediction of coagulation efficiency in cured cheeses, since it is not affected by moisture loss during ripening.

Uncited references
Caballero-Villalobos (2018), Garzón (2021).

Acknowledgements
This research project did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

Caballero-Villalobos et al., 2018. J. Dairy Sci 101, 3878–3886.
Garzón et al., 2021. J. Dairy Sci. 104, 8618–8629.

doi: 10.1016/j.anscip.2023.01.090

O-015
Relationships between milk composition and coagulation process in ovine breeds from Spain using canonical correlation analysis

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Keywords: Sheep; Milk composition; Milk coagulation; Canonical correlation

Introduction
Sheep milk is used in Spain mainly for cheesemaking, and production systems have historically taken advantage of the use of native breeds, which are linked to the tradition and the climate conditions of their natural areas of production. Even so, in the last decades, some of these autochthonous breeds have been progressively replaced by foreign breeds with longer lactations and higher milk yields. Nonetheless, these increases in yield have been reported to influence fat and protein content and, therefore, performance of milk during coagulation. The aim of this study is to examine the relationships between physicochemical traits and milk coagulation properties in a set of samples from several dairy sheep breeds in order to identify parameters of quality that determine milk technological performance and curd yield.

Material and methods
This study included 832 individual ewe milk samples collected from four distinctive dairy breeds found in Spain: Manchega, Assaf and two Spanish varieties of Merino (Grazalema and Pedroches). Samples were analysed obtaining values for composition, milk coagulation properties (MCP) and individual laboratory curd yield (ILCY). Ratios obtained from coagulation variables were used as indicators of coagulation efficiency (CE), as described by Caballero-Villalobos et al. (2018). After laboratory processing, canonical correlation analysis (CCA) was used to assess the correlation matrix between coagulation properties and milk mayor components.

Results and discussion
Five CCA models were built, and high significant correlations were found between milk major components and MCP. Relation between both sets of variables were stronger in the breed Assaf, intermediate in the two varieties of Merino and low in Manchega. Although four pairs of canonical values (F1 to F4) were significant, correlations were weaker after F3, explaining less than 10% of the variability. Models developed for Assaf and Merino de Los Pedroches maintain the correlation structure described for the whole set of samples. However, Manchega and Merino de Grazalema, show their own patterns of covariation that differ from the general correlation structure.

Conclusion and implications
Quality of milk from different sheep breeds is influenced by a wide range of husbandry systems and management strategies, and canonical correlation analysis has proved to be a useful tool to explore relationship between traditional composition variables and technological performance of milk.

Acknowledgements and funding
This research project did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors**.** The authors would like to acknowledge the Spanish Association of Manchega Sheep Breeders (AGRAMA), the Association of Merino de Grazalema Breeders (AMEGRA), the Technological Agricultural Institute of Castilla y León, Spain (ITACYL) and the farmers of the region Valle de Los Pedroches (Spain) for taking part in this study.

Reference

Caballero-Villalobos et al., 2018. J. Dairy Sci. 101 (5), 1–9.

doi: 10.1016/j.anscip.2023.01.091

O-016
Use and effect of selenium-containing boli in lambs with chronic selenium deficiency

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Keywords: Lambs; Selenium; Bolus; Trace elements

Clinical history
In a sheep farm in Lower Saxony with 500 Moorschnucken, suckling lambs with an initial unwillingness to suckle and fattening lambs with poor daily weight gains and straw-like fleece were found. The herd grazes mainly nature conservation areas in the marshland. In the past, a slight selenium deficiency was detected in routine blood samples. This was tried to compensate by providing mineral feed with 50 mg/kg selenium.

Investigations
In the beginning, feeding was checked, but no reason for the symptomatology could be identified here. The ewes are only in the barn during lambing, the rest of the year they graze on marshland.
To rule out endoparasitosis as a cause, fecal samples were taken. No high burden of gastrointestinal strongylidia as well as coccidia could be detected.
Subsequently, random general examinations of the affected lambs were performed, which only confirmed the symptoms. Subsequently, serum samples were taken to check the trace element supply. In addition, the shepherd sent in liver samples from the slaughtered lambs to examine the copper, cobalt and selenium content.
The bloodsamples confirmed a selenium deficiency. Of 30 animals examined, the selenium content in 22 animals was below the reference limit of 80 µg/liter. In the liversamples the selenium content was in the lower range of the reference range of 0.25–1.25 mg/kg fresh mass.
To compensate the selenium deficiency, selenium-containing rumen boli from two different producers were given to each ten lambs. Ten animals without bolus served as control group. All animals had access to mineral feed ad libitum. Four weeks after bolus administration control blood samples showed that only one type of boli increased serum selenium levels by approximately 30%. The increase in the 2nd boli group was only 11% and almost all animals remained below the reference limit.

Differential diagnosis
As a differential diagnosis of such unspecific symptoms, a variety of causes can be considered.
Endoparasites can cause lasting damage to the gastric and intestinal mucosa, so that the nutrients contained in the feed cannot be sufficiently absorbed.
Both chronic undersupply and chronic oversupply of trace elements, such as selenium, can cause the symptoms that occur. Selenium is an important component of many enzymes that play an important role especially for growth and fertility.

Discussion
The use of selenium-containing rumen boli offers an uncomplicated way to ensure the supply of selenium. After one application, the bolus releases selenium continuously up to eight months. Selenium can also be supplied through mineral feed or injections with selenium (often in combination with vitamin E). For the farm presented, the input of Boli ensured the best possible selenium supply to the animals. However, it was shown that there were significant differences in selenium supply with the two boluses used.

doi: 10.1016/j.anscip.2023.01.092

O-017
Hypocalcaemia – An emerging disease problem in southern Australia – Is it time for a rethink globally?

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Keywords: Hypocalcaemia; Animal welfare; Vitamin D; Lambing

Clinical history
Hypocalcaemia is well-recognised in Australia, and around the globe close to lambing, particularly in older twin-bearing ewes in southern Australia.
In recent years, an increased mortality rate of ewes grazing lush, productive pastures has been observed by the author on client farms in southern Australia, south of the 34th parallell. Particularly on farms whose pastures were well-fertilised, highly productive and as well as being lush, provided plentiful Food On Offer during winter and spring, which coincided with lambing time. Further, the ewes tended to be dual-purpose Merinos or maternal Prime Lamb breeds with higher reproductive and growth rates. A series of investigations were commenced on these farms to determine the cause of the mortalities. They tended to be around lambing but also extended to yarding for marking and weaning.

Investigations
A number of different approaches to diagnosis was undertaken including full wet chemistry analysis of pastures, trace element testing of blood and liver and necropsies.

Differential diagnosis
Pregnancy toxaemia (ketosis).
Cu deficiency.
Responsiveness to calcium boroglucanate administration.

Discussion
Agriculture Victoria report that advisers, veterinarians and farmers across Victoria report that hypocalcaemia is an increasing issue in Victoria, as well as an increase in dystocia and "downer ewes". Reduced lamb growth rates, abnormal skeletal (including dental) development and fragile bones that tend to break have also been reported.
This is hypothesised to be due to a changing sheep industry increasing the hypocalcaemic risk for ewes in southern temperate Australia. The key factors are likely to be increasing calcium demands from higher reproductive rates and faster growing lambs. At the same time, profit-driven farms are sowing modern, more productive pasture cultivars and fertilising them optimally. This has resulted in increased dry matter production, higher pasture quality and pastures that are generally lusher. Low Vitamin D levels in southern Australia impacts even further on Ca homeostasis on farms below the 34th parallel.
Therefore, it is hypothesised that hypocalcaemia might affect more flocks in the future as well as elsewhere around the world, particularly situated greater than the 34th parallel.
Global cloud cover has been increasing by 1%/decade and this is likely due to increasing global temperatures. Hence, this may also increase the risk of hypocalcaemia.
Treatment of hypocalcaemia is problematic, hence there is an economic and animal welfare imperative to implement effective prevention programs. It is unfortunate that a lack of peer-reviewed science in sheep impacts on our ability to recommend evidence based veterinary science, but there is a pressing need to prevent welfare impacts.

Acknowledgements and funding
No funding apart from farmers funding the investigations. I acknowledge numerous discussions with veterinary colleagues including Dr. Bruce Watt, Dr. Joe McGrath and others too numerous to mention.

doi: 10.1016/j.anscip.2023.01.093

O-018
Assessment of disease and trace element status in non-pregnant sheep at pasture

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Keywords: Disease; Copper; Cobalt; Selenium

Introduction
Disease and nutritional status may have significant effects on flock profitability. However assessment of status can be difficult in sheep at pasture, given their often remote location and lack of specific clinical signs. Trace element supplementation in sheep at pasture is also problematic, with intakes of mineral supplements variable and often non-specific containing multiple minerals. Blood sampling is a useful tool to assess the presence of disease issues and trace element status, allowing targeted intervention to correct any issues that may affect flock profitability.

Material and methods
Samples were received from a total of 1,644 individual sheep from 107 separate groups during the period from July 2017 to November 2022 inclusive (last 5 years). Heparinised plasma and serum samples were received from veterinary surgeons all over the UK, and transported to the RDSVS laboratory for analysis using a Beckman AU480 wet chemistry system for albumin, total protein (which was then used to derive globulin), plasma copper and GSHPx (for the assessment of long-term selenium status). Vitamin B12 (for the assessment of cobalt status) was undertaken by SRUC Veterinary Services.

Results and discussion
Of the individual sheep plasma samples received, 41.2% had albumin levels below 30 g/l and 57.3% had globulin levels over 50 g/l. Combining these two measures, 72.5% of samples showed either low albumin and/or elevated globulin levels, indicating the presence of possible disease issues or chronic inflammation. Assessment of trace element status was undertaken using group mean results. Of the 107 groups, 0.9% had plasma copper levels below 9.4 μmol/l, 3.7% had GSHPx levels below 50 IU/gram of haemoglobin indicating poor long-term selenium status, and 19.2% had Vitamin B12 levels below 336 pmol/l indicative of cobalt deficiency. A further 26.9% of group mean Vitamin B12 results were in the 336–500 pmol/l marginal reference range used for assessment (Suttle, 2022).

Conclusion and implications
Biochemical evidence of disease issues appeared to be common in sheep during summer and autumn grazing, and the most common causes of such low albumin and/or elevated globulin results are likely to be parasitic gastroenteritis, fascioliasis, lameness, mastitis and respiratory disease. Although copper and selenium deficiency were relatively infrequently diagnosed, cobalt deficiency was diagnosed in nearly 20% of groups, indicating that cobalt supplementation of sheep at pasture may be necessary. This study has highlighted key production limiting conditions that may be present in sheep at pasture during late summer and autumn.

Acknowledgements and funding
The enthusiastic cooperation of farmers, veterinary surgeons, commercial nutritional advisers and independent consultants is gratefully acknowledged.

Reference

Suttle, N., 2022. Mineral Nutrition of Livestock. CABI.

doi: 10.1016/j.anscip.2023.01.094

O-019
Exploring the relationships between coagulation, composition, microbiology and colorimetry of bulk tank milk from Manchega sheep

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Keywords: Milk coagulation properties; Composition; Microbiology; Colorimetry

Introduction
Milk quality control is one of the main targets of the dairy sheep sector. However, most quality control systems continue to apply criteria based exclusively on either milk composition or other standards regarded in the legislation. Milk coagulation properties (MCP) are deemed of great importance, but are not considered in quality systems, even though small ruminant milk is mainly intended for cheesemaking. Some previous studies have focused on coagulation properties but have not been linked in conjunction with other characteristics of ewe's bulk tank milk. Thus, the aim of this study is to explore bulk tank milk quality, estimating MCP and their relationship with composition, colour values and differential microbiological quality.

Material and methods
A total number of 308 bulk milk samples from 77 flocks of Manchega sheep in Castilla-La Mancha (Spain) were collected with seasonal periodicity. Composition and somatic cell count were determined with MilkoScan and Fossomatic, and colour was measured and expressed using the CIELAB colour space. MCP were monitored on a Formagraph, and bulk tank samples were subsequently grown in a wide variety of culture media to determine differential bacterial counts. For statistical analysis, samples were classified in 3 groups according to their coagulation time and curd firmness, studying the relationship between composition, microbiology and colour parameters using Spearman correlation and GLM procedure.

Results and discussion
There is a great disparity in results related to technological parameters of sheep milk, being this wide range of results of considerable importance from the perspective of cheese profitability. In this study, relationships have been found between MCP and some physical-chemical, microbiological and colorimetric parameters. In addition, significant differences are observed in some of the physical-chemical and microbiological of bulk tank milk according to season of the year, farm size or coagulation group.

Conclusion and implications
Few published studies exist on the quality characteristics and technological properties of bulk sheep milk and, therefore, little is known about the sources of variation in milk from this species. The present study shows that faster coagulations and higher curd yields are related to milk richer in major components and higher microbial counts. Furthermore, factors such as season and size of the farm influence the quality of milk. A more detailed study of other factors affecting bulk milk would be necessary to assess its final processing into cheese.

Acknowledgements and funding
This work is part of the project RTA2011-00057-C02-0, funded by the National Institute of Agricultural and Food Research and Technology (INIA), Government of Spain.

doi: 10.1016/j.anscip.2023.01.095

O-020
Estimating cheesemaking traits from quality characteristics of bulk sheep milk

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Keywords: Milk coagulation properties; Composition; Microbiology; Colorimetry

Introduction
Sheep milk production is of great importance in the Mediterranean areas and is mainly used to produce cheeses of long-date tradition. For this reason, milk quality control is one of the main targets of the dairy sheep sector. However, most quality control systems are based exclusively on milk composition and standards from legislation on food hygiene. Although most milk is processed into cheese, cheesemaking traits are not taken into account in quality control system due to the difficulty in obtaining these parameters at the field level. Thus, the aim of this study was to obtain technological parameters based on the characteristics of bulk tank sheep milk.

Material and methods
This study included 77 flocks of Manchega sheep located in Castilla-La Mancha (Spain). A total number of 308 bulk tank milk samples were collected with seasonal periodicity. Composition and somatic cell count were determined using MilkoScan and Fossomatic, and colour was

measured and expressed using the CIELAB colour space. MCP were monitored using a Formagraph viscometer, and bulk tank samples were subsequently grown by culturing to determine differential bacterial counts. For statistical analysis, the REG STEPWISE was performed MCP variables, including composition traits and microbiological counts as independent variables.

Results and discussion
Estimation of technological parameters based on the physico-chemical, microbiological and colour characteristics of bulk tank sheep milk are of great relevance, since they differentiate between technological attributes and coagulation performance. It has been established that for quality parameters of curd, estimations are not highly significant, reaffirming the conclusions of other studies. However, results of the regression of curd yield with respect to composition and microbiological characteristics of bulk tank milk could be used to estimate this quantitative parameter of the coagulation process, which relies largely upon casein.

Conclusion and implications
Milk quality control systems and dairy sheep breeding programs should include casein as one of their indicators, which is deemed useful for both the determination of technological aptitude of milk and genetic improvement of dairy breeds. However, the great variability of coagulation traits of bulk milk in relation to its quality and make it necessary to develop studies under controlled conditions to explore the possibility to estimate technological parameters of milk.

Acknowledgements and funding
This work is part of the project RTA2011-00057-C02-0, funded by the National Institute of Agricultural and Food Research and Technology (INIA), Government of Spain.

doi: 10.1016/j.anscip.2023.01.096

O-021
Investigating animal health and diseases in Australian lamb feedlots

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Keywords: Lamb; Feedlot; Disease; Health

Introduction
Specialist lamb finishing systems (feedlots) are increasingly being utilised by Australian lamb producers to combat the seasonal fluctuations of nutrient supply in extensive pasture-based systems. Confinement feeding energy dense diets is a practical method to realise the potential of high growth genotype lambs (Hegarty et al., 2006; Oddy and Walmsley, 2013). By meeting market specifications at younger ages, total nutrient intake decreases and feed resources can be prioritised elsewhere, improving overall production efficiency. There are however health risks associated with lot feeding lambs. The practice of lot feeding lambs inherently occurs after lambs are weaned from their dams, which is a known period of stress. Furthermore, dietary changes, potential transport and mixing of lambs of different age groups and origins, as is often the case when feed lotting, exacerbates this stress. Under these circumstances, certain infectious agents which may be present in healthy animals may cause disease in these stressed lot fed lambs.
The incidence of certain diseases in lamb feedlots is largely unknown in Australia, due primarily to a lack of diagnostics and reporting.

Material and methods
This project sought to better understand the incidence of animal health issues specific to lamb feed lotting in Australia. This has been done by gathering animal health and performance information from established feedlots, performing post mortem examinations and disease investigations on a cohort of lambs which have died in these feedlots and gathering abattoir surveillance data in relation to lambs which come from the selected feedlots.

Results and discussion
Pneumonia, coccidiosis and salmonellosis were most common in feedlots where lambs were mixed from multiple properties whereas poliencephalomalcia and acidosis where more likely to occur in home bread flocks.

Conclusion and implications
This project has allowed for identification of the most significant lamb health issuesin Australian feedlots and provides insight into the risk factors associated with these conditions.

Acknowledgements and funding
Thank you to Animal Health Australia and Meat & Livestock Australia for funding this work.

References

Hegarty, R., Shands, C., Marchant, R., Hopkins, D., Ball, A., Harden, S., 2006. Effects of available nutrition and sire breeding values for growth and muscling on the development of crossbred lambs. 1: Growth and carcass characteristics. Austral. J. Agric. Res. 57 (6), 593–603.
Oddy, V.H., Walmsley, B., 2013. A scoping study to explore the limitations on productivity of meat sheep due to nutrient supply.

doi: 10.1016/j.anscip.2023.01.097

O-022
Balancing between welfare and production in Israeli sheep

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Keywords: Welfare; Sheep; Economy; Isaral

Over the last few years, protein from animal products has been rising sharply among Israeli consumers leading to increased demand for meat production. One of the ways to increase sheep production with a minor increase in farm expenses is by controlling reproductive efficiency in sheep for meat production. using a genetic trait to increase prolificacy, i.e., the average number of lambs born per lambing (LB/L), was one of the ways the Israeli ministry of agriculture found a way to help its farmers.
Farm animals are used for the greater good to produce food for human consumption. The developing livestock farming technology that aims for a high, intensive production system creates an inherent conflict between the need to maintain sheep welfare and increased productivity.
The welfare-productivity (McInerney) model shows that beyond a point, an increase in welfare standards may deduct the livestock productivity costs. Nevertheless, very high welfare standards may become increasingly expensive.
Balancing the economic need for profit with the necessity of safeguarding the sheep welfare under the intensive rearing system is one of the main important roles of the ministry. Furthermore, the equalizer between the utilitarian and the deontology aspect of sheep welfare under the Israeli intensive rearing system should be debated.

doi: 10.1016/j.anscip.2023.01.098

O-023
Evaluation of the reproductive performance of ewe-lambs after administration of melatonin

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Keywords: Ewe-lamb; Melatonin; Sheep; Reproduction

Introduction
The objective of the study was to assess the reproductive performance of ewe-lambs after administration of melatonin, with special reference to (a) pregnancy and lambing rates and (b) number of lambs born.

Material and methods
In total, 180 ewe-lambs (age 6 to 7 months, bodyweight 40 to 45 kg) in six different flocks in Greece were allocated at random in two equal groups; those in group R were administered melatonin implants and those in group C were controls. Administration was carried out in the summer, specifically from 1 to 20 July. On day 1 of the study, one melatonin implant was placed in each R group animal. Melatonin implants were also placed in rams in each of the study farms (three implants per ram). Thereafter, female and male animals were separated. Then, on day 43 after melatonin administration, rams were introduced to the ewe-lambs at a ratio of 1 ram to 15–18 females. Detailed ultrasonographic examination of the uterus was performed on days 108–112 and again on days 155–160 day after melatonin administration (i.e., 65–69 and 112–117 days after ram introduction to females). Lambings started on day 224 (group R) or 230 (group C) after melatonin administration. Animals that lambed and the number of lambs born of each ewe was recorded. Statistical analysis was performed by using Pearson chi-square test or analysis of variance, as appropriately according to the type of data.

Results and discussion
On day 108–112 after melatonin administration, ultrasonographic examination revealed pregnancy rates 90.0% *versus* 67.0% for animals in group R or C, respectively ($p = 0.0002$). On day 155–160 after melatonin administration, respective pregnancy rates were 95.3% versus 81.7% ($p = 0.006$). A significantly higher proportion of animals in group R lambed than animals in group C: 97.6% *versus* 79.3% ($p = 0.0001$); moreover, the proportion of group R animals that lambed within 170 days after ram introduction to females was significantly higher than respective proportion of group C animals: 71.8% *versus* 28.0% ($p < 0.0001$). In general, lambings occurred earlier among group R animals than among group C ones: on average on day 256 *versus* day 272 after melatonin administration ($p = 0.001$); Finally, more lambs were born in group R than in group C: 1.20 versus 0.93 lambs per ewe-lamb into the study ($p = 0.005$).

Conclusion and implications
The results confirmed that melatonin administration was effective in achieving earlier reproductive performance in ewe-lambs. This was shown by the higher proportion of animals that lambed and the higher number of lambs produced by these animals, comparatively to untreated controls. The results support administration of melatonin to ewe-lambs, with the objective to improve their reproductive management.

Acknowledgements and funding
The study was financially supported by Ceva Sante Animale.

doi: 10.1016/j.anscip.2023.01.099

O-024
Ovulation rate and fertility performances of synchronized ewes treated with the Kisspeptin-analogue C6

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Keywords: Kisspeptin; Fertility; Synchronisation; Pregnancy

Introduction
The neuropeptide kisspeptin and its receptor, KiSS1R, govern the reproductive timeline of mammals by triggering puberty onset and promoting ovulation by stimulating gonadotrophin-releasing hormone (GnRH) secretion.
The suboptimal pharmacological properties of endogenous kisspeptin, notably its short half-life and consequently its poor pharmacodynamics, fetters its use in an experimental setting. To overcome this issue, a synthetic KISS1R agonist was created, and named Kisspeptin C6 (KissC6) (Decourt et al., 2016). In this study, the effect of KissC6 on ovarian dynamics and fertility was tested.

Material and methods
Eighty-two mature Rasa Aragonesa ewes (LW:56.9 ± 3 kg; BCS:3.1 ± 0.6) were synchronized using a 14-day progestogen-based program initiated on May 10th 2022. All the animals were blood collected one week before sponge introduction and the day of sponge insertion, to determine ovarian cyclicity before the starting of the study: animals were categorized being anoestrous when both serum samples contained less than 0.5 ng/ml of progesterone.
The ewes were randomized according to BCS, LW, and cyclicity status, and assigned to one of the three experimental groups: Negative CTR, no treatment applied at sponge removal ($n = 20$); eCG ($n = 20$), 480 IU eCG i.m. administered at sponge removal, and KissC6 ($n = 42$), ewes received 15 nmol KissC6 by i.m. injection 24 h after sponge removal.
Ewes were transrectal ultrasound scanned (US) from the time of sponge removal Day 0 every 24 h until day 4, to determine the timing of ovulation; one additional US examination was performed 84 h after sponge removal.
Ewes were cervically inseminated 55 h after sponge removal with fresh semen from five different rams equally balanced between treatments.
Data were analyzed using a non-parametric Fisher exact-test for two proportions.

Results and discussion
The ovulation rate between the 3 different groups was (30%^{a}, 95%^{b} and 52.4%^{a,b}, for Negative CTR, eCG and KissC6 respectively, ($P < 0.01$). The average timing between AI and ovulation (h), for ovulated ewes, was 44.0 ± 2.5^{b}, 27.8 ± 2.1^{a} and 29.5 ± 1.7^{a,b}, for Negative CTR, eCG, and KissC6 respectively ($P = 0.04$).
In the absence of ovulation, animals presenting a persistent follicle above 7mm in diameter 4 days after sponges removal were classified as cystic, the incidence of cystic condition in the various treatments was 10%^{a}, 5%^{a} and 24%^{a,b}, for Negative CTR, eCG, and KissC6 ($P = 0.04$). Pregnancy per AI was evaluated by transabdominal US examination at 30 and 50 days after AI; the results were 5%^{a}, 40%^{b} and 2.4%^{a}, for Negative CTR, eCG, and KissC6 respectively ($P < 0.001$).

Conclusion and implications
From the results achieved in the current study, Kisspeptin analog C6, at the dose of 15 nmol, does not achieve fertility performances comparable with the ones of eCG on synchronized ewes.

Reference

Decourt, C., Robert, V., Anger, K., Beltramo, M., et al., 2016. A synthetic kisspeptin analog that triggers ovulation and advances puberty. Sci. Report 6, 26908.

doi: 10.1016/j.anscip.2023.01.100

O-025
Alternatives to improve the reproductive performance of ewes synchronized with a 15-day interval prostaglandin F2α-based protocol and cervical fixed timed AI

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Keywords: Prostaglandin; Insemination; Cervical; Ewe

Introduction
Increasing the interval between prostaglandin F2α (PG) doses up to 14 to 16 days apart ("long interval" protocols) determined better reproductive outcomes in ewes after cervical fixed timed AI 56 hours from second PG in ewes (FTAI; 1). These protocols achieved conception rates comparable to progesterone-eCG based protocols (Fierro and Olivera-Muzante, 2017), but lower than obtained with pre-synchronized spontaneous estrus ewes (Olivera-Muzante et al., 2020), limiting its adoption. To improve the reproductive outcomes of estrous synchronised ewes with a long interval PG-based FTAI protocol, this experiment evaluated the effect of moment respect to second PG dose and the number of FTAI services performed.

Material and methods
During the breeding season (March-June; CICOMA-SUL; 31° 03′ S - 57° 13′ W; Salto, Uruguay), 505 Merino ewes grazing native basaltic pastures (1200 kg/DM/Ha; CP: 10.5%, ADF: 38.8%, NDF: 62.6% and water *ad libitum*) were selected. Based on their reproductive category (107 nuliparous; 398 multiparous), BC (3.2 ± 0.4, score 1-5) and BW (39.8 ± 4.1 kg; means ± SD) ewes were randomly assigned to four groups, synchronised with two PG injections 15 days apart (Delprostenate 160 μg per dose; Glandinex®, Universal Lab. Uruguay) and FTAI at 44, 56, 68 or 44 and 68 ± 1.5 hours after second PG dose, PG15-44 (n = 129), PG15-56: Control (n = 126), PG15-68 (n = 128), and PG15-44/68 (n = 128) group, respectively. Cervical FTAI was performed simultaneously in all groups by two technicians using 150 million viable sperms per ewe from a fresh semen pool, extended with UHT skim milk, 1 + 1, from 12 adults Merino rams. Ewes from PG15-44/68 group were also inseminated 24 hours previously with a fresh semen pool from the same rams and similar conditions. Fertility (pregnant/total ewes × 100), prolificacy (foetuses/pregnant ewes) and fecundity rates (foetuses/total ewes × 100) on Day 60 were evaluated by transabdominal ultrasonography (3.5 MHz convex array transducer). Differences between groups were analyzed using the CATMODE procedure (SAS).

Results and discussion
There were no significant differences between groups ($P > 0.05$) in fertility (64.1, 66.4, 66.7 and 73.8%). Prolificacy in PG15-44 was lower ($P < 0.05$) than other groups (1.07 ± 0.03, 1.27 ± 0.05, 1.23 ± 0.05 or 1.20 ± 0.04), and final fecundity was lower than PG15-44/68 group (68.8, 84.0, 81.7 and 89.9%; PG15-44, PG15-56, PG15-68 or PG15-44/68 groups respectively), without differences with other groups.

Conclusion and implications
We concluded that the best time to perform the FTAI after a 15 day-PG interval protocol would be between 44 to 68 hours, without benefits of using double insemination in the times evaluated.

Acknowledgements and funding
To Facultad de Veterinaria-Udelar, Uruguayan Wool Secretariat (SUL). Financed by CSIC I+D 3 project.

References

Fierro, S., Olivera-Muzante, J., 2017. Anim. Reprod. Sci. 180, 78–84.
Olivera-Muzante, J., Fierro, S., Minteguiaga, M.A., 2020. Anim. Reprod. Sci. https://doi.org/10.1016/j.anireprosci.2020.106482.

doi: 10.1016/j.anscip.2023.01.101

O-026
"Echo-synch" protocol, new tool for vets to improve fertility in dairy ewe-lambs at their first reproductive season

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Keywords: Reproductive efficiency; GnRH; Transrectal ultrasonography; Veterinary

Introduction
Mediterranean dairy sheep breeding typically implies a mating season starting in late spring for adult ewes with lambing in late autumn. On the other hand, ewe-lambs born in autumn are usually mated in the reproductive season of the following year (late August – December). Considering that ewe-lambs respond poorly to the male effect and tend to have a lower response to synchronization protocols in respect to the adult ewes. Thus, the reproductive management of ewe-lambs is often based on natural mating, keeping the young ewes and males in single flock, without considering the difference in animals age and weight. This practice leads to a long lambing season with the bulk of the ewe-lambs lambing in March-April (pregnancy onset October-November). In addition, ewe-lamb's reproductive and productive performance are lower compared to adult ewes.

Material and methods
In a previews study we've demonstrated that only medium-sized lambs respond very well to the administration of GnRh analogues. For this reason, it will be one of the main objectives of the veterinarian who manages the reproduction of a flock to try to bring to the mount animals as homogeneous as possible. However, this is not always possible because the lambs are weaned at different times, and some are susceptible to parasitic problems.
L' EchoSynch Protocol is based on weekly gynecological visit by transrectal ultrasonography made by a trained veterinary.
During gynecological examination vet evaluate ovaries, to establish whether the presence of a corpus luteum, and the uterus. Lambs with a CL or luteinized cyst will undergo therapy with 125 mcg of Cloprostenol IM and the following day will be placed in the mating group with rams. In lambs that are about to pass puberty the uterine size increases considerably and although there is not yet an active corpus luteum, the thickening of the endometrium is evident, often edematous and with marked vascular tunic. These animals can be inserted into the mating group with rams with or without administration of GnRh. Instead, lambs that do not have CL nor a good uterine evolution will undergo further therapy with GnRh analogues (gonadorelin, 40 μg/head) to be re-evaluated the following week. The animals still classified as "small" weighing less than 25 kg will undergo as the only therapy that of food, possibly antiparasitic, but above all the waiting therapy since in addition to helping us to achieve a better body condition will serve to increase the effects of the photoperiod for overcoming puberty.

Results, conclusion and implications
The current fertility of ewe-lambs in the first breeding season in Sardinia is below 50%.
The correct nutritional management combined with the use of GnRH, US and PGF2α, defined "Echo-Synch" strategy, can successfully reach >90% fertility in ewe-lambs.

doi: 10.1016/j.anscip.2023.01.102

O-027
Determination of goats oestrus and pregnancy rate of progesterone supported co-synch synchronization method

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Keywords: Saanen goat; Synchronization; Estrus; Fertility

Introduction
In addition to minimizing treatment costs, synchronization of oestrus and ovulation in goats, provides easy management of labor, farm and birth season.Estrus synchronization is essential for both successful pregnancy results and cost reduction in artificial insemination organizations in goats. Unlike the ovsynch, a fixed-time insemination can be performed with the 2nd GnRH injection with co-synch synchroniza-

tion method. In this study, it was aimed to investigate the possibility of applying the progesterone supported co-synch protocol and to determine the pregnancy results by fixed-time artificial insemination in goats.

Material and methods
For the research, 20 female and 3 male (for estrus detection) Saanen goats raised in Bursa Uludağ University veterinary faculty research and application center were used. Intravaginal sponge (Esponjavet, HIPRA, Spain) with medroxyprogesterone acetate was applied to the goats with an injection of 0.004 mg (i.m.) GnRH analogue (buserelin) on Day 0.On the seventh day of the study, the sponges were removed by injection of the PGF2alpha analog (1 ml Juramete).On the 9th day of the study, the second injection of 0.004 mg buserelin was made and artificial insemination was applied. After the sponge was removed, oestrus screening was done with a buck to determine the onset and duration of estrus, at 6-hour intervals until the estrus subsided (84th hour). In order to control the pregnancies estrus screening was done again 17–30. days, In addition, an ultrasound examination was performed on the 30th day of the study.

Results and discussion
All animals in the study showed estrus within 78 hours after the sponge was removed. The highest estrus time was observed between 42th and 54th Hours, and estrus concentrated between 36th and 66th Hours throughout the research. The first estrus time started 37.2 hours after the sponge was removed and lasted for 31.9 hours. As a result of fixed-time insemination, 40% pregnancy was achieved.

Conclusion and implications
As a result, it was determined that the use of a progesterone source in the co-synch protocol caused earlier onset and aggregation of estrus. In order to increase the pregnancy rate, different applications such as increasing the dose of frozen semen or, if conditions are suitable, insemination can be used.

Uncited references
Martínez-Álvarez et al. (2007), Martinez-Rojero et al. (2006), Viudes-de-Castro et al. (2009).

References

Martínez-Álvarez, L.E., Hernández-Cerón, J., GonzálezPadilla, E., Perera-Marín, G., Valencia, J., 2007. Serum LH peak and ovulation following synchronized estrus in goats. Small Rum. Res. 69, 124–128.
Martinez-Rojero, R.D., Hernandez Ignacio, J., HernandezHernandez, H., Michel-Aceves, A., Valencia Mendez, A., 2006. Intrauterine artificial insemination in Creole goats with cooled semen. Agrociencia 40, 70–76.
Viudes-de-Castro, M.P., Salvador, I., Marco-Jiménez, F., Gómez, E.A., Silvestre, M.A., 2009. Effect of oxytocin treatment on artificial insemination with frozen–thawed semen in Murciano-Granadina goats. Reprod. Dom. Anim. 44, 576–579.

doi: 10.1016/j.anscip.2023.01.103

O-028
Non-reproductive use of exogenous melatonin in small ruminants

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Keywords: Melatonin; Lambing; Survival rate; Colostrum quality

Introduction
Melatonin is synthesized in the pineal gland, and transfers the day/night signals to the reproductive neuroendocrine axis. Subcutaneous implants of melatonin are used to advance the breeding season in sheep, although in recent years, alternative uses of melatonin in small ruminants have been established, mainly focused on the survival and growth of the offspring, and the improvement of colostrum and milk quality.

Material and methods
The results of 8 peer-reviewed articles published have been analyzed and the results have been summarised.

Results and discussion
It has been reported that lambs born from ewes implanted with melatonin 70–90 days before lambing presented a higher survival rate at birth and weaning. Melatonin administered in ewes carrying twins, on day 80 and 125 of pregnancy, had a clear effect on the survival of the second lamb, this effect been higher in long parturitions (more than 90 minutes). The increased survival is due to the neuroprotective effects of melatonin during intrapartum hypoxia. Moreover, it was reported that fetal brown fat deposition, the main source of heat at birth, is increased by melatonin implants in pregnant sheep. Twin fetuses from implanted mothers had 35% more brown fat, were 5%–8% heavier at birth and had a larger chest diameter and a trend towards greater body length. In fact, we have recently reported that lambs born from melatonin-treated ewes during pregnancy presented an increased rectal temperature, and their average and minimum body surface tem-

perature of the shoulder, mid loin, and hips was also higher than lambs born from untreated ewes. Thus, exogenous melatonin could be an alternative to increase the survival rates at lambing trough an increment of the birth temperature of the newborn.
Several experiments have evidenced the positive effect of exogenous melatonin on colostrum and milk quality. We have observed that melatonin implants at lambing increased the fat content of the milk, especially at the end of lactation, and increased the growth rate of their lambs, and exogenous melatonin implanted one month before lambing had a positive effect on colostrum quality as reflected in an increase in IgG concentrations. Moreover, ewes that received one or two melatonin implants 40 d before lambing produced colostrum that had a higher IgG concentration than that produced by non-implanted ewes, and produced more milk, which had a lower SCC.

Conclusion and implications
Melatonin implants during pregnancy have effects on the parturition mechanisms, the brown fat content of the lamb, and colostrum and milk quality, all this resulting in a better thermoregulation, body temperature, health and survival of the new-borns.

doi: 10.1016/j.anscip.2023.01.104

O-029
Melatonin implants in pregnant ewes increased rectal temperature and body surface thermography in lambs at birth

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Keywords: Ewes; Lambs; Melatonin; Thermography

Introduction
Hypothermia is the main cause of death in newborn lambs. To avoid hypothermia after birth, lambs require heat generation using energy from brown fat tissue. Studies showed that thermography may detect thermogenesis linked to subcutaneous brown fat depots. Alternatives to increase this tissue, as exogenous melatonin in pregnant ewes, has been reported to build up the amount of brown fat in newborn lambs. However, there is limited information on the effect of the hormone on surface temperature at birth measured by thermography. This trial aimed to evaluate the effects of exogenous melatonin implants in late pregnant Rasa Aragonesa ewes on rectal temperature and body surface thermography of shoulders, mid loin, and hip in lambs at birth.

Material and methods
Ewes received a subcutaneous melatonin (18 mg, CEVA Salud Animal, Barcelona) implant (MEL, $n = 25$) at day 120 of pregnancy, while control ewes (CON, $n = 26$) did not receive. At birth, lamb rectal temperature (RT) (°C) was measured with a thermometer, and thermography images were taken at a 1 m distance from the dorsal midline of the lambs with a thermal camera (Thermal Imager, Testo 880). Images were analyzed using Testo IRSoft, where three areas were identified (shoulder = ST, mid loin = LT, and hips = HT). For each picture, minimum, average and maximum temperatures were recorded. The effects of the treatment on rectal temperature and body surface thermography were evaluated statistically using the GLM PROC in a model including melatonin treatment, sex, birth type, and their interaction.

Results and discussion
No effect of sex, birth type, and interactions on ST, LT, and HT were observed. There was an effect ($p < 0.05$) of melatonin on RT (MEL:39.0 ± 0.1, CON:38.7 ± 0.1), and minimum (MEL:19.7 ± 0.3, CON:18.8 ± 0.3) and average (MEL:23.2 ± 0.4, CON:21.9 ± 0.4) ST body surface temperature. Additionally, there was an effect ($p < 0.001$) on minimum, average and maximum LT body surface temperature (MEL:19.9 ± 0.3, CON:18.7 ± 0.3; MEL:23.6 ± 0.4, CON:22.3 ± 0.4; MEL:24.9 ± 0.3, CON:24.0 ± 0.4, resp.). Regarding the HT area, the MEL group had the highest increase ($p < 0.001$) in body surface temperature of minimum (MEL:20.6 ± 0.3, CON:18.9 ± 0.3), average (MEL: 23.8 ± 0.3, CON: 22.0 ± 0.4), and maximum (MEL: 25.8 ± 0.4, CON: 23.8 ± 0.43). Moreover, the MEL group had the higher ($p < 0.001$) minimum (MEL:20.6 ± 0.3, CON:18.9 ± 0.3), average (MEL: 23.8 ± 0.3, CON: 22.0 ± 0.4), and maximum (MEL: 25.8 ± 0.4, CON: 23.8 ± 0.43) body surface HT temperature.

Conclusion and implications
In conclusion, exogenous melatonin treatment during late pregnancy in ewes increased rectal temperature and the average and minimum body surface temperature of the shoulder, mid loin, and hips in newborn lambs.

Acknowledgements and funding
F Canto was funded by the National Agency for Research and Development (ANID)/Scholarship Program/DOCTORADO BECAS CHILE/2020 - 72210031.

doi: 10.1016/j.anscip.2023.01.105

O-030
Melatonin implants during the last third of pregnancy in sheep improve lamb performances until weaning

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Keywords: Sheep; Melatonin; Lambs; Performance

Introduction
Subcutaneous implants of melatonin are used extensively to advance the breeding season in sheep, although in recent years, alternative uses of melatonin in small ruminants have been established, mainly focused on the survival and growth of the offspring. We have previously demonstrated that implanting melatonin at lambing enhances lamb growth and maintains a high fat content in milk during lactation, and treatment with melatonin implants at the fourth month of pregnancy resulted in a higher colostrum quality. The aim of this work was to study differences among lambs born from ewes implanted or not with exogenous melatonin 40 days before lambing.

Material and methods
A total number of 575 lambs (294 males, 281 females; 199 singles, 376 multiple) born in two farms (Farm1, $n = 354$; Farm2, $n = 221$) located in Zaragoza (Spain) were used. They were divided into two groups: lambs whose mothers were treated with one melatonin implant (18 mg melatonin; Melovine, CEVA Salud Animal, Barcelona, Spain) 39 ± 7 days before lambing (group M, $n = 248$), and lambs whose mothers were non-treated (group C, $n = 327$). Lambs were weighed (kg) at birth (LW0) and at weaning (47 ± 8 days of age) (LWW), and the average daily growth rate (g/day) (AGR) was calculated as [(LWW-LW0)/age at weaning]. The effects of farm, sex of the lamb, type of parturition (single or multiple), and group (M or C), were tested by a GLM. After that, an ANOVA was used to determine statistical differences between sex, parturition and groups.

Results
Both farm, sex of the lamb, type of parturition and group had a significant effect ($P < 0.05$) on LW0, LWW and AGR, and also the interaction between farm and the rest of the factors on AGR. M lambs had a mean (±S.E) higher LWW (12.26 ± 0.10) than C lambs (12.00 ± 0.08) ($P < 0.05$). In particular, male M lambs had a higher LWW and AGR than male C lambs (12.62 ± 0.15 and 0.189 ± 0.041 vs. 12.13 ± 0.12 and 0.174 ± 0.033, resp.; $P < 0.05$). No differences between female M and C lambs were observed. Considering the type of parturition, single male M lambs presented the highest LW0 (4.79 ± 0.11), LWW (13.19 ± 0.25), AGR (0.212 ± 0.067) and the lowest age at weaning (40.6 ± 0.8 days) than the rest of the lambs, with significant differences ($P < 0.05$) with single male C lambs (4.49 ± 0.07; 12.36 ± 0.19; 0.185 ± 0.059 and 43.7 ± 0.9, resp.). No differences between groups were detected for multiple male M and C lambs, or single or multiple female M and C lambs.

Conclusion
The treatment of pregnant ewes with melatonin 40 days before lambing increase the lamb performances until weaning, and in particular, this effect was more evident in single male lambs, who presented the highest LW0, LWW and AGR compared with the rest of the lambs.

Funding
F. Canto was funded by ANID/Scholarship DOCTORADO BECAS CHILE/2020 72210031.

doi: 10.1016/j.anscip.2023.01.106

O-031
Immunomodulatory role of melatonin against coccidiosis in pre-term pregnant ewes and their offspring: A pilot study

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Keywords: Pregnant ewes; Melatonin; IgG; Coccidia infestation

Introduction
Previous studies conducted by the same researchers revealed that maternal melatonin treatment throughout embryonic development exerted an antioxidant and immunomodulatory role on newborn lambs during the first crucial hours of their life (Bouroutzika, 2021). The present study aimed to investigate the effect of melatonin administration on humoral response in pre-partum ewes infested with *Eimeria spp.* and their offspring.

Material and methods
Twenty four pregnant ewes were allocated into four equal groups, the KM (coccidia-melatonin), KC (coccidia), CM (only melatonin) and CC (control). The ewes of KM and CM groups were treated with melatonin implants throughout their pregnancy, as previously described (Bouroutzika, 2020). On day 120 of pregnancy the ewes of KM and KC were orally infested with a dose of 500,000 oocysts of a mixture of different *Eimeria* species (mainly *E. ovinoidallis*), whereas the ewes of CC served as controls. Similar hygienic and health management practices (nutrition, vaccinations, anthelmintic treatments, disinfections etc.) were applied to all groups. In total, 38 lambs were born (9, 11, 10 and 8 lambs from group KM, KC, CM and CC, respectively). Faecal samples were collected from all ewes before infestation and at parturition, for counting oocysts per gram faeces (OPG) by means of McMaster test. Blood immunoglobulin (IgG) levels were determined in ewes' plasma collected twice (the day of infestation and at parturition), lambs' plasma collected twice (24 and 72 hours after their birth) and colostrum samples collected twice (parturition and 72 hours later), using a sheep IgG Elisa kit.

Results and discussion
The results showed an OPG increase at parturition in all groups ($P > 0.05$). The IgG concentration was greater at parturition both in blood and colostrum of KM-ewes ($P < 0.05$) compared to other groups. All newborns showed an increase in IgG concentration from 24 to 72 hours of their life. However, the greater titre and a significant increase within time were only found in lambs born from KM-ewes ($P < 0.05$). Likewise, strong correlations were only detected in IgG of KM group; between ewes and colostrum at parturition ($r = 0.947$ $P = 0.0021$), colostrum at parturition and lambs at 24 h ($r = 0.885$ $P = 0.0096$) and between ewes at parturition and lambs at 24 h after birth ($r = 0.951$ $P = 0.0018$). This study indicated the immune-enhancing action of melatonin against coccidiosis during late stages of pregnancy in ewes and their newborn offspring.

Conclusion and implications
Considering that almost all young lambs are usually exposed to *Eimeria spp.* and get infested during their early life, melatonin treatment prenatally could possibly be an alternative management tool assisting the control and prevention of clinical coccidiosis in lambs. This melatonin action remains to be validated in sheep flocks.

References
Bouroutzika et al., 2020. Antioxidants (Basel) 9. https://doi.org/10.3390/antiox9030266.
Bouroutzika et al., 2021. Animals, 11. https://doi.org/10.3390/ani11113161.

doi: 10.1016/j.anscip.2023.01.107

O-032
Polymorphisms of the melatonin receptor 1A (*MTNR1A*) gene of Rasa Aragonesa rams affect their fertility after artificial insemination

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Keywords: Melatonin; Receptor; Artificial insemination; Fertility

Introduction
In the Rasa Aragonesa (RA) breed, the presence of a particular RsaI polymorphisms of the *MNTR1A* gene is associated with a shortened anestric period and more complete ovarian cycles per year, and can influence the reproductive performance of young and adult rams in spring. Specifically, RA ram-lambs born in autumn that carry the TT or GG genotypes are more likely to reproduce in their first spring, and adult TT or GG rams exhibit more intense reproductive behavior as measured by a sexual behavior test in spring.The aim of this work was to evaluate the effect of the polymorphisms of the *MNTR1A* gene of rams used in the artificial insemination (AI) program of the RA breed on the fertility of the ewes.

Material and methods
The fertility rate (pregnant or not) of 4,332 ewes, inseminated between 2019 and 2021 in 45 sheep farms, has been used. Twenty-six rams housed in the semen collection center of the Association of RA Sheep Breeders (ANGRA) were genotyped for their RsaI and MnlI polymorphism of the MTNR1A gene as follows: genotype CC ($n = 19$; 2,127 AI), CT ($n = 6$; 832 AI), and TT ($n = 7$; 1,373 AI) for the RsaI allele, and GG ($n = 13$; 2,200 AI), GA ($n = 10$; 1,606 AI), or AA ($n = 3$; 526 AI) for the MnlI allele.The effect of season (seasonal anestrus (March-June) and

breeding season (July-February)), year, farm, and carrying the different genotypes of the MNTR1A gene on fertility rate was tested by the GLM procedure, and the X^2 test.

Results and discussion
Season ($P < 0.001$), farm ($P < 0.001$) and the Rsal ($P < 0.05$) and Mnll ($P < 0.001$) polymorphisms had an effect on the proportion of pregnant ewes after AI. More pregnant ewes were found after AI in the breeding season (65%) than during the seasonal anestrus (55%) ($P < 0.001$). For the Rsal polymorphism, CC (63%) and CT (64%) rams produced a higher fertility than TT (60%) rams ($P < 0.05$), and for the Mnll, significant differences among genotypes were observed (GG: 61%; GA: 67%; AA: 55%) ($P < 0.001$). However, considering season, significant differences among genotypes for both alleles were observed only during the breeding season (CC: 66%; CT: 68%; TT: 62%; $P < 0.05$, and GG: 64%; GA: 70%: AA: 55%; $P < 0.001$), and not during the seasonal anestrus (CC: 58%; CT: 51%; TT: 53%, and GG: 57%; GA: 54%: AA: 51%).

Conclusion and implications
In conclusion, carrying one or another genotype of the *MNTR1A* gene by rams modifies the fertility rate of ewes after AI, especially during the breeding season. It is likely that changes in semen quality are responsible of these differences.

Acknowledgements and funding
Ministerio de Ciencia e Innovación, Spain (Project PID2020-113239RB-I00. FC was funded by ANID/Doctorado Becas Chile/2020 - 72210031.

doi: 10.1016/j.anscip.2023.01.108

O-033
Factors associated with variation in reproductive performance of ewes inseminated laparoscopically

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Keywords: Laparoscopic; Insemination; Lambing rates; Mixed-effects

Introduction
Satisfactory reproductive performance of ewes in genetic improvement programmes with laparoscopic artificial insemination (Lap-AI) is important to optimise progress. A few studies, including one small UK study, have investigated associations between a number of factors and outcomes of Lap-AI including: farm; ram; semen type; year; season/month; ambient temperature; PMSG dose; use of teaser rams. The aim of our study was to investigate factors associated with variation in lambing rates in a large longitudinal study.

Material and methods
Flocks using Lap-AI in the southwest of the UK were surveyed annually from 1995 to 2005. Inseminations were carried out on owner's farms, other farms or an AI centre. All owners ($n = 117$) who used Lap-AI during the study period were surveyed; 83% ($n = 97$) responded and provided data on lambing rates (LR) for 80.4% of 14299 inseminated ewes. Lambing rates (LR) were calculated as proportion of ewes from one flock inseminated on one day with semen from one ram that lambed. Binomial mixed-effects models with ram and farm as cross-classified random effects were used to identify factors associated with LR.

Results and discussion
In total 71% (8176/11493) of ewes lambed, 77% of 4005 ewes inseminated with fresh semen and 68% of 7488 ewes inseminated with frozen semen. In contrast to the previous UK study, LR was significantly higher for fresh (OR:1.52, 95%CI:1.30–1.78) than frozen semen, suggesting fertility of frozen semen is less than fresh as reported by others; significantly lower when day maximum ambient temperature (MAT) was ≥25 °C (OR:0.69, 95%CI:0.54–0.88) compared to <25 °C; and varied by year and month (higher in July (OR:1.46, 95%CI:1.07–1.99), lower in November/December (OR:0.55, 95%CI:0.33–0.93), compared to August. *For inseminations with fresh semen*: LR was significantly lower when MAT ≥25 °C (OR 0.69, 95%CI:0.54–0.88) compared to <25 °C; higher when use of teaser rams was not stated (OR:1.85, 95%CI:1.28–2.68) compared to when they were not used. To our knowledge, this is the first time that MAT ≥25 °C on the day of insemination with fresh semen has been associated with reduced LR in the UK; elsewhere, others have reported negative effects of high MAT on the day of artificial and natural insemination. *For frozen semen*: LR was significantly lower in 2004 (OR:0.52, 95%CI:0.35–0.75) and 2005 (OR:0.69, 95%CI:0.47–1.00) compared to 1995; and when ≥65 ewes were inseminated (OR:0.78, 95%CI:0.65–0.93) compared to <65.

Conclusion and implications
Lambing rates (LR) of ewes following Lap-AI vary widely. Frozen semen is less fertile on average than fresh; MAT ≥25 °C on the day of insemination with fresh semen, and insemination of ≥65 ewes day^{-1} with frozen semen, are associated with lower LR. The study provides new evidence for factors that can be used to improve reproductive performance of ewes inseminated with Lap-AI.

Acknowledgements and funding
We are indebted to the participants.

doi: 10.1016/j.anscip.2023.01.109

O-034
The role of housing conditions on the success of artificial insemination in intensively reared dairy ewes in Greece

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Keywords: Housing; Artificial insemination; Dairy ewes; Pregnancy

Introduction
Artificial insemination (AI) is an assisted reproduction technique that enhances genetic improvement of livestock (Faigl et al., 2012). However, success in sheep depends on many factors.
The objective was to assess the role of housing conditions during summer months on success rates of cervical AI, with cooled semen, in intensively reared dairy ewes in Greece.

Material and methods
The study involved 2,083 Lacaune ewes from 23 flocks that were serviced during May to September. An estrous synchronization protocol with insertion of progestogen sponges for 14 days and eCG administration at sponge removal, was used. All ewes were inseminated 54–57 hours after sponge removal with cooled semen (15 °C) from 10 Lacaune rams. Pregnancy diagnosis was performed by trans-dermal ultrasonography at 35–40 days after AI. Data recording started the day after sponge placement (15 days prior to AI) and lasted up to 14 days after AI. Daily records included temperature, relative humidity, and Temperature-Humidity Index (THI) inside the shed. Available space and volume per animal, frequency of bedding renewal, access to a yard and indoor light were also recorded in each farm. Binary logistic regression was used for the statistical analysis.

Results and discussion
Temperature and THI increase at days −15 to +4 around AI (day 0) had a significant ($P < 0.05$) negative effect on pregnancy rates (reduced likelihood of pregnancy by −6% and 7%, respectively). The latter also decreased significantly ($P < 0.05$) in farms with high stocking density, non-frequent bedding renewal and outdoor access of ewes (by 30%, 34% and 44%, respectively). Results are in general agreement with previous findings in dairy cows (Schefers et al., 2010).

Conclusion and implications
Overall, results indicate that appropriate housing conditions are key factors for increasing the success of AI in intensively reared dairy ewes during summer months. The latter would be beneficial in terms of production and the overall sustainability of intensive dairy sheep farming systems.

Acknowledgements and funding
Partially funded by the project, "Recording and evaluation of factors affecting artificial insemination success using fresh ram semen in Greek breeding conditions" (MIS 5007366), under the call for proposals, "Supporting researchers with emphasis on new researchers" (EDULLL 34). The project is co-financed by Greece and the European Union (European Social Fund-ESF) by the Operational Programme Human Resources Development, Education and Lifelong Learning 2014–2020.

References

Faigl, V., Vass, N., Jávor, A., Kulcsár, M., Solti, L., Amiridis, G., Cseh, S., 2012. Artificial insemination of small ruminants—A review. Acta Veterinaria Hungaria 60, 115–129.
Schefers, J.M., Weigel, K.A., Rawson, C.L., Zwald, N.R., Cook, N.B., 2010. Management practices associated with conception rate and service rate of lactating Holstein cows in large, commercial dairy herds. J. Dairy Sci. 93, 1459–1467.

doi: 10.1016/j.anscip.2023.01.110

ISVA: General diagnosis to reduce Antibiotic usage

O-035
Survey of veterinary practices on antibiotic prescribing and administration in sheep flocks in the Highlands and Islands of Scotland

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Keywords: Antibiotics; Sheep; Vets; Prescribing

Introduction
Minimising prophylactic antibiotic (PAB) use is essential to preserving effective control of bacterial conditions of humans and animals. There are limited data on how vets prescribe antibiotics and how antibiotics are used in sheep flocks in the Highlands and Islands of Scotland. The Highlands and Islands Veterinary Services Scheme (HIVSS) was established to financially support delivery of veterinary care to remote farms and crofts. The aim of this study was to gather evidence on factors influencing PAB prescribing by HIVSS veterinary surgeons.

Material and methods
An online questionnaire was developed with input from HIVSS veterinarians and related literature. It was distributed via email with follow-up email reminders and telephone calls. Each vet practice was offered a sheep/calf fluid pump attachment as a 'thank you' for participation. Statistical analysis of preliminary results included frequencies and ranked ANOVA.

Results and discussion
Data collection is ongoing, preliminary results included 53 respondents from 15 practices. Most vets (67.5%) thought PAB use in sheep had decreased in the previous 10 years. Fifty percent were still concerned about overall levels of antibiotic use in sheep. Many vets agreed or strongly agreed that client pressure to prescribe (67%) and lack of rapid diagnostics (56%) made it hard to reduce PAB use. Eighty-nine percent of vets thought neonatal infections would decrease if management practices to prevent them were implemented instead of PAB. However, 27% of vets believed that veterinary practice profits would then decrease and 58% that practice profits would remain unchanged. Moreover, vets thought implementation of proactive flock health planning was impaired by clients only wanting veterinary input in emergency situations (68%). Approximately half of the respondents had less than five clients engaged in meaningful flock health planning (55%) or discussed PAB use with fewer than five clients in the previous 12 months (49%). Vets qualified for 10 years or less were more likely to strongly agree that there is a genuine risk of antimicrobial resistance impacting on the wider community than vets qualified for longer (Cohen's $f = 0.915$, $p < 0.01$).

Conclusion and implications
This is the first study to explore the barriers and facilitators to reducing PAB use among HIVSS vets. Despite the perception that PAB use has decreased, concerns about overall levels of use persist among vets. They agreed that implementation of best practice would improve on-farm disease status. However, the perceived lack of financial benefits to veterinary practices could be a significant barrier to veterinary effort in this area. This presents an opportunity to identify meaningful, profitable ways that local vets can engage sheep keepers to drive improvements in animal health and PAB use.

Acknowledgements and funding
We wish to thank Quality Meat Scotland for funding support and Freda Scott-Park for questionnaire distribution.

doi: 10.1016/j.anscip.2023.01.111

O-036
Use of antibiotics against bacterial infections on dairy sheep farms: Patterns of usage and associations with health management and human resources

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Keywords: Antibiotic; Dairy sheep; Health management; Treatment

Introduction
The objectives of the study were (a) to describe the patterns of antibiotic usage against four major clinical problems and (b) to evaluate factors that were associated with their use on small ruminant farms.

Material and methods
A study was performed in 325 dairy sheep flocks in Greece by means of visiting the farms and performing an interview with the farmers using a structured questionnaire. The following outcomes were considered: 'calculation of bodyweight for administration of antibiotics by weighing', 'administration of antibiotics to animals at dose prescribed', 'observation of withdrawal period after administration of antibiotics', 'number of antibiotics used for treatment of clinical mastitis', 'use of antibiotics in cases of abortion', 'routine administration of

antibiotics to newborns', 'use of antibiotics for the treatment of pneumonia in lambs', 'use of antibiotics for the treatment of diarrhoea in lambs'. Univariable analysis of associations was performed, followed by creation of multivariable models as appropriate.

Results and discussion
Farmers mostly administered the antibiotics to animals at the dose prescribed (81.2%) and observed the necessary withdrawal periods (98.8%), but fewer farmers (22.5%) weighed the animals to calculate bodyweight before antibiotic administration. For the treatment of clinical mastitis, oxytetracycline, penicillin and streptomycin were used more frequently; on average, 2.03 different antibiotics were used per farm, most frequently in injectable forms (89.2% of farms). In cases of abortion, oxytetracycline was most frequently administered; on average, 1.12 different antibiotics were used per flock. In 65 farms (20.0%), routine administration of antibiotics was performed to newborns; oxytetracycline and ampicillin were administered more often in lambs. For the treatment of lamb pneumonia, oxytetracycline, penicillin and tulathromycin were used more frequently; on average, 1.33 antibiotics were used per flock. For the treatment of lamb diarrhoea, oxytetracycline, amoxicillin and penicillin were used more frequently; on average, 1.34 antibiotics per flock. Results of multivariable analyses indicated 12 different variables associated with the various outcomes. Of these, 8 variables were related to the socio-demographic characteristics of farmers: education was significant for three outcomes; age, experience, professional involvement, farming family tradition and daily period spent at the farm were each significant for one outcome.

Conclusion and implications
The study presented a facet of the interactions between people and farm animals in the food-producing chain. The importance of training farmers regarding correct usage of antibiotics became prominent. Improved antimicrobial usage, based on correct scientific principles and compliance with regulations and policies, coupled with surveillance on the farms are important for improving the welfare of farm animals and minimizing development of antibiotic resistance. These people–animal interactions can be considered as another approach within the 'One Health' concept.

doi: 10.1016/j.anscip.2023.01.112

O-037
The effect on mortality of metaphylactic tulathromycin in a lamb feedlot

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Keywords: Tulathromycin; Mortality; Feedlot; Lambs

Introduction
Ovine Respiratory Complex (ORC) is the major cause of death in lambs in fattening conditions, associated to immunosuppression caused by stress and concomitant diseases, with many asymptomatic animals. Tulathromycin is a macrolide used to treat respiratory disease in cattle and swine, it can be used for metaphylaxis, and it has shown high efficacy against Pasteurella spp. infections in sheep and pigs in Spain, with low levels (<15%) of resistance reported. The increased concern about antimicrobial resistance should be an important factor in the prescription of antimicrobial methaphylaxis against ORC at the arrival of a lamb feedlot. The aim of this work was to study the effect of methaphylactic tulathromycin on the mortality of feedlot lambs.

Material and methods
2235 lambs arriving at a fattening lamb unit were used (June 2022), from different origins, 2–4 months old. At arrival, animals with official identification number (ID) ending in even number were allocated to Control group (not treated, and no placebo) and odd numbers belonged to Treatment group, and given tulathromycin (Draxxin 100 mg/ml), 2.5 mg/kg bodyweight, IM. All animals were subjected to equal husbandry and feeding. Date of death was recorded and number of days after arrival calculated. Treatment and Control groups were compared: mortality rate (Pearse Chi-square test); mean number of days between death and arrival (independent T-student test); and survival rate (Kaplan-Meier survival analysis).

Results and discussion
Mortality rate was 7.2% (82 out of 1132 animals) and 11.9% (131 out of 1102 animals) in Treatment and Control groups, respectively ($p < 0.001$). Cause of death was not confirmed; however, ORC is the main cause of death in fattening lambs. The stress of treatment could have increased the risk of disease, but still, these animals showed significantly less mortality.
Mean number of days between death and arrival was 21.0 and 17.9 for the Treatment and Control groups, respectively ($p = 0.039$). The analysis did not take into consideration age, origin, or presence of clinical disease (2). Clinical examination was not performed at arrival, as it is not practical to perform individual medicine in feedlot conditions when hundreds of animals are arriving, therefore, it is not known if tulathromycin was given to clinical or not obviously diseased animals. Other variables could have been used to understand the impact on animal welfare; however, mortality related to ORC is commonly associated with chronic disease and suffering.

Conclusion and implications
Metaphylactic tulathromycin had a positive effect on the survival rate of the feedlot lambs, therefore its use should be considered in ORC high-risk situations. This study should be repeated in mild weather conditions, in order to understand if the differences persist between the groups, so metaphylaxis can be applied to more specific situations.

doi: 10.1016/j.anscip.2023.01.113

O-038
Isolation of *Listeria ivanovii* from milk of ewes: Prevalence, association with milk quality, antibiotic susceptibility, predictors, whole genome sequence and phylogenetic relationships

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Keywords: Listeria; Virulence factors; Whole genome sequence; Zoonosis

Introduction
Objectives were to (a) investigate presence of *Listeria* spp. in the bulk-tank sheep milk in Greece, (b) identify relevant predictors, (c) study whole genome sequence of isolates and define antibiotic resistance genes, virulence factors genes, mobile elements and CRISPR/CAS loci and (d) reveal phylogenetic relationships of strains.

Material and methods
Milk samples were collected aseptically from bulk-tank of flocks. Samples were examined microbiologically for *Listeria* spp. (ISO11290-1:2017). Identity was confirmed by MALDI-TOF. Isolates were tested for antibiotic susceptibility. 36 management-, 6 demographic- and 9 climate-related variables were evaluated as potential predictors, by means of univariable and multivariable analysis. Strains were sequenced in S5XLS system and Ion Torrent Suite; reads were assembled using SPAdes genome assembler. Genomes were annotated using Prokka v.1.14. Average cover-age for each genome was computed using bbmap. Other bioinformatics tools employed were: ResFinder, VirulenceFinder, Mobile Element Finder, PHASTER, Plasmid Finder, CRISPRCasFinder. BLAST analysis was performed to determine origin of sequence of spacers. Phylogenetic relationships of genomes of isolates were compared with previously recovered strains, with Clustal Omega, RAxML with GTRGAMMA, iTol and BLAST Ring Image Generator.

Results and discussion
Listeria monocytogenes was isolated from one and *Listeria ivanovii* from three sheep farms. No associations were found between isolation of *Listeria* and milk quality (somatic cell counts, milk composition). No antibiotic resistance of isolates was detected. The following predictors were identified: (a) presence of pigs ($p < 0.0001$), (b) low environmental humidity ($p = 0.006$) and (c) high number of ewes ($p = 0.045$) in farms. Among farms with pigs, those where *Listeria* was isolated, had higher number of pigs (median: 10) than those where the organism was not isolated (2) ($p = 0.04$). Neither antibiotic resistance genes, nor mobile elements, intact prophages and plasmids were found in any genome. Fifteen virulence factor genes (*flaA*, lap, *oppA*, *rli55*, *rli60*, *rsbv*, *clpp*, *degU*, *fri*, *hfq*, *inlC*, *lhrC*, *lsp*, *tcsA*, *tig*) were detected. Five possible CRIPSRs and one CAS cluster were found. The three strains were assigned to *L. ivanovii* subsp. *ivanovii* branch. The strains were phylogenetically close to PAM 55 strain; only minor differences were identified (e.g., in the region near 1800 kbp).

Conclusion and implications
Infrequent isolation of *Listeria* from samples from sheep farms, linked with lack of isolation from dairy products, as indicated in relevant scientific literature from in Greece, indicates a low risk for people consuming such products. The identification of predictors of the isolation of the organism should be taken into account in the health management of farms for preventing dissemination of the pathogens. The findings of the bioinformatics studies, considered together, suggest that possibly reduced evolutionary diversity of the three strains is reflected in the reduced pathogenicity of the organism.

doi: 10.1016/j.anscip.2023.01.114

O-039
Pathology of ovine pulmonary adenocarcinoma; Is diagnosis from gross pathology sufficiently accurate?

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Keywords: OPA; Pathology; Diagnosis; IHC

Introduction
Ovine pulmonary adenocarcinoma (OPA) is an infectious neoplastic lung disease of sheep caused by jaagsiekte sheep retrovirus (JSRV) which can have a significant negative impact on sheep welfare and productivity. Sheep flocks that have not been affected with OPA will pay a premium for stock from verified OPA-free sources. However, the long incubation period between infection and development of clinical disease, combined with the lack of a reliable pre-clinical test can make it difficult to confidently classify an individual animal or flock as "OPA-free".
It has recently been proposed that a risk-based accreditation scheme for OPA might be developed based on post-mortem examination (PME) of lungs at livestock disease surveillance centres or abattoirs. Our experience in the investigation of naturally-occurring OPA cases over the past 20 years enables us to offer advice on the wisdom of such an approach.

Material and methods
Clinical cases of OPA, pre-clinical cases identified by on-farm rapid trans-thoracic ultrasound scanning (TTUS) and negative controls (total $n = 450$) were euthanised by lethal dose of phenylbarbitone and then their hind-quarters were elevated to assess lung fluid accumulation ("wheel-barrow" test). The lungs were removed and photographed according to a standard protocol and tumour distribution was recorded on a 2-dimensional lung schematic ("lung map"). The average distribution of OPA lesions was assessed by overlaying the "lung maps" from individual animals. Samples from a standard set of lung regions were collected into formalin, processed into paraffin wax, and stained with haematoxylin and eosin or immuno-labelled with antibody specific for JSRV.

Results and discussion
If lung fluid was present (>1 ml $n = 154$ sheep) OPA was always confirmed histologically and usually the tumours were large, generally affecting at least a quarter of the total lungs. If lung fluid was not present, PME gross examination alone was often not able to differentiate OPA from non-OPA respiratory disease (sensitivity:92%; specificity:85%; $n = 297$ animals, 91 of which were OPA positive). In confirmed OPA cases lesions were most commonly present in the cranioventral regions of the lung. On histopathological examination, small aggregates of neoplastic epithelial cells can be difficult to differentiate from non-OPA bronchiolar epithelial hyperplasia. In these cases, immunohistochemistry for JRSV is required for a definitive diagnosis.

Conclusion and implications
If lung fluid is observed a diagnosis of OPA can be made with certainty.
In the absence of lung fluid, gross pathological changes affecting the cranioventral areas and having the appearance of small lesions disseminating from the leading edge of the tumour are identifiable as OPA.
If alternative gross pathological changes are present, histological and/or IHC examination is required to be confident of a correct diagnosis. Lung sampling should focus on the cranioventral regions of the lung.

doi: 10.1016/j.anscip.2023.01.115

O-040
Control of ovine pulmonary adenocarcinoma: New insights from experimental studies

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Keywords: Ovine pulmonary adenocarcinoma; Experimental infection; CT; Tumour growth rates

Introduction
Ovine pulmonary adenocarcinoma (OPA) is an infectious neoplastic pulmonary disease of sheep caused by jaagsiekte sheep retrovirus (JSRV). OPA has traditionally been considered a slow progressive disease with clinical cases typically being seen in older animals. In order to develop OPA control programmes we need to understand at what point a JSRV positive animal becomes infectious. To begin to address this our study describes for the first time monthly imaging and respiratory sampling results from experimentally infected sheep from the point of JSRV instillation to the development of OPA tumours.

Material and methods
JSRV was produced in vitro by transient transfection of 293T cells with the infectious molecular clone pCMV2JS$_{21}$. Under anaesthesia, JSRV was delivered via a bronchoscope to the segmental bronchus of the right cardiac lung lobe of 18, 4–5 month old Texel x Scotch Mule lambs. Every 4 weeks, up to 9 months post-JSRV instillation, sheep were anaesthetised for thoracic computed tomography (CT) scanning, transthoracic ultrasound and sample collection. Diagnosis was confirmed through post-mortem examination, histology and immunohistochemistry. 3D reconstructions were generated from the CT scans to estimate tumour volumes. Tumour volume doubling (TVD) times were calculated using a modified Schwartz formula. RNA extracted from respiratory samples was analysed by RT-qPCR specific for exogenous JSRV.

Results and discussion
Five sheep developed large rapidly-growing pulmonary tumours. Right cardiac TVD times were 14.8 ± 2 days. Ten sheep had evidence of very early OPA, detected by histopathology or IHC. Increased levels of JSRV in respiratory samples, detected by RT-qPCR, was associated with progressive tumour growth.

Conclusion and implications
Our findings have important implications for within flock test-and-cull schemes. Detection of JSRV in respiratory samples occurred only when the rapidly growing OPA tumours had reached several cm in diameter. These results support the notion that removing sheep with detectable tumours will be useful in reducing within flock JSRV transmission, even when the earliest stages of OPA are undetectable. Furthermore, we showed that the incubation time from JSRV instillation to detectable OPA lesions was variable even with sheep of similar breed given the same dose of virus on the same day. The rapid growth of some OPA tumours goes against the dogma that OPA is a slowly progressive disease. Supported by previous experimental infection studies and by evidence from a study of natural cases where tumour growth was estimated by ultrasonography, these results have implications for time intervals between flock screenings for test-and-cull control programmes. Longer intervals carry the risk of allowing OPA cases to develop to the point of becoming highly infectious.

Acknowledgements and funding
Funding from Johnson and Johnson through their Lung Cancer Initiative Programme and from the Scottish Government Rural and Environment Science and Analytical Services Division.

doi: 10.1016/j.anscip.2023.01.116

O-041
Effects of paratuberculosis vaccination on productive parameters in a dairy sheep flock

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Keywords: Paratuberculosis; Vaccination; Milk production; Dairy sheep

Introduction
Paratuberculosis is an infectious disease of ruminants, caused by *Mycobacterium avium* subsp *paratuberculosis* (Map). It is worldwide distributed with serious economic effects. Clinically affected animals show a progressive loss of weight and diarrhoea. Vaccination has been considered as the most efficient method of control, that causes a decrease in the occurrence of new clinical cases. However, its effects on productive parameters has been hardly analysed. Thus, the objective of this study is to evaluate how paratuberculosis vaccination can influence on the milk production and number of newborn lambs in a dairy sheep flock.

Material and methods
The experiment was conducted in a dairy Assaf sheep flock composed of approximately 1000 adult animals in which clinical cases of paratuberculosis were recorded and, in a previous sampling, a seroprevalence of 4% was detected. During two years, half of the replacement ewes ($n = 227$) were vaccinated with the inactivated vaccine Gudair® (Vetia AH), while the remaining animals ($n = 213$) were kept as unvaccinated controls. The number of lactations, milk production per lactation (in litres) and the number of lambs born from each animal along the following 8 years were recorded. Management was the same for both groups. The results were submitted to analysis of variance and least square means comparison, after natural logarithm transformation, the results. Student's t test with the Tukey adjustement for multiple pair-wise comparisons were used.

Results and discussion
Among vaccinated animals, there was a significant ($p < 0.05$) increase in the number of lactations (1769 vs 1369) as well as an increase in the number of litres of milk produced by lactation (225,2 vs 199,43). Concerning the number of lambs born from each group, there was also a significant ($p < 0.05$) increase in the case of vaccinated animals (2477 vs 2032). According to these results, vaccination against paratuberculosis seems to have a positive effect on productive parameters such as milk production and the number of lambs obtained. These benefits could be related to the decrease in the number of clinical cases of the disease observed in the flock after vaccination (data not shown) but,

the fact that paratuberculosis vaccination could have an unspecific heterologous protection against other pathogens, as it has been recently suggested, as it occurs in BCG vaccination in human, cannot be excluded.

Conclusion and implications
Vaccination against paratuberculosis has demonstrated to have a positive effect on some productive parameter in a dairy sheep flock. Whether this is due to the decrease in the number of clinical cases of the disease or are other factors related to a improvement of the general health status of the flock needs to be further investigated. Paratuberculosis vaccination should be a recommended practice in those flocks were Map infection is present.

doi: 10.1016/j.anscip.2023.01.117

O-042
Investigation of the prevalence and impact on fertility and longevity of ovine Johne's disease

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Keywords: Ovine; Johne's; Prevalence; Fertility

Introduction
Ovine Johne's disease (OJD) is an insidious production-limiting disease caused by *Mycobacterium avium* subspecies *paratuberculosis* (MAP) which presents predominantly as progressive weight loss. OJD deleteriously impacts animal welfare and is responsible for economic losses within affected flocks although the disease has received very little attention in the UK to date.
This project aimed to estimate prevalence of OJD in the national flock of Great Britain on different farm types and assess the correlation between faecal shedding of MAP, fertility and longevity of commercial ewes.

Material and methods
Prevalence was estimated from three study populations involving 169 farms across England, Scotland and Wales from a combination of sheep only, beef only and mixed species farms. For each farm, between 10–60 ovine and/or 10–20 bovine faecal samples were tested by pooled polymerase chain reaction (PCR). Ovine samples were collected via both random and stratified sampling methods to determine flock MAP status. A subset of 122 individual ewe faecal samples underwent PCR testing. Reproductive outcome, MAP status, age and body condition score (BCS) were modelled by multiple regression analysis.

Results and discussion
Between flock prevalence estimates ranged between 61% and 71%. These results indicate that OJD is likely to be very common and widespread in the national flock. MAP was detected in 48% of flocks from sheep only farms versus 82% of flocks from mixed farms. Similarly, MAP was detected in 53% of beef herds from cattle only farms versus 65% from herds on mixed farms. The higher prevalence in both flocks and herds on mixed farms supports the hypothesis that cross-species transmission between the two species occurs.
In OJD positive flocks, non-pregnant ewes were significantly more likely to be shedding detectable levels of MAP than their pregnant counterparts ($p = 0.040$) and exhibited a trend towards lower BCS.
MAP positive flocks had a younger age profile, a significantly higher replacement rate (median 30% versus 25% ($p = 0.047$) and significantly fewer ewes retained beyond 3 years old ($p = 0.016$). These results suggest that MAP infection may reduce body condition and fertility, leading to increased and premature culling of breeding ewes, leading inevitably to higher replacement rates and a younger overall flock age profile. This in turn is likely to result in reduced lamb output as younger ewes are less productive than their mature counterparts.

Conclusion and implications
OJD is likely to be very common and under-diagnosed in UK flocks. Negative effects on fertility and longevity in infected flocks appear to lead to reduced productivity, which in turn, will negatively impact upon flock profitability, efficiency, carbon footprint and long-term sustainability.

Acknowledgements and funding
Many thanks to the farmers involved in this study. Funding provided by AHDB, HCC, Virbac and University of Liverpool.

doi: 10.1016/j.anscip.2023.01.118

O-043
Inter-laboratory ring trial to compare four quantitative polymerase chain reaction assays employed for detection of *Mycobacterium avium* subspecies *paratuberculosis*

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Keywords: Johne's; PCR; Ring trial; Laboratory

Introduction
Johne's disease is an infectious enteric disease caused by *Mycobacterium avium* subspecies *paratuberculosis* (MAP) affecting predominantly ruminants with a worldwide distribution. Faecal quantitative polymerase chain reaction (qPCR) is generally considered a more sensitive diagnostic test than serology and more rapid than culture protocols.
In this project an independent performance comparison ring trail was conducted between three different commercial MAP qPCR assay services (B, C and D) currently marketed in the UK by three separate laboratories against each other and against a fourth assay (A) (Kawaji et al., 2020) not commercially available in the UK at present.

Material and methods
A total of 205 individual samples from 5 farms (50 cattle and 155 sheep) were analysed in groups of 5 to give 41 sets of pooled results from each laboratory according to their own specific protocols. A second sample set of 38 pooled ovine samples from 10 flocks compared performance of assays A and B.

Results and discussion
The number of positive pools for assays A-D were 18, 12, 11 and 1 (43.9%, 29.2%, 26.8% and 2.4%) respectively. Percentage agreement between all four assays for both bovine and ovine pools was 43.9% with a Fleiss' kappa coefficient of 0.15 indicating very poor overall agreement. Pairwise agreement and Cohen's kappa scores ranged between 40%–90% and −0.36 to 0.62 respectively with the highest inter-rater reliability between assays A and B.
At the farm level, assays A, B and C all diagnosed the same four flocks with Johne's whilst assay D only identified one flock.
For the second data set, the number of positive results for assays A and B were 24 (63.1%) and 17 (44.7%) respectively (percentage agreement 76.3% and Cohen's kappa 0.54), again indicating that assay A is more sensitive than assay B.
Potential explanations for the wide variation in results between assays include differences in sample volume, pooling methodology, DNA extraction protocols and primer pairs employed as well as interpretation of results.

Conclusion and implications
Variation between laboratories offering MAP qPCR assays is a significant concern. Lack of sensitivity will lead to under-diagnosis of this important disease and lack of reproducibility will reduce confidence in any result obtained. Further work is required to validate and standardise the performance of assays within and between laboratories for both bovine and ovine samples. This would assist farmers and veterinarians in making more informed decisions on screening, diagnosis and control of Johne's disease.

Acknowledgements and funding
Funding provided by HCC, Virbac and University of Liverpool.

Reference

Kawaji, S., Nagata, R., Minegishi, Y., Saruyama, Y., Mita, A., Kishizuka, S., Saito, M., Mori, Y., 2020. A novel real-time PCR-based screening test with pooled faecal samples for bovine Johne's disease. J. Clin. Microbiol. 58 (12).

doi: 10.1016/j.anscip.2023.01.119

O-044
Screening of sheep- and goat herds for *Mycobacterium avium* ssp. paratuberculosis using both environmental samples and specific antibodies in blood serum

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Keywords: Screening; Paratuberculosis; Blood; Feaces

Introduction
Little valid information is currently available on the spread of paratuberculosis in sheep and goat herds, mostly based on serological testing. Therefore, a pilot study was carried out in Thuringia, Federal State of Germany to screen sheep flocks and goat herds for MAP.

Material and methods
In 165 flocks with a size of 2 to 2879 animals, 2550 sheep and 1171 goats were examined. Blood samples taken in the context of the brucellosis screening according to Annex IV Part I of Delegated Regulation (EU) 2020/689 were additionally examined for paratuberculosis antibodies. Sample size was calculated to detect a within-herd prevalence of 5% with 95% confidence. Depending on the farm size, one to five environmental faecal samples were collected in each farm and tested by bacteriological culture and a commercial real-time PCR for direct detection of MAP genome after DNA extraction from faeces.

Results and discussion
41 sheep (1.61%) and 29 goats (2.48%) were serologically positive. Thirty-four (20.61%) of the farms had at least 1 seropositive individual animal. Thereof, 10 herds had more than one reactor. In one goat herd with only five animals one reactor was detected. Non-negative results of bacteriological culture and/or real time PCR of environmental samples were obtained in five herds. MAP was not detected in the environmental samples of all other farms, including 22 farms with one reactor and 130 farms with only seronegative results.
The mean apparent within-herd prevalence in seropositive herds with >50 animals was rather low (2.79%).
We did not observe an association between a positive serological result of the animal and age, nutritional status or the presence of diarrhoea, or spatial clusters.

Conclusion and implications
The apparent between-herd sero-prevalence of 20.6% in herds was lower than compared to previous studies (Stau et al., 2012). Ten/165 flocks had more than one reactor and/or non-negative results in the environmental samples indicating a higher probability of being truly positive. In 5 of these 10 herds a positive association between MAP detection in environmental samples and antibody detection in serum samples was observed. This may be due to the fact that the sample size for antibody detection was designed to detect a within-herd prevalence of 5%. In farms with a lower within-herd prevalence environmental sampling is probably not sensitive enough to detect infected herds.

Reference

Stau, A., Seelig, B., Walter, D., Schroeder, C., Ganter, M., 2012. Seroprevalence of Mycobacterium avium subsp. paratuberculosis in small ruminants in Germany. Small Ruminant Res. 105 (s 1–3), 361–365.

doi: 10.1016/j.anscip.2023.01.120

O-045
Correlation of fecal egg count with clinical parameters in dairy sheep

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Keywords: Famacha©; Body condition score; Dag score; Interrater agreement

Introduction
Gastrointestinal nematode infections may lead to substantial economic losses in sheep farming due to reduced growth, emaciation and reduced performance. In order to identify and subsequently treat infected animals various monitoring concepts (e.g. Famacha© system, Body Condition Score (BCS), Dag Score and Fecal Egg Count (FEC)) are applied as part of the Targeted Selective Treatment strategy. These surveillance strategies help to reduce the risk of anthelmintic resistance. Previous studies have shown that these parameters change with increasing egg excretion. In order to detect animals at risk at an early stage, trained farmers are able to apply these methods.

Material and methods
The objectives of this study were to investigate the associations between the Fecal Egg Count and Famacha© Score, Body Condition Score and Dag Score. Individual fecal samples were collected from 1196 adult lactating sheep from 16 dairy sheep flocks in different regions of Austria. The Fecal Egg Count was determined using the MiniFlotac techinque. Famacha© Score, Body Condition Score and Dag Score were assessed using standard methods and score sheets. The correlations between egg shedding and the clinical parameters were calculated

using Spearman rank correlation. Randomly selected ewes were examined independently by three raters (rater 1 = veterinarian = reference, rater 2 = student 1, rater 3 = student 2) to test the agreement using the intraclass correlation (ICC).

Results and discussion
Results reveal that only the Body Condition Score was associated with the EpG values ($\rho = -0.176$; $n = 1.154$; $p < 0.001$). Famacha© Score ($\rho = 0.044$; $n = 338$; $p = 0.419$) and Dag Score ($\rho = 0.034$; $n = 1.196$; $p = 0.239$) showed no significant correlation with EpG. The statistical analysis for the Interrater Agreement indicates moderate to good agreements between the students and the veterinarian for the Famacha© Score (ICC: 0.678; $p < 0.001$), Body Condition Score (ICC: 0.642; $p < 0.001$) and Dag Score (ICC: 0.669; $p < 0.001$). The study shows that only the BCS was significantly correlated with rising egg excretion whereof the correlation was only weak ($\rho = -0.176$). The Famacha© Score and Dag Score were not correlated with FEC. The moderate to good agreement in the clinical examination between the raters shows that the training of students who apply clinical monitoring concepts is essential.

Conclusion and implications
From a practical point of view, this implies that emaciation, anemia or diarrhea should not automatically be associated with high egg excretion as other factors (feeding, environmental factors, duration of the disease) may also have an impact on the animal's clinical appearance. In addition, clinical findings may differ depending on the predominant gastrointestinal nematode species, as bloodsucking *Haemonchus contortus* is known to cause anemia but feces tend to be firm.

Funding
This work has been funded by the Program "Top Vet Science" financed by Vetmeduni Vienna.

doi: 10.1016/j.anscip.2023.01.121

O-046
Inhibition of egg hatching assay of *Haemonchus contortus* in vitro exposed to *Heterotheca inuloides* cass (Arnica Montana) ethanolic extract

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Keywords: *Heterotheca inuloides* cass; *Haemonchus contortus*; Inhibition of egg hatching assay; Anthelmintic

Introduction
Heterotheca inuloides cass, commonly called Arnica montana, has been used as an anti-inflammatory in animals and humans and is widely related to topical and oral use. On the other hand, *Haemonchus contortus* causes severe infections in small ruminants related to its hematophagous characteristic and therefore localized inflammation. The objective of this work was to determine the ovicidal effect of *Heterotheca inuloides cass* (Arnica montana) on *Haemonchus contortus* eggs in vitro.

Material and methods
H. contortus eggs were obtained from a donor animal and were challenged with the following treatments: ethanolic extract of *H. inuloides cass* at concentrations of 2.5, 5, 20, 30, 40, 50, 60, 80 and 160 mg/ ml, distilled water was used as a negative control and ivermectin (5 mg/-ml) as a positive control. To solubilize the extract, a dispersion with polyvinylpyrrolidone was used. The data obtained was analyzed through the SAS program using the PROBIT tool.

Results and discussion
The LC50 was obtained at 12.20 mg/ml (10.56–13.87 mg/ml) and the LC90 at 52.01 mg/ml (47.08–57.72 mg/ml). The ethanolic extract of *Arnica montana* showed a concentration-dependent effect on *H. contortus* eggs, in addition to reaching 100% lethality using low concentrations. In conclusion, *H. inuloides cass* has a lethal effect on *H. contortus* eggs, inhibiting their hatching.

Conclusion and implications
Heterotheca inuloides cass showed an ovicidal effect at a concentration of 80 mg/ml, which can be considered the lethal concentration 90. *Haemonchus contortus* eggs exposed to the ethanolic extract show inhibition of development and could be considered subject to further studies on its anthelmintic capacity once herbal alternative that favors the integrated control of parasites.

Uncited references
Rodríguez et al. (2003), Rodríguez-Chávez et al. (2015), Soto-Islas (2018).

Acknowledgements and funding
This research received financial support from Project: Support Program for Research and Technological Innovation Projects (PAPIIT-UNAM), titled: Evaluación del efecto tóxico del extracto *n*-hexánico de *Artemisia cina* y cinaguaiacina sobre los parámetros bioquímicos en sangre y alteraciones anatomopatológicas en ratas Wistar después de su administración por vía oral (IA204822).

References

Rodríguez, N., Durand, R., Bulnes, C., Gallardo, Y., Muñoz, M., Rodríguez, J., 2003. Mortalidad en ovinos como consecuencia de la infestación por *Haemonchus contortus* y *Moniezia expansa*. Salud Animal. 25 (2).
Rodríguez-Chávez, J.L., Coballase-Urrutia, E., Sicilia-Argumedo, G., Ramírez-Apan, T., Delgado, G., 2015. Toxicological evaluation of the natural products and some semi synthetic derivatives of *Heterotheca inuloides* Cass (Asteraceae). J. Ethnopharmacolo. 175, 256–265.
Soto-Islas, M., 2018. Caracterización de la actividad biológica in vitro de compuestos fenólicos presentes en *Heterotheca inuloides cass* en dos estadios de desarrollo. Tesis de licenciatura. Universidad Autónoma del Estado de Hidalgo. Instituto de Ciencias Básicas e Ingeniería. Disponible en: dgsa.uaeh.edu.mx:8080/bibliotecadigital/bitstream/handle/231104/2161/.

doi: 10.1016/j.anscip.2023.01.122

O-047
Anthelmintic resistance in sheep and goat: Results of faecal egg count reduction tests and associated risk factors

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Keywords: Anthelmintic; Efficacy; Faecal egg count; Risk factors

Introduction
Gastrointestinal parasitism remains, in sheep and goat populations with access to grass, one of the first causes of morbidity and mortality. Number of studies have demonstrated that the resistance of digestive parasites, and more particularly of nematodes, to antiparasitic molecules has been increasing considerably for several years. Moreover breeders'practices are directly involved in the appearance of resistance mechanisms in parasite populations. In Belgium, few large-scale studies have been conducted to date to evaluate the level of gastrointestinal nematodes resistance and to establish which herd management factors are associated with a loss of efficacy of anthelmintic drugs.

Material and methods
Faecal Egg Count Reduction Tests (FECRTs) were carried out in a number of 30 herds of small ruminants (15 sheep herds and 15 goat herds) spread over Belgian territory in order to assess the efficacy of anthelmintic treatments. The active substances used were freely chosen by the veterinarians and breeders. For each tested drug, 10 animals were rectally sampled at D0 and sampled again 14 days after the treatment (D14). FECRTs were carried out on pooled samples and efficacy was expressed as «normal» or «reduced». The criterion used for defining reduced efficacy was FECR < 95%. In addition, information was collected in these farms through a survey to determine their deworming habits (products used, route of administration, frequency of application, etc.).
Statistical analyses were performed with SigmanPlot® software. The level of significance was set at a *P*-value < 0.05 for all tests.

Results and discussion
Forty-seven percent (7/15) of the goat herds monitored presented a result qualified as "normal". In sheep herds, this percentage was equal to 60% (9/15). Benzimidazoles (BZ) and macrocyclic lactones (MLs) were mainly used in the two species and respectively associated with 50% (4/8) and 65% (13/20) of «normal» results. Levamisole and monepantel were each used on a single farm with «reduced» efficacy for levamisole and «normal» efficacy for monepantel. In goats, eprinomectin employed as pour-on solution was strictly associated with reduced efficacy comparing injectable route.
Moreover, it appears that the following elements are directly correlated with a «normal» efficacy : an annual deworming frequency of two treatments or less, an individual animal weighing for dosage assessment and the use of the oral route or the injectable route to administer anthelmintic drugs.

Conclusion and implications
The results demonstrate a striking lack of efficacy of certain anthelmintic drugs in goat herds as in sheep herds and highlight the importance of the impact of deworming habits on the efficacy of these drugs.

Acknowledgements and funding
The authors will particularly thank the Belgian Sheep and Goat Health Fund for its financial support.

doi: 10.1016/j.anscip.2023.01.123

O-048
Apicomplexa in sheep

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Keywords: Apicomplexa; Sheep; Toxoplasma; Sarcocystis

Introduction
The apical complex is a group of organelles that enable infective stages to enter their host cells. The Apicomplexa can be grouped into those with a direct life cycle, those with an intermediate or prey host, and those that have an arthropod vector. Evolving imaging technology, augmented by immunological and molecular advances, has seen more than a century of development in the way these parasites are identified and taxonomically classified. The latter two technologies have also enabled the identification of previously unrecognised antigenic proteins, many of which are shared between genera, and some of which hold immunogenic potential, and novel putative targets for chemical intervention.

Material and methods
The author's own database and Google Scholar were interrogated using the search terms "apicomplexa, sheep, toxoplasma, neospora, sarcocystis, babesia, theileria".

Results and discussion
Cryptosporidium and *Eimeria* spp have direct life cycles (homoxenous), infect the intestinal mucosa epithelium, thrive under conditions of high stocking densities, and are clinically characterised by diarrhoea. They are immunogenic and hence pose a bigger threat to younger and immunocompromised animals than healthy adults. Management of coccidiosis relies heavily on chemical intervention, which can be alleviated by hygiene measures aimed at separating animals from their excreta as much as possible.
Neospora caninum, *Sarcocystis* spp, and *Toxoplasma gondii* are all characterised by the formation of tissue cysts containing dormant bradyzoites in a wide variety of intermediate host species. They are heteroxenous, with a predator-prey life cycle, even though transplacental vertical transmission has also been shown to occur. Their pathological impact ranges from carcase downgrading/trimming/condemnation on aesthetic grounds, to production and reproduction loss, to serious concern for public health. Some of them cause macroscopically recognisable lesions, but some require detection and identification by serological or molecular means.
Biological transmission by either single-host ticks, as in the case of *Babesia motasi*, where trans-ovarian transmission is necessary for continuity, or multi-host ticks, with trans-stadial transmission, as for *Theileria* spp., characterises the third group.

Conclusion and implications
Apicomplexa vary in the risk they pose to economical sheep production, native wildlife survival, and public health. Preventing spillage from processing plants' effluent ponds is important for avoiding contamination of water sources. Of greater concern than the direct impacts on sheep production, is the threat posed by tissue cysts containing bradyzoites that have in recent decades been shown to be zoonotic in the case of e.g., *T.gondii* and *Sarcocystis* spp. Immunological control in intermediate hosts is theoretically possible, but thus far only commercially achieved against *T.gondii* in sheep.

Acknowledgements and funding
The literature search was conducted at the owner's own time and expense. No funding was received.

doi: 10.1016/j.anscip.2023.01.124

O-049
Results from the Norwegian surveillance programmes in sheep

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Keywords: Disease status; Notifiable diseases; Sheep; Surveillance programmes

Introduction
Norway is in a unique position in Europe regarding the absence or low occurrence of many serious contagious animal diseases. Some surveillance programmes are compulsory according to EU regulations, while others are national programmes initiated by Norwegian authorities. The surveillance programmes in sheep were established in 1997 (scrapie), 2003 (small uminant lentivirus infections, i.e. maedi-visna and caprine arthritis encephalitis), 2004 (*Brucella melitensis*) and 2014 (ovine footrot). The scrapie and *Brucella* programmes are designed in accordance with Regulation (EC) No 999/2001 and Council Directive (91/68/EEC), respectively. In the following, the main results from the surveillance programmes in sheep in Norway from the last ten years are reported.

Material and methods
The Norwegian Food Safety Authority is the governmental body responsible for the surveillance programmes and performs inspections and collects test samples. Hoof inspectors trained and employed by the Norwegian Meat and Poultry Research Centre (Animalia) inspect for footrot and collect samples in slaughterhouses. The Norwegian Veterinary Institute performs the laboratory analyses, operate surveillance programmes and advice governing authorities. The analyses are performed using Rose Bengal test on blood samples (*Brucella melitensis*), ELISA on brain and blood samples (scrapie and lentivirus infections, respectively) and PCR on hoof swabs (footrot / *Dichelobacter nodosus*).

Results and discussion
Brucella melitensis has never been detected in Norway, and EFSA granted Norway disease-free status for *Brucella melitensis* in April 2021. Classical scrapie has not been reported in Norwegian sheep since 2009. Five to 16 cases of Nor98 / atypical scrapie are detected each year. Antibodies against small ruminant lentivirus was detected in the Norwegian surveillance programme in 2019 in a sheep flock in Trøndelag county. This led to an epidemiological investigation, and in total nine positive herds were detected in the outbreak. The disease has not been detected in sheep since 2020. Footrot was detected in the surveillance programme in 2017 and lead to the detection of seven other infected herd. The last detected case of virulent footrot in Norway was in 2019. Limited import of animals, strict regulations on movement of small ruminants, good registers of livestock and diseases, relatively small herd sizes and Norway's geographical location and cold climatic conditions, may all have contributed to the unique animal health situation in Norway.

Conclusion and implications
The Norwegian surveillance programmes in sheep in 2013 to 2022 have contributed to detection and control of important notifiable diseases, and documentation of animal health. The results from the programmes document the good health status in sheep in Norway, and the programmes have contributed to preserve good sheep health and welfare.

doi: 10.1016/j.anscip.2023.01.125

O-050
Sheep surveillance activities: A shield against emerging sheep disease threats in the European territory

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Keywords: Control; Disease; Preparedness; Surveillance

Introduction
The recently introduced Animal Health Law in the European Union describes the special measures that need to be taken against animal diseases, which do not normally occur in the Union. Emerging, transboundary, transmissible diseases can have significant adverse repercussions on animal health, on animal welfare, on trade activities and on livestock sustainability. The wide variety of geographical and climatic particularities in Greece, coupled with an extensive borderline pose a high risk of disease incursion into the country.

Material and methods
Clinical and passive surveillance for diseases is an integral part of all veterinary activities in the entire territory of the country. Additionally, targeted active surveillance in sheep in the administrative regions of Central Macedonia, Eastern Macedonia-Thrace, Northern Aegean and Southern Aegean (specifically in the islands of Rhodes and Kos) is also in place; this includes clinical examinations for foot-and-mouth-disease, peste-de-petits-ruminants and sheep-pox, as well as sampling and serological testing for foot-and-mouth-disease and peste-de-petits-ruminants. Simultaneously, in the Thrace region of Greece, Bulgaria and Turkey similar surveillance work is performed within the framework of a specific Transboundary High Risk Area Coordinated Epidemio-surveillance ('THRACE') programme. Further, assessment of surveillance results, awareness campaigns, simulation exercises, training activities and observation of the epidemiological evolution of diseases worldwide are performed continuously by the central veterinary service of the Ministry of Agriculture and Food of the country, with the aim to enhance preparedness and to improve contingency planning in cases of disease confirmation.

Results and discussion
During the period 2018–21, approximately 190,000 sheep were clinically examined for foot-and-mouth-disease, peste-de-petits-ruminants and sheep-pox. Moreover, approximately 78,500 blood samples were collected and tested serologically for foot-and-mouth-disease

and peste-de-petits-ruminants, always with negative results. No cases of foot-and-mouth-disease have been diagnosed in Greece since 2000, whilst peste-de-petits-ruminants has never been detected in the country. Sheep-pox (36 outbreaks) was diagnosed in the island of Lesvos, during the period 2016–18. On that occasion, the national contingency plan was immediately activated (stamping out, zoning, animal movement restrictions, intensive clinical investigation etc.) and the disease was contained in the island and fully controlled. No further outbreaks have been confirmed in the country ever since.

Conclusion and implications
In areas of high-risk for disease incursion, the level of awareness by veterinary authorities, practicing veterinarians and farmers is high. Continuous measure implementations is necessary in these areas for the prevention of introduction of exotic diseases into the European Union; these aim to improve early detection of an incursion and enhance preparedness. Joint actions and establishment of collaborative networks at national and cross-border levels strongly support and enhance the effectiveness of the surveillance systems in place.

doi: 10.1016/j.anscip.2023.01.126

O-051
A participatory journey to understand barriers to sheep scab control in Northern Ireland: Notifiable disease status and state authorities – help or hindrance

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Keywords: Sheep scab; Farmers; State authorities; Participatory

Introduction
Sheep scab is endemic throughout the United Kingdom (UK); however Northern Ireland (NI), where scab remains notifiable, lagged the other countries of the UK in control initiatives. A farmer-driven group of sheep-sector representatives was formed to address the lack of action on scab in the NI flock. In particular this group focused on barriers farmers and industry faced breaking the taboo about scab and improving scab control. This group recognised the limitations they faced progressing scab control without signficant current data to present to industry and state authorities, highlighting the inpact of the disease. This paper focuses on the participatory journey, and the barriers to scab control the group encountered since beginning in 2019.

Material and methods
Mixed methods were used to investigate the barriers to scab control in NI. An open knowledge exchange meeting, followed by discussion groups, were used to initiate the process between 2019 and 2022, led by sheep-sector representatives. Following a partnership with established animal health institutes, grant funding was obtained, which supported a series of six knowledge exchange meetings across NI in the summer of 2022 followed by funding for 100 on-farm diagnostic visits in response to suspected cases of sheep scab. These visits were conducted by the farm's own veterinarian, with free diagnostic blood testing and subsidised flock treatment provided where scab was diagnosed. Finally, a national survey was undertaken, which was openly accessible online for all NI sheep farmers, with copies sent to a randomly selected sample of 600 NI sheep farmers with a pre-paid return envelope provided.

Results and discussion
Knowledge gaps and a lack of authoritative data on the distribution or prevalence of sheep scab, despite its notifiable status, were identified. In particular farmers had limited knowledge of diagnostic tests and treatment protocols, lacked the statutory competency certificate required to purchase and use sheep dip, or suitable facilities for dipping on-farm. State authorities' figures on the annual rate of scab outbreaks were considered to be unrecognisably low by stakeholders. Their low prevalence data led the officials to question the need for better control. Farmers and veterinarians reported distrust between farmers and state officials leading to a failure to report scab outbreaks.

Conclusion and implications
Currently state authorities take a passive approach to scab control based on low disease reporting levels. This data is being compromised, in part, because farmers are reluctant to engage with state officials due to concern about the consequences, including possible flock restrictions, of disclosing concern about a scab outbreak in their flock. A fresh approach is being developed to overcome this present impasse through meaningful participatory action, with encouraging levels of uptake of the self-reporting scheme to provide a stepping-stone to national scab control.

Acknowledgements and funding
BBSRC award (BB/W020521/1).

doi: 10.1016/j.anscip.2023.01.127

O-052
Detecting genetic disorders by routine post mortem monitoring: Type 1 primary hyperoxaluria in Zwartbles Sheep and epidermolysis bullosa in Bleu de Maines

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Keywords: Genetic disorde; Sheep; Hyperoxaluria; Epidermolysis bullosa

Introduction
After initial findings of severe oxalate nephropathy ($n = 4$) in the UK in 2011, more cases ($n = 5$) in Zwartbles sheep were detected at GD. Primary hyperoxaluria, a rare autosomal recessive metabolic disease, leads to an accumulation of calcium oxalate in various tissues that finally results in renal failure. Epidermolysis bullosa is an innate genetic disorder in which the epidermis is separated from the dermis by little friction due to mutations in structural anchoring proteins at the dermal-epidermal junction. In 2022, three Bleu du Maine lambs were diagnosed with epidermis bullosa by GD.

Material and methods
Routine necropsies for national monitoring purposes revealed phenotypes consistent with both distinctive genetic disorders in these specific breeds. Consequently genetic marker tests are being developed in collaboration with VHL.

Results and discussion
Zwartbles lambs that died between one and four months of age showed clinical signs varying from sudden death to growth retardation, dyspnoea, and fever. On post mortem examination, macroscopic findings were consistent for all five cases, revealing a moderate to good body condition score and an urine-like smell of the carcass. Kidneys showed pale firm cortices with medullary atrophy, and prominent dilation of calyces and pelvices. Histopathological analysis revealed severe chronic tubulointerstitial crystalline nephropathy with numerous intralesional oxalate crystals.
Macroscopic findings of two six weeks old, and one two month old Bleu du Maine lamb revealed hoof sloughing as well as multiple ulcerations on the head, oral cavity, skin over the carpal and tarsal joints, and on the ruminal pillars. Histopathology of the skin and hoofs showed abrupt subepidermal clefts, epidermal detachment directly above the basal membrane, and ulceration without significant inflammation. Cleft formation was observed above the PAS-positive basement membrane.
In 2020, a collaboration between Switzerland, UK and the Netherlands resulted in a detailed description of deleterious AGXT missense variant associated with type 1 primary hyperoxaluria (PH1) in Zwartbles Sheep. VHL designed a genetic marker test for commercial use. In collaboration with Dutch Zwartbles breeder associations nearly three hundred sheep were genetically tested, revealing a carrier percentage of approximately 20%.
Epidermolysis is a heterogenous heritable genetic disease comprising of different mutational and phenotypic subtypes.
Epidermolysis bullosa occurs across species, and is known as "butterfly disease" in humans. In sheep the disease has been reported in various breeds, amongst which Corriedales, Suffolks, Black headed mutton, and Mouton Vendéen sheep, but not yet in Bleu du Maines. VHL is currently working on a genetic marker test.

Conclusion and implications
Genetic testing allows accurate diagnosis of genetic disorders in animals with suspect clinical phenotypes and, it enables breeders to apply selective breeding.

Acknowledgements and funding
Institute of Genetics, Switzerland.
SRUC Consulting Veterinary Services, UK.
Ministry of Agriculture, Nature and Food Quality, the Netherlands.

doi: 10.1016/j.anscip.2023.01.128

O-053
Pathological and immunohistochemical evidence of a possible *Francisellaceae* family member causing ovine abortion in Uruguay: Should we be concerned about tularemia in South America?

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Keywords: Abortion; Sheep; Francisella; Uruguay

Clinical history
In July 2015, 2 of ∼200 (∼1%) pastured sheep in a farm in Colonia, Uruguay, aborted at ∼4 months of gestation.

Investigations
Fetal autopsy revealed enlarged liver with rounded edges, myriad discrete white to yellowish <2 mm in diameter foci disseminated throughout the hepatic parenchyma (severe multifocal widespread necrotizing hepatitis), and moderate fibrinous peritonitis and pericarditis.
Tissues (liver, adrenal gland, spleen, lung, heart, kidney, and brain) were fixed in formalin and routinely processed for histopathology. Microscopic examination revealed severe acute multifocal random fibrinonecrotizing neutrophilic and histiocytic hepatitis, multifocal neutrophilic myocarditis, and pneumonia.
Formalin-fixed paraffin-embedded sections of liver were processed by immunohistochemistry using a primary mouse monoclonal IgG3 antibody against *Francisella tularensis* lipopolysaccharide (Thermo-Fisher Scientific, clone T14, MA1-21691). The immunohistochemistry revealed strong abundant intralesional granular immunoreactivity in the necrotic foci, which was largely intracytoplasmic in infiltrating neutrophils and macrophages.
Formalin-fixed sections of liver were processed for transmission electron microscopy. Despite autolysis, intra-histiocytic and extracellular ∼0.7–1.7 μm gram-negative coccobacilli colocalized with the foci of necrotizing hepatitis.

Differential diagnosis
Toxoplasma gondii, *Chlamydia* spp., *Listeria monocytogenes*, *Salmonella* spp., and *Coxiella burnetii* were ruled out by immunohistochemistry in liver. No intralesional curved bacilli (*Campylobacter*) or spirochetes (*Leptospira*, *Flexispira*, *Helicobacter*) were observed with Steiner's silver stain. No intralesional fungi were observed with Gomori's methenamine silver stain. No intralesional bacteria were observed with tissue Gram stain.

Discussion
The *Francisellaceae* family comprises gram-negative coccobacilli, with four currently recognized genera, of which only *Francisella* is of clinical relevance. *Francisella tularensis* is the type and most studied species, as it causes tularemia, a highly transmissible, potentially life-threatening zoonotic disease.
Sheep have been regarded as the only livestock species affected by epizootics of tularemia and have been implicated in disease transmission to humans. The abortifacient effects of *F. tularensis* in sheep have been described in the USA, and tularemia has been regarded as an overlooked syndrome in this species.[1]
The etiologic diagnosis in our case was based on the immunohistochemical demonstration of abundant intralesional *F. tularensis* lipopolysaccharide antigen. Immunohistochemistry has proved useful in the diagnosis of tularemia (O'Toole et al., 2008). However, definite genus/species identification would have required bacterial isolation and/or DNA analysis.
Tularemia occurs over almost the entire Northern Hemisphere; however, it is very rarely reported in the Southern Hemisphere, with published cases restricted to Australia. South America has been considered free of tularemia; this status seems to be based solely on the lack of disease reporting. However, tularemia may have been undiagnosed considering the limitations of disease surveillance systems in the region. Our results raise concerns about the possible occurrence of tularemia in South America.

Acknowledgements and funding
INIA's grant PL_27.

Reference
O'Toole et al., 2008. Tularemia in range sheep: an overlooked syndrome? J. Vet .Diagn. Invest. 20, 508–513.

doi: 10.1016/j.anscip.2023.01.129

O-054
Rapid whole flock trans-thoracic ultrasound examination with immediate culling reduces the prevalence of ovine pulmonary adenocarcinoma in commercial flocks

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Keywords: Ovine pulmonary adenocarcinoma; Ultrasonography; Control; Animal welfare

Introduction
Ovine pulmonary adenocarcinoma (OPA) is an infectious neoplastic lung disease of sheep caused by Jaagsiekte sheep retrovirus (JSRV). The disease is invariably fatal and a significant welfare concern during the agonal stages. Currently, there is no commercially available diagnostic test to identify all individual sheep in a flock with OPA tumours, and therefore no control strategy. This study investigated whether culling sheep with suspected ovine OPA, based upon rapid, 6–12 monthly flock screening of all adult sheep using trans-thoracic ultrasound examination, reduced annual incidence.

Material and methods
Both sides of the chest of all adult sheep in 31 commercial flocks in the United Kingdom were scanned using a 6.5 MHz microarray probe connected to a real-time, B-mode ultrasound machine at a rate of 120–150 animals per hour. Video recordings of all lung and pleural lesions were captured using Elgato software. The specificity and sensitivity of this method for detecting macroscopic OPA lesions, based upon 540 necropsies, has been reported elsewhere. There were no changes to farm husbandry practices. Progeny of culled ewes could not be identified and were not routinely culled. Standard veterinary fees corresponding to 150 euros/hour were charged.

Results and discussion
Farms have joined the programme at various stages over the past seven years; four years' data are presented to provide meaningful flock numbers. 19,100 sheep from 21 commercial sheep flocks scanned twice during year 1 yielded 545 sonograms consistent with OPA (2.9%). Ten flocks, comprising 9650 adult sheep, scanned six times over three years, had 289 OPA cases (3%) in year 1, 172 (1.8%) in year 2, and 150 (1.6%) in year 3. Data from flocks 6 totalling 6,650 sheep experienced 214 OPA cases (3.2%) in year 1 and 88 (1.3%) in year 4. Flocks scanned annually (15,100 adult sheep) had 223 OPA cases (1.5%) identified when screened in year 1 and 136 in year 2 (0.9%). Six flocks had 64 cases in year 1 and 33 in year 4. The initial reduction in OPA prevalence could be explained by removal of some sheep with tumours developing over more than 12 months and reduced horizontal spread of JSRV achieved by culling sheep with moderate/advanced disease.

Conclusion and implications
Whole flock trans-thoracic ultrasound examination and immediate culling of all suspected cases reduced the OPA prevalence within 12 months in commercial UK sheep flocks with further, but smaller, reductions over the next three years. Clinical audit based upon laboratory confirmation of OPA was essential to ensure accurate interpretation of sonographic findings. These studies, undertaken on UK farms and charged standard veterinary fees, provide data on the expected change in annual OPA incidence with a test and cull policy and expected costs.

doi: 10.1016/j.anscip.2023.01.130

O-055
Applied proteomics in 'One Health' in sheep

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Keywords: Food safety; One Health; Proteomics; Zoonotic infection

Introduction
'One Health' summarises the idea that human health and animal health are interdependent and bound to the health of ecosystems. The purpose of proteomics methodologies and studies is to determine proteins present in samples of interest and to quantify changes in protein expression during pathological conditions. The objectives of this presentation are (a) to review the application of proteomics technologies within the One Health concept in sheep and (b) to appraise their role in the elucidation of diseases and situations relevant to One Health.

Material and methods
The study develops in two parts. The first refers to proteomics applications in zoonotic infections and will explore the use of proteomics for studying pathogenetic pathways, transmission dynamics, diagnostic biomarkers and novel vaccines in prion, viral, bacterial, protozoan and metazoan zoonotic infections in sheep. The second refers to proteomics applications in mechanisms of antibiotic resistance development and novel discoveries about antibiotic resistance.

Results and discussion
The applications of proteomics in One Health primarily include the control of zoonoses. These aim to study the protein–protein interactions or post-translational modifications involved in pathogenesis of diseases, as well as detecting biomarkers for early diagnosis and therapeutic targets. Proteomics studies of mechanisms of adapting resistance by various bacteria to antimicrobial agents have also been performed. Proteomics have nowadays become an important research tool for life scientists because of their use of protein characterisation and biomarker discovery.

Conclusion and implications
Proteomics implements high-throughput technologies, which are constantly improving. The rapid evolution of these technologies allows the production of large-scale data on the DNA, RNA and protein levels in various tissues. Further, sophisticated computational tools can help to integrate those datasets, with the aim to enhance information. Such data are continuously employed in approaches when the complete genome has not been completely sequenced, as is the case with some farm animals, including sheep. Concurrently, technological advancements in the area of mass spectrometry, the success of the genome projects and the development and wide dissemination of bioinformatics tools have contributed to the advancement of the proteomics approaches and methodologies. In the future, sensitive analysis of several hundreds of proteins, including the low-abundant ones in complex biological samples, will be achieved. Proteomics offer novel perspectives in the understanding of the pathophysiology of various infection processes, capitalise on comparative studies to provide answers and provide possible biomarkers for early and accurate diagnosis of diseases and for therapeutic targets. All the above will ultimately enable the implementation of targeted proteomics in clinical laboratory settings, shedding more light on biomarker research and ultimately the promotion of the One Health concept.

doi: 10.1016/j.anscip.2023.01.131

O-056
Productive and metabolic profile of “Elite milking ewes”

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Keywords: Dairy Sheep; Production; Metabolic; Health

Introduction
Genetic improvement on dairy sheep farms provides animals with high productive yields. High levels of production can produce metabolic disorders that should be prevented through proper nutrition. This study tries to find out if the feeding strategies of this type of animals, based on the usual nutritional models, are suitable under practical conditions.
The objective of this work is to compare the results of two types of sheep (Elite and High Production, HP) belonging to the same farm and feeding group, regarding productive parameters and metabolic and health indicators throughout 4 periods set up per lactation (prepartum PREP, early lactation, EL, medium lactation, ML, and late lactation, LL).

Material and methods
A total of 18 multiparous lacaune ewes were randomized into two groups of 9 animals (Elite, with previous lactation of more than 650 liters) and HP (more productive ewes of the farm but without becoming Elite). Individual production data (milk production, MY; percentage of fat, MF, and protein in milk, MP, milk fat and protein production, KgF+P), and body status data (body condition, BCS, live weight, BW) were taken. In addition, some blood parameters, as indicators of metabolic and health status were analyzed (somatic cells account, SCA, transaminases, AST, ALT, beta hydroxybutyrate, BHBT, non-esterified fatty acids, NEFA, glucose, GLU, and calcium, Ca) during each of the 4 periods stablished (PRE, 7–13 days before lambing, EL, 3–38 days after lambing, ML, 49–100 days after lambing and LL, 123–162 days postpartum). Some statistical analysis was performed, both by groups of animals and by periods (ANOVA). Besides, the correlations between the parameters of animal status and metabolic and health parameters and the productive results were also calculated.

Results and discussion
The average of MY obtained was 3.28 liters/day in the Elite group and 2.59 in the HP one. Significant differences between the two groups of animals ($p < 0.001$) in MY and KgF+P were found. The comparison between periods showed significant differences ($p < 0.001$) in BCS, MY, MF, MP, KgF+P, ALT, GLU, NEFA. Although the differences by groups found in our study were expected, in the case of ALT, (in all periods within physiological levels) we need to do more investigations. The most correlated parameter with MY was ALT (0.463, $p < 0.05$)

Conclusion and implications
There are no differences between animals in terms of metabolic and health indicators and milk quality, consequently we can conclude that our feeding strategies are suitably implemented in the practical conditions studied.

Acknowledgements and funding
Thanks to SAT LOS FRANCOS (Spain).

Uncited reference
González-García et al. (2015).

Reference

González-García, E. et al., 2015. The effects of parity, litter size, physiological state, and milking frequency on the metabolic profile of Lacaune dairy ewes. Domes. Anim. Endocrinol. 50, 32–44.

doi: 10.1016/j.anscip.2023.01.132

O-057
Symmetric dimethylarginine as an early serum parameter to detect kidney injury in sheep and goats

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Keywords: SDMA; Cachexia; Renal function; Small ruminants

Introduction
Conventional parameters to assess renal function like serum creatinine and urea concentrations are very variable related to the patienťs age, body mass, breed and diet. In this context, serum creatinine depends closely on the total number of muscular cells and urea or blood urea nitrogen concentrations are directly influenced by alimentary protein content. Also the sensitivity levels of these parameters are heavily restricted, since detection of kidney injury is only possible when glomerular filtration rate is already reduced to less than 40 %. In companion animals like cats and dogs, new renal biomarkers such as symmetric dimethylarginine (SDMA) are hence increasingly utilized to improve the diagnosis of early kidney diseases. SDMA, in contrast to creatinine, is produce by all types of cells. Although direct kidney damage generally plays a minor role in small ruminants, the use of this relatively new parameter in sheep and goats may facilitate the detection of subclinical kidney damage by phytotoxins and the ante mortem diagnosis of cachexia. This study therefore aims to provide reference values for SDMA in small ruminants and to investigate renal specificity and demographic independence of this serum parameter in its application within two so far completely new species.

Material and methods
SDMA concentrations were measured applying a commercial competitive ELISA in serum samples from a total of 111 sheep and 89 goats. The animals were presented for treatment at the Clinic for Swine and Small Ruminants at the University of Veterinary Medicine Hannover, Germany, between 2016 and 2021. Reference values were determined by bootstrapping and confidence intervals of serum SDMA concentrations in a subpopulation of clinically healthy animals with creatinine concentrations within the reference range. Correlation analyses and Wilcoxon tests for independence of SDMA from demographic factors such as age, body mass and sex and correlation to serum creatinine were performed on a study population additionally including animals with clinical abnormalities and elevated serum creatinine concentrations to achieve high variance in the data set. In addition, a small group of sheep with clinically severe emaciation, low serum creatinine and high serum urea values was examined to test the possibility of a clinical ante mortem diagnosis of cachexia. Results were compared with post mortem findings.

Results and conclusion
Since a significant correlation between SDMA and creatinine concentrations in serum was demonstrated in both species, and SDMA seems less depending on age and body mass compared to creatinine, this new biomarker might be highly interesting for the application also in sheep and goats. Nevertheless, this retrospective investigation can only serve as a pilot study and is not able to replace a systematic evaluation of serum SDMA in small ruminants on a larger number of individuals with more precise information on kidney condition.

doi: 10.1016/j.anscip.2023.01.133

O-058
Isolation and molecular characterization of orf virus strains from sheep and goats clinical cases

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Keywords: Ecthyma; Characterization; Virus isolation; Spain

Introduction
Orf virus (ORFV) is the etiological agent of contagious ecthyma, a worldwide distributed disease with significant economical impact. The disease affects mainly sheep and goats, but the virus can infect another ruminants and also humans. Previous studies describe the genetic diversity of ORFV which is associated with the geographical origin of the strains. Although the disease is present in our country, there is no information about the diversity of viral strains circulating in our small ruminant industry. This study describes the preliminary results of isolation and molecular characterization of ORFV strains in sheep and goat flocks from the Iberian Peninsula.

Material and methods
A total of 61 clinical cases of sheep (n = 47) and goats (n = 14) compatible with contagious ecthyma were received in our lab during 2019-2022. Skin swabs or scabs samples came from 13 Spanish provinces (n = 56) and Portugal (n = 5). Identification of ORFV was performed by using a commercial qPCR kit (EXOone ORF virus) which targets the B2L gene. A representative selection of positive cases, 17 from Spain and 4 from Portugal, were further sequenced for the complete B2L gene in order to perform phylogenetic analysis. Additionally, in 10 clinical cases with positive results, viral isolation was performed in primary kidney cells following previously described protocols.

Results and discussion
Orf virus was detected by qPCR in 64% of evaluated samples, mainly in goats (86%) than sheep (57%); with identification of this virus in farms from all different Spanish provinces. Complete sequences of B2L gene were obtained for the 21 selected cases and phylogenetic analysis showed two main clusters corresponding to the ovine (n = 11) and caprine (n = 10) origin of the samples. This genetic divergence associated to the host specie, has been also recently described with ORFV strains from the Sardinia region in Italy. The main cluster of ORFV strains from sheep origin also showed two main internal subgroups, suggesting a more broad diversity of this virus in sheep than in goats. Successful virus isolation was performed in 7 of 10 samples, with cytopathic effects observed between 3 and 5 days post inoculation and consisting of cell rounding and detachment. High viral loads (10^5–10^6 TCID50/mL) were obtained from infected cell cultures.

Conclusion and implications
This study showed a wide distribution of ORFV infection in the small ruminant farms in our country; but also a high genetic diversity for the virus strains from sheep and goats origin. Our data supports previous findings about the genetic differentiation between ORFV strains from these two related animal species. Knowledge of ORFV heterogeneity is also relevant to adopt adequate control and immunization measures against this disease. The successful isolation of this virus may also be useful to implement diverse experimental studies, but also future immunization methods.

doi: 10.1016/j.anscip.2023.01.134

O-059
Haemodynamic parametres of blood flow in the umbilical artery: Healthy ewes *versus* ewes with pregnancy toxaemia

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Keywords: Doppler; Pregnancy toxaemia; Sheep; Ultrasonography

Introduction
The objectives of the work were to study the haemodynamic characteristics of blood flow in the umbilical artery of ewes during the final stage of gestation and identify differences between healthy animals and ewes with pregnancy toxaemia.

Material and methods
Seventeen pregnant ewes, all bearing twins, were included in the study after 130th day of gestation; of these, 7 animals were controls with blood values of β-hydroxyburate <1.0 mmol/L and 10 animals had blood values of β-hydroxyburate >2.0 mmol/L. Animals were examined repeatedly, every five days until lambing, with pulsed-wave Doppler examination of the umbilical arteries. The examinations were per-

formed with the ewes on standing position, using a microconvex transducer with frequency 5.0–8.0 MHz and 120 mm scanning depth. Measurements were taken at the entrance of the umbilical artery on the abdomen of each foetus. At least three consecutive, continuous spectral waveforms were taken during each examination. The following ultrasonographic parametres were calculated: (a) diametre of the umbilical artery, (b) resistance index, (c) pulsatility index, (d) mean velocity, (e) end diastolic velocity of blood flow and (f) blood volume.

Results and discussion

Throughout the study, i.e., from 130th day of gestation to lambing, significant differences were found between healthy ewes and ewes with pregnancy toxaemia in the mean diametre of the umbilical artery (0.76 cm *versus* 0.67 cm, respectively; $p < 0.0001$), the mean pulsatility index (0.99 *versus* 1.88; $p = 0.004$), the mean velocity (0.38 cm s^{-1}*versus* 0.31 cm s^{-1}; $p < 0.0001$) and the mean blood volume (1027 mL *versus* 743 mL; $p < 0.0001$) at the entrance of the umbilical artery on the abdomen of each foetus. No significant differences between the two groups of ewes were seen for the mean resistance index (0.65 *versus* 0.66 c after day 130 of pregnancy, respectively; p=0.61) and the mean end diastolic velocity of blood flow (0.22 cm s^{-1}*versus* 0.21 cm s^{-1}; $p = 0.54$). This lack of significant difference in the resistance index and the end diastolic velocity of blood flow between the two groups of ewes indicates that the reduced blood volume in the umbilical artery in ewes with pregnancy toxaemia, is of maternal origin, as the foetal vascular elasticity did not appear to be affected. The reduced blood volume into the foetus of ewes with pregnancy toxaemia may account for the increased perinatal mortality of newborns from such ewes.

Conclusion and implications

Doppler ultrasonographic examination can be employed in ewes during the final stage of gestation for assessment of the blood perfusion to foetuses. This can be a predictor for risk for peri-parturient problems and neonatal death. The results can guide the attending veterinarian towards the appropriate health management strategy for animals with pregnacy toxaemia.

doi: 10.1016/j.anscip.2023.01.135

O-060
Hematological profile of maedi-visna seropositive dairy sheep

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Keywords: Hematological parameters; Maedi-visna; Dairy sheep; Seropositive

Introduction

Scientific evidence to support hematological changes in maedi-visna (MV) infected sheep is limited. The objective of the study was to assess the effect of MV seropositivity on hematological parameters of naturally infected dairy sheep.

Material and methods

A total of 582 Chios and Lacaune milking ewes, at the last stage of lactation from four intensive MV-positive farms were used for the study. For each individual ewe a physical examination was performed and information regarding age, breed, body condition score, and the occurrence of arthritis, respiratory disease, mastitis, udder and body abscesses were recorded. Also, a serum and a whole blood sample were collected for the detection of SRLV-specific antibodies (ELISA, CAEV/MVV Total Ab Test, IDEXX) and the hematological analyses (Mindray BC-30Vet) which included: white blood cell count (WBC), granulocyte count (GC), lymphocyte count (LC), monocyte count (MC), percentages of granulocytes (GP), lymphocytes (LP), and monocytes (MP), red blood cell count (RBC), hemoglobin concentration (HGB), hematocrit (HCT), mean values of corpuscular volume (MCV), corpuscular hemoglobin (MCH), and corpuscular hemoglobin concentration (MCHC), red cell distribution width coefficient of variation (RDW-CV) and standard deviation (RDW-SD), platelet count (PLT), mean platelet volume (MPV), platelet distribution width (PDW), plateletcrit (PCT), platelet large cell count (P-LCC), and platelet large cell ratio (P-LCR). Analysis of covariance (SPPS v23) was used to assess the effect of MV serological status on hematological parameters, after adjusting for the random effect of farm, and the effects of breed, age, the occurrence of specific disorders (fixed effects), and BCS (covariate).

Results and discussion

Seroprevalence at the animal level was 52.1% (303/582). Prevalence of arthritis, respiratory disease, and mastitis was 12.2% (71/582), 4.8% (28/582), 1.2% (7/582), respectively. Udder and body abscesses were found in 12.7% (74/582) and 3.6% (21/582) of the ewes, respectively. MV seropositive animals had significantly higher values of MCV (0.69fL, 95% CI, 0.18–1.20, $P < 0.01$), MCH (0.26pg, 95% CI, 0.09–0.43, $P < 0.01$), MPV (0.1fL, 95% CI, 0.03–0.17, $P < 0.01$), PDW (0.11, 95% CI, 0.05–0.17, $P = 0.001$) and P-LCR (1.23%, 95% CI, 0.1–2.36, $P < 0.05$), and lower value of PLT (32.6 $\times$ 109/L, 95% CI, 3.2–61.9, $P < 0.05$) compared to seronegative animals. Clinically healthy animals had significantly lower LC and LP and higher GP and MP ($P < 0.05$).

Conclusion and implications
Hematological profile of MV seropositive ewes corresponds to macrocytic anaemia and thrombocytopenia. The diagnostic value of hematological analyses in the differential diagnosis of MV needs to be further investigated.

Acknowledgements and funding
The implementation of the doctoral thesis was co-financed by Greece and the European Union (European Social Fund-ESF) through the Operational Programme «Human Resources Development, Education and Lifelong Learning» in the context of the Act ‘‘Enhancing Human Resources Research Potential by undertaking a Doctoral Research” Sub-action 2: IKY Scholarship Programme for PhD candidates in the Greek Universities».

doi: 10.1016/j.anscip.2023.01.136

O-061
Administration of vaccines in dairy sheep farms: Patterns of vaccination, associations with health and production parameters, predictors

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Keywords: Farmer; Health management; Sheep; Vaccine

Introduction
This presentation reports findings regarding patterns of vaccine usage in sheep flocks throughout Greece. The objectives of the study were (a) to describe the patterns of vaccine administration in sheep farms and (b) to highlight factors that were associated with vaccinations in the farms.

Material and methods
A study was performed in 325 dairy sheep flocks in Greece. The farms were visited and an interview was used with the farmers using a structured questionnaire. Vaccinations against brucellosis (*Brucella melitensis*), chlamydial abortion, clostridial infections, contagious agalactia, contagious ecthyma, footrot, paratuberculosis, pneumonia or staphylococcal mastitis were considered. Univariable analysis of associations was performed, followed by creation of multivariable models as appropriate.

Results and discussion
Vaccination against brucellosis, which is legally implemented in the country as part of the national campaign to eradicate the infection, was performed in all farms (in 100.0%) into the study. Among the other vaccinations, anti-clostridial vaccination was the one most frequently performed (in 97.2% of farms), followed by vaccination against contagious agalactia (in 57.2% of farms), pneumonia (in 44.3%), chlamydial abortion (in 40.0%), staphylococcal mastitis (in 38.8%), paratuberculosis (in 3.4%), foot-rot (in 1.5%) and contagious ecthyma (in 0.9%); vaccination against toxoplasmosis was not reported (in 0.0% of farms). On average, 2.8 optional vaccinations (i.e., additionally to vaccination against brucellosis) were performed in the farms. The increased number of vaccines administered was associated with a higher average milk production in the respective farm. There was an association of vaccination against staphylococcal mastitis with a reduced recovery of staphylococci from the bulk-tank raw milk. In multivariable analyses, significant associations of the administration of the various optional vaccines were seen with 15 variables, 11 related to health management practices and 4 related to the demographic characteristics of farmers. The collaboration with a veterinarian, the management system applied in the farms and the farmers’ general education were each associated with the administration of vaccines against two of the above infections.

Conclusion and implications
The study explored the vaccination patterns in small ruminant farms. Internationally, vaccinations have contributed to controlling many major infectious diseases, despite the misinformation and the unsubstantiated resistance to their use. The correct implementation of vaccination programs, based on sound scientific principles and full compliance with established regulations and policies, are important for the improvement of the welfare of farm animals. Although most sheep farms function at a low technological level, this species is important in the agricultural industry in Greece. Moreover, as the use of vaccines would contribute to decreasing the incidence of the various infections and potentially the use of antibiotics in the farms.

doi: 10.1016/j.anscip.2023.01.137

O-062
Control of *Moraxella boviculi* keratoconjunctivitis through autogenous vaccination

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Keywords: Keratoconjuncitivitis; Vaccination; Moraxella; Sheep

Clinical history
On November 4th 2021 one group of 200 ewes out of a flock of 800 was visited with a complaint of several animals appearing blind. During the visit, several other ewes seemed to be affected. Upon arrival it was clear that the majority of the ewes were either uni- or bilaterally affected. The flock was scattered throughout the field and was responding abnormally to both humans and sheep dogs due to lack of vision. The flock was brought indoors to examine and treat them.

Investigations
On examination, 70% of the flock seemed to be affected. They presented with uni- or bilateral epiphora, blepharospasm, conjunctivitis and corneal oedema. No ulcerations were seen. As this group was to be housed with 3 other breeding groups for lambing in 2 months, it was decided to take conjunctival swabs to determine the causative pathogen.

Differential diagnosis
Possible causative agents for keratoconjuntivitis in sheep are *Moraxella* spp., *Mycoplasma conjunctivae*, *Chlamydia pecorum* and *Listeria monocytogenes*. As the possibility of carriers, the possibility to reach bacterial cure and the possibility to vaccinate differs between those possible agents it was important to reach a diagnosis.

Diagnosis and treatment
Conjunctival swabs of 4 animals were taken and send to the laboratory for bacterial culture. Swabs were streaked out on blood agar and chocolate agar plates and got incubated for 72h at 37 °C. PCRs for Mycoplasma spp. and Chlamydia spp. remained negative. *Moraxella boviculi* was cultured from 3 swabs. To prevent the spread from this group to the other groups during lambing it was decided to vaccinate the flock with an autogenous vaccine as no commercial vaccine is available. For vaccine production the isolated *Moraxella boviculi* strain was propagated, inactivated, and then mixed with a mild mineral oil as adjuvants. The vaccine schedule was set up so that the ewes that had already been in contact with the disease received one vaccination to lower the shedding by potential carriers. The remainder of the flock received two vaccinations 3 weeks apart.

Outcome
During lambing at the end of January, no new ewes were seen to have clinical signs of disease. Up to 5 of the exposed ewes showed some minor discharge or corneal scarring. The flock remained free of disease up until writing of this abstract.

Discussion
Although the disease might have been self-limiting within the flock over a period of time, vaccination was carried out to prevent the ewes from going blind while lambing. This would have greatly impacted the welfare of both ewes and lambs. It also reduced the number of antibiotic and pain relief treatments that would have been carried out during lambing. This case report underlines the positive effects of autogenous vaccination for sheep health.

doi: 10.1016/j.anscip.2023.01.138

O-063
Evaluation of recombinant viral-vectored vaccine against contagious ecthyma in sheep

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Keywords: Orf virus; Sendai; viral vector; ecthyma contagious

Introduction
Orf virus, a member of the parapox genus, is the causative agent of Contagious Ecthyma (CE). In young animals, Orf virus produces painful cutaneous proliferative lesions in the mouth and muzzle that develop into ulcer and crusts, whereas in adults CE can be found in nipples, affecting normal lactation and milking. In CE outbreaks, mortality rarely exceeds 1% but morbidity may reach 90%, being responsible of severe economic losses in all countries. Vaccines are based on attenuated strains of Orf virus that elicit short-lived protection due to its unique immunomodulatory properties. Currently, there is no available vaccines against Orf in Spain and there is a need of new vaccine prototypes against this common infection of small ruminants.

Material and methods
In this work, a recombinant Sendai-based viral vector (SeV-GFP) expressing Orf0059 (SeV-GFP0059) was constructed and used in an *in vivo* challenge for evaluation of antibody production and protection level in sheep. Three groups of 10 adult sheep each were inoculated using an intranasal nebulizer either with recombinant Sev-GFP0059, SeV-GFP, or culture media in the control group. Antibody production was evaluated weekly by a home-made ELISA based on protein 109. Orf virus was isolated from field tissue samples and titrated by Reed and Muench method. After immunization, the experimental groups were infected by needle-free Dermojet syringe inoculation with 10^3 $TCID_{50}$ per animal. Two experimental infections were needed to reproduce lesions associated to Orf virus infection.

Results and discussion
During the experiment, serological reactions to the Orf virus were exclusively observed in animals inoculated with SeV-GFP0059, after the experimental inoculations with Orf virus. Macroscopic results indicated that animals immunized with Sev-GFP0059 did not present lesions compatible with CE. However, 50% of the control group and 20% of the Sendai-based viral vector (SeV-GFP) showed CE compatible gross lesions. Microscopically, minimal lesions were observed in the SeV-GFP0059 group, whereas the other two groups presented the typical severe proliferative dermatitis that characterizes CE. Furthermore, the Sev-GFP0059 group presented a significant nasal-associated lymphoid tissue (NALT) hyperplasia when compared to control and SeV-GFP groups.

Conclusion and implications
These results indicate that the recombinant Sendai-based viral vector with the Orf virus-encoded 0059 gene can protect animals from natural infection, potentially reducing morbidity and economic losses caused by CE.

doi: 10.1016/j.anscip.2023.01.139

O-064
Ultrasonography: A applicable tool for clinical diagnoses of different small ruminants' disorders

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Keywords: Diseases; Goat; Sheep; Ultrasound

Introduction
Pathologies represent a significant barrier to achieving a highly productive flock, mainly impairing its welfare, which makes securing a fast, low-invasiveness, and low-cost diagnosis, as ultrasonography, very important.

Material and methods
A four-year retrospective study (2019–2022) on ultrasound data was carried out in Rio de Janeiro State - Brazil to account and describe the appearance of certain pathologies of small ruminants. A total of 32 animals from Veterinary Farm School's flock and local farmer flocks raised under extensive and intensive management systems were used. All animals were submitted to US scan to reach the diagnosis of their clinical disorders. US were performed using a portable device with a 7.5 MHz linear rectal or 5 MHz convex transducer according to region scanned. In those cases, the sonographic findings were confirmed by a biopsy guided by US and histopathology, or followed by natural death or euthanasia, with posterior anatomopathological examination.

Results and discussion
Among all the cases, it was possible to notice: 5 idiopathic retocolitis (15.62%; 5/25), 3 fetal vitality evaluation indicated to cesarean section (9.38%; 3/32), 3 lymphomas (9.38%; 3/32), 2 uterine tumor (6.25%; 2/32), 2 pleuropneumonia (6.25%; 2/32), 2 spermatic granulomas (6.25%; 2/32), 1 uterine torsion (3.13%; 1/32), 1 vesical prolapse (3.13%; 1/32), 1 visceral caseous lymphadenitis in mesenteric chain (3.13%; 1/32), 1 dental abscess (3.13%; 1/32), 1 gangrenous pneumonia and lung adenocarcinoma (3.13%; 1/32), 1 scapulohumeral dislocation with osteoarthritis and testicular degeneration (3.13%; 1/32), 1 chronic septic arthritis (3.13%; 1/32), 1 udder cysts (3.13%; 1/32), 1 abomasal ulceration and impaction (3.13%; 1/32), 1 obstructive urolithiasis associated to hydronephrosis and uroperitoneum (3.13%; 1/32), 1 udder abscess (3.13%; 1/32), 1 septic myositis and fasciitis (3.13%; 1/32), 1 intussusception (3.13%; 1/32), 1 liver tumor (3.13%; 1/32) and 1 intestinal volvulus (3.13%; 1/32). According to our outcomes, through US can be provided clinically useful information about a variety of

pathologies, both in terms of the disorders and their progression stages, making the establishment of a diagnosis easier and corroborating as a great differential tool in some cases, also making it possible to improve therapy, as well as the prognosis prediction.

Conclusion and implications
This image tool turns out to be considerably helpful to use under field conditions once it's cheaper and faster, generating a presumptive diagnostic capable of guiding the future decisions of the production line, and also representing a relief for those who raise small ruminants as pets.

doi: 10.1016/j.anscip.2023.01.140

O-065
Ultrasound diagnosis in small ruminants: Occurrence and description of genital pathologies

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Keywords: Goat; Reproductive disorders; Sheep; Ultrasonography

Introduction
Reproductive pathologies represent a significant barrier to achieving a highly productive flock, which makes securing a fast, low-invasiveness, and low-cost diagnosis very important.

Material and methods
In this research, we report on an eight-year retrospective study (2012–2020) of ultrasound data carried out in Rio de Janeiro State, Brazil, to explore the occurrence and appearance of certain reproductive tract pathologies of small ruminants. A total of 3463 animals from 16 sheep flocks (1688 ewes and 55 rams) and ten dairy goat flocks (1704 does and 16 bucks) raised under extensive and intensive management systems, respectively, were used in the study. All animals were submitted to ultrasound examination of their reproductive tracts, which occurred during the breeding and outbreeding seasons. A Chi-square test was performed ($p \leq 0.05$) to determine if any species presented significantly more disorders.

Results and discussion
Ewes (4.14%; 70/1688) had fewer ($p < 0.05$) reproductive disorders than does (8.98%; 153/1704), while rams (43.63%; 24/55) and bucks (56.25%; 9/16) presented no difference ($p > 0.05$). Among the 153 cases of reproductive disorders found in does, hydrometra was the most frequent finding ($p < 0.05$), represented by 50.98% (78/153) of cases. Subsequently, the presence of aseptic embryonic fetal loss (11.76%; 18/153), recent fetal loss (8.49%; 13/153), follicular cysts (7.84%; 12/153), and hydrosalpinx (5.88%; 9/153) were the median findings. Finally, the occurrence of cystic endometrial hyperplasia (3.27%; 5/153), luteal cysts (2.61%; 4/153), retained placenta (1.96%; 3/153), pyometra, endometritis, and paracervical abscess (1.31%; 2/153), ovarian hypoplasia, mummified fetus, cervicitis, paraovarian cyst, and uterine tumor (0.65%; 1/153) was less frequent. From the 70 cases of reproductive disorders presented by ewes, recent fetal loss (22.85%; 16/70) and cystic endometrial hyperplasia (20.00%; 14/70) were the most frequent findings ($p < 0.05$). Other findings included the presence of aseptic embryonic fetal loss (15.71%; 11/70), hydrometra (10.00%; 7/70), and follicular cyst (8.57%; 6/70). Finally, the occurrence of a luteal cyst and septic embryonic fetal loss (4.28%; 3/70), pyometra and macerated fetus (2.85%; 2/70), ovarian tumor, placenta retention, mucometra, uterine adherence, uterine torsion, and paracervical abscess (1.42%; 1/70) was less frequent. In bucks, no difference was identified among the findings: testicular microlithiasis (55.55%; 5/9), testicular degeneration (22.22%; 2/9), and testicular tumor and hydrocele (11.11%; 1/9). In rams, testicular microlithiasis presented as the most frequent finding (75.00%; 18/24; $p < 0.05$). In comparison, varicocele (8.33%; 2/24), inguinal hernia, testicular degeneration, hydrocele, and cryptorchidism (4.16%; 1/24) presented as the least frequent findings.

Conclusion and implications
Ultrasonography provided clinically useful information about the reproductive tract, both in terms of the disorders and their stages, making the establishment of a diagnosis easier, and also making it possible to improve therapy, as well as the prognosis prediction.

doi: 10.1016/j.anscip.2023.01.141

O-066
Prevalence and clinical significance of major respiratory pathologies indentified during rapid whole flock ultrasonographiy in sheep flocks

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Keywords: Respiratory disease; Prevalence; Ultrasonography; Clinical significance

Introduction
The objective of this study was to determine the prevalence and clinical significance of respiratory pathologies in adult sheep diagnosed using rapid trans-thoracic ultrasonography.

Material and methods
All adult sheep in 25 sheep flocks in the United Kingdom were scanned at 6–12 month intervals between March 2019 to August 2022 as part of an ovine pulmonary adenocarcinoma (OPA) control programme. Using a 6.5 MHz microconvex probe connected to a real-time, B-mode ultrasound machine approximately 120–150 sheep were examined per hour. Three flocks were housed for 2–3 months during late gestation. Respiratory lesions considered clinically significant were defined as >2cms' thick exudate extending over the majority of the lung field in one or both sides of the chest (pleurisy), and >4 cm diameter anechoic lesions containing hyperechoic strands/dots within the ventral pleural space (fibrin clots and pleural abscesses). Irregular >2 cms' deep lung consolidation causing irregular breaks in the visceral pleural line, often containing small abscesses and with >2 mm overlying pleurisy, were classified as bacterial pneumonia. Lesions were recorded using Elgato software. Sheep with bacterial pneumonia and pleural exudate were treated with antibiotics as directed in each farm's veterinary flock health plan; most often a single intramuscular injection of long-acting oxytetracycline. Fibrin clots and pleural abscesses with 3–10 mm thick hyperechoic capsules were not treated. The sensitivity and specificity of ultrasonographic diagnoses identified during this study have been reported elsewhere.

Results and discussion
229 of 184,400 sheep (0.12%) showed significant accumulation of pleural exudate causing unliateral collapsed lung in severe cases. No sheep was reported ill by the farmer when scanned although some had received antibiotic treatment 1–28 days earlier but there had been very few contemporaneous entries in the farm's medicines record book. Serial ultrasound examination of sheep indicated that an organised fibrin matrix was consistent with respiratory disease approximately 14–42 day earlier. Pleural fibrin clots and abscesses were recorded in 185 sheep (0.10%) often with contiguous pleurisy. 183 adult sheep (0.10%) showed sonographic changes consistent with bacterial pneumonia. By contrast, 1534 adult sheep showed sonographic changes indicative of OPA.

Conclusion and implications
Rapid ultrasound examination reliably demonstrated pleural pathology but could not always differentiate between encapsulated fibrin and abscesses. The presence of very large quantities of organised pleural exudate suggests that adult sheep can survive certain severe respiratory bacterial infections without antibiotic therapy. Ultrasound-guided thoracocentesis of early cases and culture would allow informed antibiotic treatment where necessary. Antibiotic efficacy in respiratory disease could be objectively determined by sonographic monitoring especially chronic consequences such as pleural abscessation which can extend to 20 cm diameter. On-farm trans-thoracic ultrasound examination requires no skin preparation and takes less than one minute.

doi: 10.1016/j.anscip.2023.01.142

O-067
Using ultrasound scanning to identify and control Ovine Pulmonary Adenocarcinoma

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Keywords: Sheep; OPA; BCS; Ultrasound

Clinical history
A flock of 400 hill sheep, based in Co. Wicklow, Ireland, reported suboptimal fertility levels and difficulties maintaining body condition. These sheep grazed a combination of upland mountainous grazing and enclosed perennial ryegrass based pastures. Ewes were housed for a period of six to eight weeks prior to lambing in March and all female ewes were home bred with only breeding rams purchased for the previous five years. Increased levels of ewe mortality were reported, particularly post gathering and housing pre-partum. Ewes were initially being treated for suspected pneumonia. In spite of antibiotic treatment in clinical cases, and initiation of vaccination protocols for respiratory disease, the issues became progressively worse.

Investigations
To further investigate ewe mortality, post mortem investigations were conducted at DAFM Regional Veterinary Laboratory. Combining gross findings, histopathology and PCR positive results for Jaagsiekte sheep retrovirus, Ovine Pulmonary Adenocarcinoma (OPA) was diagnosed. Based on the OPA diagnosis, ewes that were showing symptoms (loss of body condition and respiratory symptoms) were separated from the main flock and culled initially but flock performance remained below target.

Differential diagnosis
In response all sheep >12 months of age underwent thoracic ultrasonography in June 2018 (Barley and Grant, 2018). Ewes were classified into four categories following ultrasound scanning: clear, slight suspicion (minor lung issue, treat in consultation with vet), highly suspicious (serious lung damage likely OPA but not definite) and condemned (clear signs of OPA). All ewes classified as 'highly suspicious' or 'condemned' were culled post-scanning. Lungs from a sub-section of culled ewes were examined post-mortem after the initial scan. The results were analysed using the methods described by Cicchetti and Feinstein (1990). Agreement between the ultrasound and gross visual post-mortem examination was strong (P *pos* 0.90, P *neg* 0.80). Thoracic ultrasound was repeated in February 2019 and July 2022.

Discussion
Ultrasound scanning reduced the level of OPA present in the flock. The number of ewes classified as either 'highly suspicious' or 'condemned' reduced from 13% to 3% between the first and second thoracic scans and remained at 3% following the third thoracic scan. Mean ewe BCS at mating increased from 2.7 pre-thoracic scanning to 3.0 the year after initial scanning took place and fertility also improved. These results indicate that correctly applied thoracic ultrasound scanning is an effective method of identifying and controlling OPA.

Acknowledgements and funding
The authors wish to acknowledge the Department of Agriculture, Food and the Marine for their support in this research.

References

Barley, J., Grant, P., 2018. Jaagsiekte – the tip of the iceberg. Proceedings of the Teagasc National Hill Sheep Conference 2018, pp. 12–14.
Cicchetti, D.V., Feinstein, A.R., 1990. High agreement but low kappa: II. Resolving the paradoxes. J. Clin. Epidemiol. 43 (6), 551–558.

doi: 10.1016/j.anscip.2023.01.143

O-068
Prevalence of ovine pulmonary adenocarcinoma at first flock screening in 107 flocks totalling 70,750 adult sheep

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Keywords: Ovine pulmonary adenocarcinoma; Prevalence; Ultrasonography; Flock screening

Introduction
Ovine pulmonary adenocarcinoma (OPA) is an infectious neoplastic lung disease of sheep caused by Jaagsiekte sheep retrovirus (JSRV). The disease is invariably fatal and a significant welfare concern during the agonal stages. Data reporting OPA in UK sheep flocks are based upon very small scale knackery investigations, cull ewe studies at abattoirs, and necropsies at regional veterinary laboratories (passive surveillance). This study reports prevalence figures for suspect OPA cases identified ultrasonographically during the first screening of 70,750 adult sheep in 107 UK flocks.

Material and methods
Flock size ranged from 120 to 2,400 adult sheep with a median size of 700. Both sides of the chest of all adult sheep (>18–24 months) were scanned using a 6.5 MHz microarray probe connected to a real-time, B-mode ultrasound machine at a rate around 120–150 animals per hour. Breeds included Scottish Blackface (77), Scottish mule (11), Highlander (3), Swaledale (5), polled Dorset (3), other breeds (8). Video recordings of all lung and pleural lesions were captured using Elgato software. The specificity and sensitivity of this technique based on 540 necropsies have been published elsewhere.

Results and discussion
The flock prevalence of OPA at first scanning ranged from 0% to 4.7% (median 1.7%). No OPA was identified in 12 flocks, <1% (33 flocks), 1–2% (40 flocks), 2–3% (14 flocks), 3–4% (5 flocks) with five flocks greater than 4%. Nine of 17 flocks expected no OPA and had no cases. Eight flocks expected no OPA but 1–6 cases (up to 0.8%) were identified. Five flocks believed that OPA was present in the flock but no cases were found at first scanning. This is the first large scale report of whole flock OPA prevalence data in the UK albeit that inclusion was heavily biased towards flocks with suspected or laboratory-confirmed history of disease. Nonetheless, OPA appears widespread both geographically and breeds affected. Extrapolation of these data to the UK national flock allow economic and welfare consequences to be more accurately assessed. Passive surveillance appears to greatly underestimate the prevalence of OPA.

Conclusion and implications
OPA is a major problem in the UK but disease prevalence appears to be grossly underestimated by passive surveillance. The presented data from 107 flocks allow economic and welfare consequences for the UK national flock to be more accurately assessed. Whole flock ultrasound scanning at 6-12 month intervals with immediate culling has significantly reduced OPA prevalence in most participating farms. However, reducing OPA prevalence in the UK will be limited by the number of veterinary practitioners with sufficient expertise and a structured accreditation programme for those farmers selling breeding stock.

doi: 10.1016/j.anscip.2023.01.144

O-069
Test-and-cull based on ultrasound screening reduces the annual incidence of ovine pulmonary adenocarcinoma in affected flocks

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Keywords: Sheep; Disease control; Ultrasound; OPA

Introduction
Ovine pulmonary adenocarcinoma (OPA) is a common sheep disease with obvious detriment to sheep welfare and farm profitability. It is caused by Jaagsiekte sheep retrovirus (JSRV). There is presently no vaccine, routine laboratory diagnostic test or treatment for OPA.
Clinical signs of OPA include weight loss, dyspnea and excessive fluid from the lungs. At this stage a large proportion of the lungs is affected and JSRV is detectable in respiratory secretions and exhaled breath. Pre-clinical OPA is difficult to identify and represents a risk of transmission to other sheep in the flock, albeit a lower risk than from clinically obvious OPA. We hypothesised that identifying and removing OPA cases from the flock as early as possible would reduce within-flock transmission of JSRV and thereby reduce the number of new cases of OPA year-on-year.
The aim of this study was to evaluate the effect of culling all suspect OPA cases identified by a rapid throughput trans-thoracic ultrasound scanning (TTUS) protocol on annual OPA incidence.

Material and methods
Twenty farms were enrolled in the study; sixteen had a history of OPA in the previous three years, 4 had unknown OPA status. More than 121,000 rapid TUS scans were undertaken at approximately 120 sheep/hour, once or twice-yearly over two to seven years. We have previously reported our specificity and sensitivity estimates for this screening test established from 450 necropsies.

Results and discussion
Overall, there was a significant reduction ($p < 0.05$) in annual OPA incidence for the nine flocks that remained in the programme for 5 or more years. Annual disease incidence was reduced by at least 75% in seven of nine flocks totalling around 9600 adults although two flocks showed little or no change in OPA prevalence. One flock, tested for 4 years, was negative for OPA throughout. Two of three flocks scanned three times, and four of seven flocks scanned twice, showed a reduction in OPA prevalence. Three flocks showed no difference but each of these flocks recorded only one OPA case.

Conclusion and implications
High throughput TTUS undertaken for five or more years significantly reduced the annual incidence of OPA ($p < 0.05$). Clinical audit of the ultrasound diagnosis by regular necropsy examination of culled sheep, and reflective learning, were critically important to the success of this project.

Acknowledgements and funding
This work was funded by the Scottish Government Rural and Environment Science and Analytical Services Division and the Clyde Wind Farm Development Fund.

doi: 10.1016/j.anscip.2023.01.145

O-070
Review of the diagnosis and vaccine timing in series of enterotoxaemia cases

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Keywords: Enterotoxaemia; Epsilon; Vaccine; Prelambing

Introduction
Pre-lambing clostridial vaccination is widely recommended, but efficacy in preventing clostridial infections in lambs when ewes are vaccinated in mid pregnancy has not been established. In addition, epsilon toxin detection in the intestinal contents of sheep is used to diagnose enterotoxaemia despite scant and contradictory information as to the test's specificity. This review aims to address these issues

Material and methods
Sheep disease investigations submitted to Agriculture Victoria laboratories between 2016 and 2021 were searched for diagnosis of clostridial disease. Over 30 cases of enterotoxaemia and two cases of tetanus were examined

Results and discussion
Epsilon toxin was detected in six out of nine sheep where brain pathology confirmed enterotoxaemia (sensitivity 66%).
Epsilon toxin was detected in four out of six sheep where pathology excluded enterotoxaemia. This equates to a specificity of 33%, albeit from a small non-random sample.
Enterotoxaemia was confirmed in six cases and suspected in two cases in lambs under six months of age. In all eight cases, none of the affected lamb's dams had been given a pre-lambing vaccination. In three of the eight cases, lambs had been vaccinated two to three months prior to death.
In sheep over six months enterotoxaemia was confirmed in 19 cases and suspected in two cases. Enterotoxaemia losses continued for 1–2 weeks post vaccination in several cases. Potection started to wane after three months, particularly in first year. Some of the losses in vaccinated sheep may be explained by poor vaccine administration.
The highest enterotoxaemia mortality was 130 deaths out of 520 unvaccinated two-year old ewes. The average mortality in unvaccinated flocks was eight percent.
Two outbreaks of tetanus were reported, both outbreaks were in lambs immediately post marking where neither ewes nor lambs had been vaccinated.

Conclusion and implications
Epsilon toxin detection alone cannot be used to confirm a diagnosis of enterotoxaemia. Diagnostic specificity may be improved by using a combination of positive epsilon toxin and negative beta toxin to confirm a diagnosis of entertoxemia. This in on the assumption that the positive detection of both toxins is suggestive of post mortem overgrowth.
Pre-lambing vaccination of ewes is critical to protect lambs from enterotoxaemia. This study provides no evidence that vaccinating ewes just prior to lambing protects lambs for first five months better than vaccinating mid-pregnancy.
Lambs slaughtered by six months age do not require clostridial vaccination, provided ewes are vaccinated prior to lambing.
Sheep retained past five months of age should be double vaccinated prior to six months of age. Annual vaccination thereafter will be adequate in most flocks. In high-risk scenarios vaccination may be required every three months.

Acknowledgements and funding
Agriculture Victoria for data reviewed.

doi: 10.1016/j.anscip.2023.01.146

O-071
Curative efficacy of eprinomectin injection against gastrointestinal nematodes and lungworms in lambs

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Keywords: Gastrointestinal nematodes; Lungworms; Lambs; Eprinomectin

Introduction
Gastrointestinal nematodes (GIN) and lungworms impact the health and the productivity of grazing sheep across the world. In dairy sheep within Europe, their economic impact has been estimated around €151 million annually (Charlier et al., 2020). Eprinomectin is frequently selected for the treatment of GIN and lungworms in lactating dairy sheep, as it benefits from a zero-day milk withdrawal period and until recently, only a topical formulation was registered. Since 2020, an injectable formulation is licensed (“Eprecis® 20 mg/mL Solution for Injection, Ceva Santé Animale”). Although “Eprecis® Injectable” is indicated for both GIN and lungworms, published evidence of its efficacy was only available for GIN so far (Termatzidou et al., 2020). To address this gap, the efficacy of eprinomectin injection against both gastrointestinal and lung nematodes in lambs is reported hereafter.

Material and methods
This study was a blinded, randomized, controlled trial performed according to VICH guidelines. Fourteen worm free lambs of approximately 3 months of age were experimentally challenged on Day -28 with a mixed culture of infective gastrointestinal larvae (*Haemonchus contortus, Cooperia curticei, Trichostrongylus colubriformis* and *Teladorsagia circumcincta*), and a culture of lung nematode larvae (*Dictyocaulus filaria*). After 27 days, fecal samples were collected from all lambs to assess fecal egg counts. Establishment of infection was confirmed (≥777 eggs per gram (epg)). On Day 0, animals in Group 1 received 0.2 mg/kg of “Eprecis® Injectable” by subcutaneous injection. The animals in Group 2 did not receive any treatment. Fecal samples were collected from all animals on Days 3, 5, 7, 9, 11 and 14 for fecal egg counts. On Day 14, the lambs were euthanized, and the abomasum, small intestine and lungs collected. The samples were processed, and the number and species of worms were recorded.

Results and discussion
Following treatment (Day 0) the mean faecal egg counts for Group 1 decreased to 50 epg by Day 3 while the Group 2 mean faecal egg counts remained elevated at 2,892 epg. The mean number of adult nematodes in the untreated control group (Group 2) at day 14 were higher than in the treated group (Group 1). Additionnally, no lungworms were found in the lungs of treated animals at this time point. On Day 14 the effectiveness was >97.5% for all species. Per the standards of VICH GL7, “Eprecis® Injectable” is considered effective against *Haemonchus contortus, Cooperia curticei, Trichostrongylus colubriformis, Teladorsagia circumcincta* and *Dictyocaulus filaria*.

Conclusion and implications
In this challenge study, one subcutaneous administration with “Eprecis® 20 mg/mL Solution for Injection” was found highly effective against GIN and lungworms in young lambs. In addition to its efficacy, eprinomectin injection is considered more reliable and suitable for selective treatments than topical formulations.

doi: 10.1016/j.anscip.2023.01.147

O-072
Infectious agents of abortion in small ruminants between 2012 and 2022

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Keywords: Abortion; Sheep; Goats; Infectious agents

Introduction
In Italy researchers did not published any recent information on the aetiological agents of infectious abortion in sheep and goats. Ruling out the common causes of abortion is useful to define the epidemiological situation in a country/region, taking into account also the zoonotic potential of many abortion agents in small ruminants. The aim of this study was to describe the main causes of abortion in sheep and goats, by exploiting abortion material submitted to Istituto Zooprofilattico Sperimentale delle Venezie (IZSVe) laboratories over a ten-year period (2012–2022).

Material and methods
During the period of study, 296 submissions (72 sheep, 224 goats) of abortion specimen (one or more fetuses with or without placenta) were examined at IZSVe diagnostic laboratories. Aborted fetuses and placentae were necropsied and a standard testing protocol was applied to samples from fetuses/placentae to investigate the following agents of abortion: *Brucella* spp., *Coxiella burnetii*, *Listeria* spp., *Chlamydia* spp., *Campylobacter* spp., *Salmonella* spp., *Toxoplasma gondii*/*Neospora caninum (T. gondii/N. caninum)*, *Schmallenberg virus (SBV)*, *Pestivirus* and other minor bacteria species. A fully investigation was not achieved for all cases, depending on the decomposition state of carcasses and the stage of gestation; therefore not always all pathogens were investigate for each submission.

Results and discussion
In submissions of ovine specimen *Chlamydia* spp. (16/69–23.2%) was the most common agent founded, followed by *Coxiella burnetii* (6/68–8.8%); other causes of abortion were: *Salmonella* spp. (3/47–6.4%), *T.gondii* (3/62–4.8%), *Pestivirus* (1/58–1.7%), *SBV* (1/28–3.6%) and *N. caninum* (2/16–12.5%). All samples resulted negative for: *Brucella* spp. (as expected in free regions), *Listeria* spp. and *Campylobacter* spp. In

goats, submissions resulted positive for: *Chlamydia* spp. (52/209–24.9%), *Coxiella burnetii* (25/207–12.1%), *T. gondii* (17/193–8.8%), *Listeria* spp. (6/155–3.9%), *Pestivirus* (6/174–3.4%), *N. caninum* (2/64–3.1%), *SBV* (1/61–1.6%), *Salmonella* spp. (1/149–0.7%). No samples resulted positive for *Brucella* spp. and *Campylobacter* spp. Considering all samples tested positive for *Chlamydia*: 84/97 (87%) were identified as *Chlamydia abortus*, 1/97 (1%) as *Chlamydia pecorum* and 12/97 (12%) were classified as uncharacterized *Chlamydia* spp. Taking into account *Salmonella* genus, in sheep, 3 strains were identified as *S. enterica subsp. diarizonae* and one strain belonged to *S. abortusovis*; in goats, the only positivity was ascribed to *S. thompson*. Moreover, among *Listeria* genus isolates (9), *L. monocytogenes* was the main species recorded (4/9), followed by *L. innocua* (1/9), *L. ivanovi* (1/9), *L. seeligeri* (1/9) and *Listeria* spp. (2/9).

Conclusion and implications
The most commonly reported abortion pathogen in small ruminants in north-eastern Italy is *Chlamydia abortus* followed by *Coxiella burnetii* and *T. gondii;* other agents of abortion are represented by *Salmonella* spp., *N. caninum*, *SBV*, *Listeria* and *Pestivirus* whose prevalence is not representative of the real epidemiological situation due to fewer samples analysed for these diseases.

doi: 10.1016/j.anscip.2023.01.148

O-073
Seroprevalence of enzootic abortion and toxoplasmosis in sheep flocks experiencing reproductive losses

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Keywords: Enzootic; Abortion; Toxoplasmosis; Sheep

Introduction
Abortions caused by *Chlamydophila abortus* and *Toxoplasma gondii* represent a serious concern for sheep producers worldwide. In the UK, abortion accounts for 30% of lamb losses, costing the sheep industry £11–48 million/year. Government surveillance data identified enzootic abortion and toxoplasmosis as the top two causes of ovine abortion during 2010–2021.
UK farmers still use antibiotics such as tetracyclines, to limit lamb losses in flocks experiencing high abortion rates, without the causative factor diagnosed.
Although there is limited previous work on seroprevalence of toxoplasmosis in UK sheep flocks, availability of more recent prevalence data for both diseases would be of great value to guide control strategies at the flock and national level.

Material and methods
Blood samples were collected from ewes on UK farms during 2022 as part of a subsidised scheme. A total of 2,401 samples were collected from sheep on 374 farms, corresponding to a population of 64,606 animals. All farms included in the scheme experienced reproductive losses during 2022 lambing season. Eight samples per farm were collected post-lambing (6 weeks to 3 months) from animals which had experienced reproductive issues (abortion, reabsorbtion, stillbirth, birth of weakly lambs) and tested for the presence of antibodies against *C. abortus* and *T. gondii* at accredited laboratories. Farmers participating in the scheme answered basic questions regarding flock size, barren rate, and lambing percentage.

Results and discussion
In the tested population, 36.9% of sheep from 74.1% of farms were seropositive for *T. gondii* and 4.9% of sheep from 17.9% of farms were seropositive for *C. abortus,* with 5.1% of sheep seropositive for both pathogens. The farmer-estimated average barren rate was 10.6%, average lambing percentage was 155%, with average flock size of 406 sheep.
Previous UK work found 54.2% of sheep were seropositive for *T. gondii* (Hutchinson and Smith, 2015). This is higher than our results, suggesting farmers are now more effectively controlling this disease in their flocks. However, lower level of seropositivity to *C. abortus* in our results compared to government surveillance data (derived from postmortem investigation), suggests farmers are more likely to submit samples suspected of enzootic abortion, potentially due to the high level of losses suffered.

Conclusion and implications
Farmers frequently rely on antimicrobials to manage suspected infectious abortion in their flocks, despite effective vaccines being available for both enzootic abortion and toxoplasmosis. Appropriate diagnosis of the causative pathogen as well as regional seroprevalence data, should help veterinarians work with their farm clients implementing effective prevention programs and reducing antibiotic reliance.

Acknowledgements and funding
We acknowledge the contribution of participating vets and farmers.
Funded by MSD Animal Health.

Reference

Hutchinson, J.P., Smith, R.P., 2015. Seropositivity to Toxoplasma infection in sheep samples submitted to AHPA laboratories between 2005 and 2012. Vet. Rec. 176 (22), 573.

doi: 10.1016/j.anscip.2023.01.149

O-074
Atypical scrapie in a seven-year-old Herdwick ewe

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Keywords: Scrapie; TSE; Atypical; Sheep

Clinical history
In March 2022, a seven-year-old Herdwick ewe was referred to the Scottish Centre for Production Animal Health and Food Safety for the investigation of circling behaviour and ill thrift during the previous 4 weeks. The ewe was part of a flock of 400 sheep, in which similar signs had not been reported.

Investigations
On clinical examination, the ewe had a body condition score of 1 (out of 5), was dull, had a wide base stance of the pelvic limbs, and moderate proprioceptive ataxia. Spinal reflexes and cranial nerve function appeared to be normal. The ewe occasionally circled to the left, and this behaviour increased after human interaction. Haematology, biochemistry and cerebrospinal fluid analysis showed no evidence of infection. The PrP genotype of this ewe was ARR/AHQ. Magnetic resonance imaging (MRI) showed lesions consistent with generalised, diffuse, bilateral and symmetrical atrophy of the forebrain. Post-mortem, the brain was submitted to the UK Animal and Plant Health Agency for pathological investigation. Immunohistochemistry (IHC) showed the presence of the pathologic form of prion protein (PrP^{Sc}) mostly in the cerebellum and in lower concentrations in the cerebrum and obex.

Differential diagnosis
Considering the ill thrift, dull behaviour, pelvic limb ataxia and circling behaviour ongoing for 4 weeks in this animal, scrapie (classical or atypical), neoplasia but also bacterial (abscess, listeriosis), viral (maedi-visna) and parasitic (sarcocystiosis, coenurosis) diseases were considered as part of the differential diagnosis. As haematology, biochemistry, and cerebrospinal fluid analysis did not suggest a bacterial, viral or parasitic disease, and MRI did not show evidence of neoplasia, scrapie (atypical or classical) was considered as the main differential diagnosis. In this case, it was more likely to be atypical scrapie, based on just one individual seven-year-old sheep being affected in the flock. The localisation of PrP^{Sc} mostly in the cerebellum confirmed the clinical diagnosis of atypical scrapie.

Discussion
Differentiation between classical scrapie and atypical scrapie can be difficult if only one individual animal is affected at the time of presentation to the veterinary practitioner. The genotype (ARR/AHQ) of this animal makes it less susceptible to classical scrapie and has been associated with an increased risk for atypical scrapie. Scrapie, classical or atypical, should be included in the differential diagnosis list whenever individual sheep are presented with dullness, wide base stance of the pelvic limbs, or circling behaviour persisting for several weeks.

doi: 10.1016/j.anscip.2023.01.150

O-075
Tertiary education in sheep and wool science and evaluation of a hub and spoke multi-institutional national model

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Keywords: Sheep; Wool; Agriculture education; Employment

Introduction
The sheep and wool industry is an important and established primary production entity for Australia. Specialised tertiary education in the field of sheep and wool is pivotal to the advancement of the industry. Sheep and wool education has evolved over time synchronously with changes in the presentation of tertiary teaching. The face-to-face teaching and 4-year specialised degree in animal and wool science has now developed into an online learning system, with individual units made available to students across the country. This is delivered using a hub institute, University of New England and spoke universities across Australia. The study evaluated the development and delivery of the hub and spoke method of tertiary education in sheep and wool science, enrolments and spoke-institute participation, drivers for students to enrol in these units and the extent to which completion of the sheep and wool units leads to employment within industry.

Material and methods
The data for this study comprised routine information gathered during university enrolment and specific student survey data from two questionnaires. The first questionnaire was an annual survey of enrolled students ($n = 289$) and the second questionnaire was a survey of graduates ($n = 128$) from sheep and wool science, both surveys were implemented using the web-based surveying tool, Survey Monkey®. To assess statistical association between survey response variables, Survey Monkey® numbered response data for each question were entered into database format and codified such that each respondent formed a row and their responses to each question formed columns. Using the statistical software JMP13 (SAS Institute, Cary, NJ, USA) two-way contingency-table analysis was performed to test association between different responses and significance determined by the chi-square value in a likelihood-ratio test.

Results and discussion
Student numbers studying sheep and wool science in the hub and spoke program have increased three and a half fold in 10 years. The continued growth in tertiary enrolments into specialised sheep and wool units is despite a significant decline of 60% of students graduating from agricultural and related courses during a similar period. The motivation of students to enrol in the sheep and wool units was predominately (56%) the 'desire to work in the sheep industry on completion of study'. The employment success of students studying the sheep and wool units is over 50%, with positions ranging from working on family properties, managing sheep properties, consulting and research being the top four positions.

Conclusion and implications
Utilising a hub and spoke model for online education delivery allows one university to specialise in a specific curriculum that can be offered across multi-institutions. The tertiary training package, developed by the sheep and wool industry, has provided an estimated 400 graduates into the industry in 10 years.

doi: 10.1016/j.anscip.2023.01.151

O-076
Integration of innovative sheep models into a veterinary curriculum

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Keywords: Teaching; Pedagogy; Clinical skills; Small ruminant

Introduction
As with veterinary curriculums globally, City University's Bachelor of Veterinary Medicine (BVM) program requires a high level of technical skills and integration and application of knowledge to achieve 'Day One Competencies'. Contrasting with students based in tertiary institutions where farms and livestock are readily accessible, in Hong Kong there are a limited number of farms our students are able to visit as part of their training. There are a small number of goats, but no sheep in Hong Kong, thus all sheep clinical skills are taught with models and during overseas placements. This has driven the creation of innovative and realistic sheep models that we have incorporated into our teaching program. Additionally, there is increasing emphasis on the reduction of animal use for teaching procedural skills. Using models before students gain access to live animals helps ensure competency and increases confidence in these skills, while improving welfare outcomes for the animals.

Material and methods
We have focused our models on those needed for students to master core skills such as physical examination, ram breeding soundness examination, blood sampling and surgical skills. Models have been built through various techniques, with 3D printing using open access software commonly used. The increasing affordability and availability of 3D printing, combined with increased availability of open-access scans of anatomically correct body-parts makes development of these types of models more accessible to a number of veterinary schools.

Results and discussion
We will highlight some of our key sheep models, including how they were created and how we have incorporated them into clinical skills teaching, using examples from each stage of the BVM as students progress from basic handling and identification through to more complex clinical procedures. In Year One, we use 3D printed models for aging sheep by dentition, a skill that many students find challenging as it

requires differentiation of deciduous and permanent incisors. In Year Three, jugular veins have been inserted into life-size model sheep, allowing students to practice blood sampling techniques, an essential skill for a sheep veterinarian. For Year Five, we have created models for ram breeding soundness examination, with normal and abnormal scrotal models available for palpation. Models are also used for surgical classes, specifically ram vasectomy and sheep caesarean, integrating individual skills to perform procedural tasks. Surgical models have parts that can be easily replaced (for example vas deferens and tunics in the vasectomy models), allowing each student to complete the whole procedure, yet reducing the overall cost and waste, as only a few replicates of the main model parts are needed.

Conclusion and implications
Our models could be easily replicated in other schools and incorporated into curricula, increasing the tools available for teaching the next generation of veterinarians.

doi: 10.1016/j.anscip.2023.01.152

O-077
Application of a knowledge management system in sheep and goat producers

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Keywords: Knowledge management; Small ruminants; Tacit; Explicit

Introduction
Sheep and goat production systems for consumption and transformation in Colombia have grown significantly in recent years. The development of sheep and goat activities has been supported by producers, whose knowledge is acquired through oral tradition, usually without technical assistance. The system behaviour in the country has drawn attention to knowledge management. This research aims to measure the effect of three forms of management on the level and use of knowledge in sheep-goat farms in six regions of Colombia

Materials and methods
The methods used to create and apply the Knowledge Management System (KMS) have their starting point in the construction of the model, which involves 4 phases: Phase I: Producer characterisation, Phase II: Management with information systems and analysis of indicators, Phase III: Intervention with knowledge management and Phase IV: Monitoring and evaluation. In these phases, the analysis of the three types of producers is developed: Group 1. ATC (producers with a conventional technical assistance system); Group 2. PI-KMS (intervened producers in which a knowledge management system is incorporated); and Group 3. NI (producers without intervention, control group), evaluating them regarding the level and use of appropriate knowledge.
This study was conducted with 66 sheep-goat producers located in six regions of Colombia. The results evaluated the level and use of knowledge occur after 3 years of work involving workshops, monitoring and technical work. It was applied surveys, allowing measuring the level and use of knowledge.

Results and discussion
When applying the Kruskal-Wallis test, sorting the answers on the level of knowledge and use of knowledge by type of producer, the following was obtained: Between type NI and ATC ($p > 0.05$), between type NI and PI-KMS ($p < 0.05$) and between ATC and PI-KMS ($p >< 0.05$); and between ATC and PI-KMS ($p < 0.05$); that is, the NI and ATC type producers are the same and these two are different from the PI-KMS type.

Conclusions
In conclusion, when applying the KMS on PI-KMS producers, the level and use of knowledge is modified ($p < 0.05$), which can lead to improving the conditions to identify and analyse, against the problems from the farm, as opposed to conventional or traditional technical assistance, with direct recommendations (ATC) or non-intervened (NI), in which a certain indifference is observed regarding the perception of improvement in the level and use or exploitation of knowledge, compared to the same tasks ($p >< 0.05$), which can lead to improving the conditions to identify, analyse, plan, decide, and act against the problems from the farm, as opposed to conventional or traditional technical assistance, with direct recommendations (ATC) or non-intervened (NI), in which a certain indifference is observed regarding the perception of improvement in the level and use or exploitation of knowledge, compared to the same tasks ($p > 0.05$)

doi: 10.1016/j.anscip.2023.01.153

O-078
African Clinical Veterinary Library App, (ACVLA) has been designed to improve clinical sign recognition, treatment outcomes and animal health skills of veterinary paraprofessionals

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Keywords: Clinical; Veterinary; Library; App

Introduction
In Africa veterinary paraprofessionals (VPPs) make 80% of the visits to sick livestock. Veterinary surgeons supervise groups of VPPs, but distances and often poor communication channels can make this supervision difficult and so the accuracy of diagnosis and treatment can be variable, so the App (ACVLA) has been designed to address these issues. NADIS (National Animal Disease Information Service) and the AVTA (African Veterinary Technicians Association) have entered into a joint venture partnership to develop the App and make it available for VPPS to use in Africa.

Material and methods
NADIS is developing an App which will enable VPPs to confirm the clinical signs present in an animal they are examining. The App uses clinical image recognition by the VPP, rather than veterinary terminology recognition to avoid literacy issues. This development will simplify training and use. Using clinical signs algorithms embedded in the image the App produces a list of possible diseases based on the clinical signs identified in the animal.
In Africa, up to 70% of medicines are counterfeit which is a major problem reducing effective treatment and animal health in the livestock industry. Once the medicine is selected by the VPP the App can be used to scan the data matrix or barcode on the label which links to a cross reference file via the Global Trade Index Number (GTIN) were the essential information for correct use can be given ie dose, frequency, method of administration, withdrawal periods, warnings, storage, etc.
Once the clinical signs for a disease have been identified and confirmed the location of the disease will be represented on a geolocation map along with the confirmed signs for that disease and whether or not laboratory tests have confirmed the disease, helping to monitor and control transboundary diseases as well as pick up new emerging disease at an early stage.

Results and discussion
NADIS will develop the App and provide it free for all VPPs. NADIS will develop an online training portal so VPP can be annually accredited in clinical sign recognition, responsible use of medicines and best practice in livestock health. The African Veterinary Technicians Association (AVTA) has over 130,000 VPP members, represented in over 30 African countries and will engage with its members in App usage.

Conclusion and implications
The App (ACVLA) has been designed to improve clinical sign recognition, treatment outcomes (responsible use of medicines) and animal health skills of VPPs thereby improving the sustainability of their businesses and those of the livestock farmers they serve. Data outputs will also improve disease surveillance and strengthen the medicines supply chain.

Acknowledgements and funding
(International Veterinary Health Division, MSD Animal Health) has provided financial assistance to develop the prototype.

doi: 10.1016/j.anscip.2023.01.154

ISVA: Global threat to sheep

O-079
Serological status of PPR and its associated risk factors in small ruminants

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Keywords: PPR; Seroprevalance; Goats; Sheep

Introduction
Peste des petits ruminants (PPR) is an extremely infectious disease that affects small domestic and wild ruminants, endangering food security and the long-term viability of farmers' livelihoods throughout Africa, the Middle East, and Asia.

Material and methods
The present study was conducted as a case study of PPR serostatus between December 2019 and November 2020 in a typical small-scale village farming setting in Punjab, Pakistan. A semi-convenience sample was taken from goat-and sheep-owning households in one village in the district, comprising up to five adults (>1 year old) and five young (<1-year-old) animals per households on four occasions (December 2019, February 2020, August 2020 and November 2020). A total of 300 serum samples were collected (233 goats and 67 sheep). Monoclonal antibodies-based commercial competitive ELISA kit (cELISA) (IDVET® Cat#PPRC-4p) was used to detect the presence of antibodies.

Results and discussion
Overall, 62% of samples were seropositive. There were no statistically significant ($p > 0.05$) differences in the proportions of seropositive between goats (64%) and sheep (55%), female (62%) and male (62%), or time of sampling (64%, 65%, 63%, 57%). Significantly more adult animals (69%) were seropositive than young ones (48.51%). The proportion of seropositive animals was similar in large (66%) and medium (65%) herds, but significantly greater than in small ones (41%). There were no differences in the proportion of seropositive in animals largely fed at home or extensively grazed, or reared with or separate from large ruminants. Our study was not able to verify whether serostatus was due to vaccination, natural infection, or a combination of both. Either way, an overall seroprevalence that was neither low (in the case of potential natural infection) nor high (for vaccination) suggests that the current situation is associated with a significant proportion of unprotected animals or natural infections circulating widely in the village. Antibodies to PPR generally persist for years after exposure or vaccination, so our results (and the fact that samples were collected four times over eleven months) are unlikely due only to the timing of sampling relative to vaccine delivery.

Conclusion and implications
These results suggest that there is a need to strengthen PPR control in typical village farming settings in Pakistan and that there is a need to comprehensively study local and institutional approaches to disease risk and control, alongside patterns of disease prevalence and circulation.

Acknowledgments and funding
This work was part of the project LS-2018-105 *Enhancing small ruminant production to benefit farming families in Punjab and Sindh,* supported by the Australian Centre for International Agricultural Research, implemented by the University of Melbourne and the University of Veterinary and Animal Sciences (Lahore).

doi: 10.1016/j.anscip.2023.01.155

O-080
PPR surveillance in a conflict zone

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Keywords: PPR; OIE; FAO; Syria

Clinical history
Acute pneumonia, lacrimation, oral lesions, swollen lips, fetid diarrhoea, morbidity 48–100%, mortality 28–44%

Investigations
In June 2016, an unusually high number of deaths in goats was reported from opposition held parts of Northwest Syria. Acute symptoms observed in sick goats included pneumonia, lacrimation, small erosions in the mouth, swollen lips and fetid dark diarrhoea, with affected sheep showing none or milder symptoms. Differential diagnosis by local veterinarians included Pasteurellosis, Clostridia and Coccidia. Reportedly, treatment failures were very common. PPR was suspected as a possible cause of the observed mortalities. Since the affected

locations were, and still are, inaccessible for Syrian government veterinarians and for UN staff, the FAO cross-border unit for Northwest Syria trained and equipped Syrian non-government veterinarians for use of the 'Field Test for PPRV' (Pirbright, UK). In September/October 2016, testing of acute clinical cases in three affected flocks, confirmed presence of PPR-positive animals. Of three goats that tested positive in the PPR antigen rapid test, two died within six days. Morbidity in goats in the three flocks ranged from 48% to 100%, while mortality in goats was between 28% and 44%, reaching 49% in goats aged less than 12 months. There was no mortality in sheep. Similar localized outbreaks were also reported in 2017, but could not be reached by trained veterinarians. Shipping samples from Northwest Syria to a Turkish laboratory proved to be impossible. To confirm the PPR field test results, Syrian non-government veterinarians were trained in the use of ELISA test kits at Cukurova University veterinary faculty in Turkey. Coordinated by the FAO cross-border unit, local Syrian veterinarians collected blood samples from 986 herds of sheep and goats in 337 locations in Northwest Syria in June and July 2019. Testing of 3404 sera for PPR antibodies (ID Screen® PPR Competition ELISA) at three field laboratories established in Northwest Syria with support by Qatar Charity, found 35.3% of sera to be positive. Presence of PPR seropositive animals was confirmed for all but one of the 27 sub-districts sampled.

Discussion
Since 1987, Syrian veterinary services had been following a non-vaccination strategy for PPR. As per 2020, OIE classified Syria as a country without official PPR status. From May 2020, the overwhelming serological evidence generated by local non-government veterinarians led to regular PPR vaccinations of sheep and goats in Northwest Syria and later also in other parts of Syria. – In conclusion, surveillance by non-government veterinarians can provide relevant information to national and regional PPR programmes and is crucial for identifying and controlling PPR in areas with restricted access. The importance of locally applied effective diagnostic field-tests for successful PPR control and future eradication cannot be understated.

doi: 10.1016/j.anscip.2023.01.156

O-081
Spread and zoonotic risk of CLA in the population of Drentse and Schoonebeeker heath sheep

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Keywords: Corynebacterium pseudotuberculosis; Caseous lymphadenitis; Zoonotic risk; Heath sheep

Introduction
Caseous lymphadenitis (CLA) is relatively uncommon disease among sheep in the Netherlands. Cases of CLA in the last decade were related to import of sheep from other European countries. In 2021, *Corynebacterium pseudotuberculosis,* the causal agent of CLA, was found in a large flock of heath sheep. As a consequence, more breeders started testing for CLA and serologically positive sheep were found on three other farms. The aim was to determine the presence and spread of CLA amongst of the Drentse and Schoonenbeeker heath sheep of the Dutch breeders association (NFDH) and to pose potential human health risk of CLA.

Material and methods
All members of the NFDH were asked to fill in a questionnaire. In the questionnaire, animal contacts in the past five years, possible clinical signs of CLA within the flock, and possible contacts with CLA infected flocks were inventoried. Based on the results farms were classified as at low-, medium- or high-risk. The medium-to-high-risk flocks were requested to conduct a clinical inspection by their veterinarian. The veterinarian was authorised to collect samples for confirmation diagnostics in case of suspicion of presence of CLA. A total of 99 blood samples of suspicious animals were serologically tested by an Corynebacterium pseudotuberculosis antibody ELISA. Three pus samples were tested by bacteriological culture.
The inventory of the zoonotic risk of CLA was based on a literature research was discussed with a physician for infectious diseases from the municipal health (GGD).

Results and discussion
NFDH has 161 members from which 73 were selected as medium-to-high-risk flocks. From these 73 flocks 59 were inspected by a veterinarian. After clinical inspection blood samples from 16 flocks with a suspicion of CLA were collected. None of the serology and culture samples tested positive for CLA. Although, no new cases of CLA were detected, the number of participants should ideally be higher, since possible infected non-participating flocks could now have been missed.
The literature search resulted in 33 descriptions of human CLA-infections. Infections were mainly found in people who were professionally involved with sheep, such as slaughterhouse personnel, sheep shearers and farmers.

Conclusion and implications
This project showed no additional spread of CLA among the heath sheep within the NFDH among the group of participants. Additional clinical inspections, especially after shearing, and testing for CLA in case of suspicion and quarantine application and additional testing of pur-

chased sheep is advised to get a better impression of the occurrence and to prevent (re)introduction of CLA. People in direct contact should be aware of the zoonotic risk of CLA. GGD advises farms with a proven infection of CLA not to fulfil a public function.

Acknowledgements and funding
This project is funded by the Dutch government.

doi: 10.1016/j.anscip.2023.01.157

O-082
Chlamydia pecorum causing ewe abortions in NSW, Australia

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Keywords: Chlamydia; Pecorum; Ewe; Abortions

Clinical history
Chlamydia pecorum (*C. pecorum*) was diagnosed as a cause of late term abortions, stillborn lambs and lambs born alive, weak and premature in ewes on five properties located in diverse environments across NSW. The first outbreak occurred in merino ewes in Northern NSW in 2018. In all other cases, the abortions occurred in 2020. The second and fifth cases occurred in the Central Tablelands of NSW in First Cross ewes and Dorper cross ewes. The third case occurred in Dorper ewes on the Western Plains of NSW and the fourth case was in merino ewes in Northern NSW. Aborted lambs were observed as early as one month prior to the expected commencement of lambing (property 5) to 10 days after lambing commenced. Foetal losses were in most case estimated at 20–30%. On Property 5, 10–12 of 130 ewes aborted before lambing but losses ceased after the ewes were injected with long acting oxytetracycline.

Investigations
In all 5 cases *C. pecorum* was detected by quantitative PCR (qPCR) and the necropsy and pathology findings from submissions from cases 1–3 and 5 supported the diagnosis. Six placentae were examined from 3 of the 5 cases. Five of the 6 revealed moderate to severe placentitis. Fourteen lambs were necropsied. Two had fibrinous serositis, four had non-suppurative hepatitis and others had inflammation of the intestinal crypts, kidneys, brain and heart.

Differential diagnosis
Chlamydia abortus was excluded in all cases. Toxoplasmosis was excluded in 4 of 5 cases, *Campylobacter* spp. were excluded on all 5 cases, Border Disease virus was excluded from 3 cases, *Coxiella burnetii* from 2 cases and *Leptospira* spp from one case. No other pathogens were detected.

Discussion
On the Central Tablelands of NSW, *Campylobacter* spp, *Listeria* spp and *Toxoplasma gondii* are most often diagnosed, while *Yersinia* spp., Border Disease virus, *Brucella ovis* and *Coxiella burnetii* are less commonly encountered. *Chlamydia* has been suspected for many years but until now has only rarely been confirmed. Our findings support previous evidence that *C. abortus,* the cause of EAE, remains exotic to Australia. *C. pecorum*, is a well-known cause of polyarthritis and conjunctivitis in sheep and was regarded as a rare cause of abortions in ewes (Watt, 2011; Walker et al 2015). However, recently cases have been reported more frequently in NSW, either due to an increase in prevalence or to improved diagnostic methods.

References
Walker, E., Lee, E.J., Timms, P., Polkinghorne, A., 2015. *Chlamydia pecorum* infections in sheep and cattle: A common and under-recognised infectious disease with significant impact on animal health. Vet. J. 206, 252–260.
Watt, B.R., 2011. Chlamydial infections in sheep. Proceedings of the 2011 District Veterinarians' conference, posted March 2014, http://www.flockandherd.net.au/sheep/reader/chlamydial-infection.html.

doi: 10.1016/j.anscip.2023.01.158

O-083
Clinical leishmaniosis due to *Leishmania infantum* in a goat: Clinical findings and treatment response

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Keywords: Goat; Leishmania infantum; Leishmaniosis in goats; Serology

Clinical history
A 2-year-old female, entire pygmy goat with history of skin lesions for several months described as a generalised *exfoliative dermatitis* with alopecia/hypotrichosis, was referred to the Ruminant Clinical Service (SCRUM). The goat was in good condition, active and normothermic on clinical examination. The most relevant finding was an enlargement of lymph nodes, a non-specific sign. The goat came from an area that it is considered as very highly endemic area of canine leishmaniosis. Moreover, the animal was not being treated with anti-parasitic repellent against sandflies.

Investigations
A medical history of the goat was recorded. Anticoagulated blood sample and serum sample were collected to perform a complete cell blood count and clinical biochemistry. The following parameters were analysed: alanine aminotransferase (ALT), alkaline phosphatase (ALKP), gamma glutamyl transferase (GGT), total bilirubin (TBil), total cholesterol (Cho), glucose (GLU), total protein concentrations (TP), creatinine (CRE), blood urea nitrogen (BUN), calcium (Ca) and inorganic phosphorus (P). A qualitative rapid test to detect the presence of *Leishmania infantum* antibodies in dogs was performed with a doubtful result. Finally, a quantitative serology based on an own developed in-house ELISA technique was performed to detect anti-Leishmania antibodies in goats. Laboratory findings revealed elevations in total protein, ALT and TBil. By contrast, a decreased of different parameters was detected, including GGT and Ca. The rest of laboratory parameters were within the reference ranges.
Serum protein electrophoresis was also performed to investigate the nature of hyperglobulinemia. The electrophoresis revealed a polyclonal gammopathy. The in-house ELISA for *L. infantum* was positive with moderate levels of anti-*Leishmania* antibodies. Anti-Leishmania therapeutic protocol was established with meglumine antimoniate at 100 mg/kg every 3 days (SID) subcutaneously for 25 days due to the impossibility to treat daily by the owner. The presence of descamative dermatitis was solved after finishing the meglumine antimoniate treatment. However, 20 days later, relapse was observed with mild exfoliative dermatitis. A protocol treatment based on allopurinol administration was established at 40 mg/kg daily SID PO for 4 months, with a complete clinical resolution.

Differential diagnosis
Initially, other more frequent diseases were discarded as lumpy wool disease, dermatophytosis, scabies, insect bites or contact dermatitis. Hyperglobulinemia in animals is an alteration caused by the increase of any or all serum protein fractions, including α-globublins, β-globulins and γ-globulins. In this case, the hyperglobulinemia was caused due to a polyclonal gammopathy being observed after *L. infantum* antigenic stimulation.

Discussion
This is the first case report describing the presence of clinical lesions due to *L. infantum* in a goat. In this sense, meglumine antimoniate and allopurinol seem to be effective in treating a goat with clinical leishmaniosis.

doi: 10.1016/j.anscip.2023.01.159

O-084
Lessons learned about *Brucella ovis* control in four different farms

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Keywords: Brucella ovis; Infertility; Control; Test-and-slaughter

Introduction
Brucella ovis is a non-zoonotic common cause of infertility in rams and reproductive failure in sheep. The only vaccine available for the prophylaxis of brucellosis in sheep is Rev1, which protects against *B. ovis* but is authorised exclusively for *Brucella melitensis* official eradication programs. Rev1 vaccination is banned in *B. melitensis* free regions to avoid potential interference in the diagnostic surveillance of this zoonosis. In Spain, a re-emergence of *B. ovis* has been reported after Rev 1 withdrawn (Muñoz et al., 2021).

Material and methods
Between 2016 and 2019, infertility problems were detected in 4 herds of different ovine breeds in Palencia (Spain), and serum and/or semen samples were submitted to the research laboratory on animal brucellosis of CITA (Aragón, Spain). An important percentage of these sera resulted positive in Agar Gel Immunodiffusion test (AGID) with *B. ovis* hot saline (HS) antigenic extract. Semen and other tissues or fluid samples from suspicious animals (males or females) were cultured on CITA selective medium and *B. ovis* infection was confirmed in the four herds by the bacteria isolation from epididymis or semen, milk and/or vaginal swabs.
In each herd, a particular control strategy was implemented (according to the farmer decision) and the sanitary status monitored by AGID (and culture, whenever possible) along several years.

Results and discussion
In **Farm A** (580 sheep), the whole herd was serologically tested, and positive animals (males and females) removed immediately. A total of 31 animals were removed in two whole test rounds with one year interval. Then, only rams were tested once a year (always before mating season) and 3 consecutive negative results achieved. In **Farm B** (1200 sheep), positive rams were removed immediately while females were tested and slaughtered gradually, in groups of 200-300, before mating. In these herds, rams have been kept monitored and the infection is apparently controlled.
In **Farm C** (324 sheep), all rams (5) were slaughtered but ewes (13% AGID positive) were only partially removed. In **Farm D**, only males (24) were submitted to test-and-slaughter. In both herds, rams remain infected 3–4 years after, as a logical consequence of having kept *B. ovis* infected ewes.

Conclusion and implications
These field experiences highlights the importance of monitoring and control *B. ovis* infection. In absence of *B. ovis* specific vaccines, to tests-and-slaughter positive animals and replace with *B. ovis* free ones was the only cost-effective strategy. Our results stress the need to act on both males and females, given the relevant role of the latter in the spread of the infection.

Acknowledgements and funding
Gobierno de Aragón (Grupo de Investigación A21_20R).

Reference

Muñoz et al., ñoz et al. 2021. Mundo ganadero. Año 31 (297), 34–39.

doi: 10.1016/j.anscip.2023.01.160

O-085
Zoonotic problems reported by sheep farmers and factors potentially contributing to the occurrence of brucellosis among them

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Keywords: Biosecurity; Brucellosis; Health management; Zoonosis

Introduction
The present study refers to an extensive countrywide investigation performed in sheep flocks throughout Greece. The study aimed to investigate the occurrence of zoonotic problems reported by sheep farmers in Greece and to study potential associations with socio-demographic characteristics of the farmers and management practices applied in the farms.

Material and methods
A countrywide investigation was performed in 325 sheep farms in the 13 administrative regions of Greece. The selected farms were visited and interviews were conducted with respective farmers. Management factors in the farms were assessed. The occurrence of zoonotic problems in the farmers was recorded. A total biosecurity score (0–6) was devised, based on biosecurity practices followed in farms. Descriptive

statistical analysis, followed by using univariable and multivariable models, were performed to describe the problems and to identify predictors for zoonotic infections of farmers.

Results and discussion
Forty-four farmers (13.5%, 95% confidence intervals (CI): 10.2–17.7%) reported experiencing a zoonotic problem. Most of the farmers (n = 35) (79.6%, 95% CI: 65.5–88.9%, of those with a zoonotic problem) (10.8%, 95% CI: 7.9–14.6%, of all) reported that the zoonotic problem had been brucellosis. Other zoonotic problems reported were the following: anthrax, contagious ecthyma, flea infestation, fungal (*Trichophyton*) infection, hydatid disease, ophthalmic myiosis and tick infestation. For the outcome 'occurrence of brucellosis', the application of hand-milking, the availability of a separate lambing area and the presence of cats in the farm emerged as significant predictors ($p < 0.01$). The mean biosecurity score in farms in the continental area of the country was significantly higher than in the islands: 3.45 ± 0.05 *versus* 2.76 ± 0.28, respectively ($p = 0.006$). There was also a significantly higher score in farms, where the farmer reported occurrence of brucellosis: 3.68 ± 0.15 *versus* 3.34 ± 0.06 in farms, where the farmer did not report such an incident ($p = 0.042$).

Conclusion and implications
Brucellosis was reported to be the most frequent zoonotic problem in sheep farmers. Management practices applied in the farms were identified as predictors for the infection in the farmers; these were machine-milking, the presence of cats in the farms and the presence of a dedicated area for obstetrical cases. Biosecurity scores were higher in farms where farmers reported occurrence of brucellosis, so we postulate that these farmers understood better the importance of biosecurity, as they had experienced a zoonotic infection in the past. In farms where the above predictors prevail, farmers should be warned of an increased potential risk for human infections and appropriate biosecurity measures should be implemented.

doi: 10.1016/j.anscip.2023.01.161

O-086
Validation of a new technique to safely sample, store and ship goat bulk tank milk to diagnose Q fever at flock level

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Keywords: Q fever; Goat; Bulk tank milk; Diagnosis

Objectives
In goats, Q fever is mainly responsible for abortions, stillbirth and birth of weak kids. It is caused by an intra-cellular bacterium: *Coxiella burnetii* (**Cb**).
Bulk tank milk (**BTM**) is an easy and representative sample to detect Cb infections at herd level using RT-PCR. But one limitation under field conditions is the need to deliver the samples in adequate conditions (quickly, refrigerated and safely) to a qualified laboratory.
Two years ago, we developed QTest, an innovative tool for Q fever diagnosis in dairy cattle. Farmers or veterinarians simply place some drops of BTM on a cellulose paper card containing chemicals that lyse cells and denature proteins while maintaining DNA integrity (collection card) and let it dry before posting it to the laboratory.
The objective of this study was to also validate this technique for goat BTM.

Material and methods
279 BTM samples from different goat flocks in western France were tested for Cb by PCR. Among the positive results, 70 were selected to cover a wide range of Ct values (25–33). The DNA extracts were then frozen (D0).
Concomitantly, each of the BTM samples were spotted on 6 collection cards, (4 circles per card). Two collection cards were stored at room temperature (20–22 °C), two at 4 °C and two at 37 °C. On D2, DNA extraction was performed from two circles of cards stored at room temperature and frozen. On D15 and D32, two circles from each storage temperature were extracted and frozen.
Finally, on D33, all DNA extracts were amplified to ensure amplification comparability.

Results
After thawing, all BTM extracts gave positive results but with higher Ct values, confirming that a freeze-thaw cycle affects PCR analytical sensitivity.
Regarding results from collection cards, the average coefficient of variation (CV%) for the Ct values of all samples was 3.43. This is compliant with the CV% of other PCR techniques performed in our laboratory. Therefore, it can be stated that the use of collection cards allows the preservation (up to 32 days) of BTM sample for Cb DNA detection by PCR, whatever the storage temperature.
Nevertheless, a few samples gave negative results regardless of the temperature and duration of storage. A likely explanation for this phenomenon is that Cb is not uniformly distributed in the milk. The quantity of Cb in some circles may be below the detection limit.

Conclusion
We showed using QTest doesn't impair the diagnosis of Q fever on BTM. Indeed, the stability of Cb DNA on a collection card is maintained for at least 32 days at different temperatures. Therefore, this technique would facilitate an easier approach to diagnosis of Q fever at herd level for goats as well as for cattle.

doi: 10.1016/j.anscip.2023.01.162

O-087
Persistent *Coxiella burnetii* infection of caprine mammary gland tissue

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Keywords: Goat; Q fever; Udder; Zoonosis

Introduction
The obligate intracellular bacterium *Coxiella (C.) burnetii* causes Coxiellosis in animals and Q fever in humans respectively. Infected goats excrete the pathogen through birth material, but also feces and milk. Humans become infected by inhalation of contaminated dusts and aerosols. Infection through consumption of raw milk may occur, but seems to be a rare event, and is still under debate. Bulk tank milk (BTM) is regularly analyzed for *C. burnetii* surveillance in dairy goat herds. Intermittent *C. burnetii* milk shedders in goats are described, but the final proof of *C. burnetii* infestation in the udder is still pending.

Material and methods
Coxiellosis was diagnosed in a 156-head dairy goat herd. Thereafter, the herd was vaccinated with an inactivated *C. burnetii* Phase I vaccine (Coxevac®, Ceva, Libourne, France) and annually revaccinated for two years. To monitor the course of infection, BTM samples were monthly collected and analyzed by PCR after vaccination. Moreover, individual milk samples were collected from all lactating goats and examined by PCR on four sampling dates approximately five months apart. One goat (#67455) tested positive on three out of four sampling dates. This goat was euthanized and numerous organ samples, including the udder and the reproductive tract, were analyzed by PCR. In addition, the mammary gland tissue was examined by immunohistochemistry and fluorescence *in situ* hybridization (FISH) to locate *C. burnetii* in the mammary gland tissue.

Results and discussion
C. burnetii DNA was repeatedly detected in monthly BTM samples. Milk samples from eleven goats contained *C. burnetii* at least once on the four sampling dates, but only goat #67455 tested positive on three sampling dates. After necropsy, *C. burnetii* DNA was detected by PCR in the mammary gland tissues from goat #67455. The presence of *C. burnetii* in the mammary gland tissue was confirmed by the detection of the pathogen with immunohistochemistry and FISH. All BTM samples tested negative for *C. burnetii* DNA after removal of goat #67455 from the herd.

Conclusion and implications
The present study confirms the existence of intermittent *C. burnetii* milk shedders in dairy goat herds. For the first time, *C. burnetii* organisms were detected within mammary gland tissue from a goat. Moreover, vaccination against *C. burnetii* did not prevent pathogen shedding through milk in infected dairy goats. Therefore, BTM surveillance of *C. burnetii* positive and subsequently vaccinated goat herds has to be complemented by individual milk tests to identify and remove intermittent shedders. Milk from such herds have to be pasteurized before human consumption to reduce the zoonotic risk.

Acknowledgements and funding
This work was funded by the Federal Ministry of Education and Research (BMBF) under project numbers 01KI1726B and 01KI2008B and as part of the Research Network Zoonotic Infectious Diseases.

doi: 10.1016/j.anscip.2023.01.163

O-088
Bluetongue virus in sheep: From natural to experimental infection

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Keywords: Bluetongue; Rams; Experimental infection; Natural disease

Introduction
Bluetongue (BT) is an infectious haemorrhagic disease of domestic and wild ruminants caused by Bluetongue virus (BTV), an arbovirus transmitted by *Culicoides* belonging to the genus Orbivirus of the family Reoviridae.
BTV infection can be asymptomatic up to clinically fatal. Recently, during BTV infection, serious consequences in the male reproductive tract resulting in testicular degeneration have been reported in rams.
BTV serotypes/strains with different virulence are well described during several BTV epidemic incursions in the world. The different clinical outcome of BT is related to a variety of factors, including host specie and specific virus serotypes/strains.
Herein, we studied whether a strain of BTV serotype 1 isolated from severe clinical cases involving rams, shapes different clinico-pathological outcomes after experimental infection by using 2 different inoculum sources.

Material and methods
An Italian field strain of BTV serotype 1 ($BTV\text{-}1_{IT2006}$) isolated during the 2006 epidemic season in Sardinia (Italy) was used to infect two groups of rams. Experimentally, one group was intradermally injected using infectious blood sampled from natural symptomatic affected rams, and the other group was infected with the same strain virus isolated in insect (KC) cells. Animals were euthanized at 7- and 10-days post-infection (dpi) and a wide range of tissues was collected for Real-Time RTPCR, histopathological and immunohistochemical examinations.

Results and discussion
Infected rams showed a similar clinical outcome after the infection with the 2 different BTV inoculum sources, reproducing clinically observed symptoms and lesions in the field. All rams developed severe clinical signs of BTV, with 2 peaks of fever (>40 °C) at 3 and 6-7 dpi. An increase in the severity of the clinical signs was determined at 7 dpi.
Grossly, hyperemia and hemorrhage were observed in the gastrointestinal tract, pulmonary artery, and the papillary muscle of the left ventricle.
No pronounced difference in the induction and progression of viraemia, as determined by Real Time RTPCR, was observed.
Interestingly, as determined in the field, all the infected rams display a clinical disease characterized by the involvement of the genital tract. Furthermore, histological examinations reflected in the organs the gross changes, and in the testis, irreversible degeneration of the tubular germinative epithelium was determined. By immunohistochemistry, BTV NS2 protein was found in the vascular endothelial cells of several organs until 10 dpi.

Conclusion and implications
Reliable models of experimental infection are considered an important research tool to develop and facilitate pathogenetic studies on BT. We found that BTV KC cell inoculum reproduces faithfully the natural disease and is a valid alternative to the use of field infectious blood for studying the pathogenesis of BTV strains, increasing the biosecurity, and standardizing the protocols to rule out the presence of bias in experimental conditions.

Acknowledgements and funding
Grant IZSSA02/16RC.

doi: 10.1016/j.anscip.2023.01.164

O-089
Epidemiologic features of Bluetongue virus in sheep: Serologic and molecular evidence

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Keywords: Bluetongue; Seroprevalence; Viropositivity; Risk factors

Introduction
Bluetongue is an arthropod-borne viral disease transmitted by *Culicoides* biting midges, affecting domestic and wild ruminants. It is considered worldwide as a threat to sheep livestock. The current study aims to assess the seroprevalence of the Bluetongue virus (BTV), confirm its active circulation, and identify the serotypes circulating in a sheep population in Morocco, as well as study the associated risk factors with BTV infection.

Material and methods
To this end, a total of 1376 samples from sheep were randomly collected in eight (out of 12) regions of the country between March 2018 and July 2021. These samples were primarily tested using competitive ELISA (c-ELISA). Subsequently, 59% of c-ELISA positives (n = 349) were analyzed for all serotypes by real-time reverse transcription-polymerase chain reaction (RT-qPCR). Following that, RT-qPCR positives were serotyped using BTV-specific RT-qPCR. The data were analyzed according to six factors, including age, sex, breed of the animals, breeding systems, season, and region of origin. The proportions of seroprevalences and viropositivity rates according to these factors were compared by calculating 95% confidence intervals with the Mantel-Haenszel Chi-Square test in OpenEpi© Software (2021).

Results and discussion
The results revealed an overall BTV seroprevalence in sheep in Morocco of 42.6%. The overall BTV viropositivity rate was of 48.1%. These viro-serological rates varied significantly by age, sex, breed of the tested animals, husbandry method, season, and geographic origin. This indicates that these parameters constitute risk factors for BTV transmission routes in sheep in Morocco. Serotypes BTV-1, BTV-4, BTV-8, and BTV-16 were detected, with the emergence of BTV-9 for the first time in Morocco. The co-infection rate was 3.1% by BTV-1/BTV-16, 2.4% by BTV-4/BTV-16, and 1.2% by BTV-4/BTV-9. Furthermore, the co-infection rate by BTV-1/ BTV-4/ BTV-16 was 2%. These may play a role in the reassortment process between the serotypes circulating in Morocco and, consequently, the emergence of new virulent strains.

Conclusion and implications
This study is the first in Morocco to assess the BTV infection rates and risk factors of its transmission among sheep herds. The current serological and molecular investigations revealed that the BTV is endemic throughout the country, with a high risk of new severe epidemics. The epidemiological evolution of Bluetongue in Morocco can be explained by the absence of an effective and sustainable preventive vaccination program, the co-existence of reservoirs and susceptible animals, the host response to infection, the environmental conditions, and the silent circulation of the BTV within Moroccan livestock. The transhumance factor and the limited control of susceptible animal movements promote BTV circulation throughout the country.

Acknowledgements and funding
This research received funding from the EU Horizon 2020 project ‘‘PALE-Blu-Understanding pathogens, livestock environment, interactions involving bluetongue”, under grant agreement No. 727393.

doi: 10.1016/j.anscip.2023.01.165

O-090
Ecology epidemiology and clinics of BTV in Israely sheep herd

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Keywords: Bluetongue; BTV-3; BTV-8; BTV-9

Clinical history
Blue Tongue Virus (BTV) was diagnosed in Israel at 1950. It was the second BTV diagnosis outside Africa. The BTV serotype was 4. Till 2005 4 more serotypes were detected. From the 60s till 2002 a polyvalent live attenuated vaccine was used mandatorily. The health and economic load of BTV started to be of interest after intensive introduction of novel serotypes to the naïve sheep herds. Since 2006 during 15 years 9 new BTV serotypes was detected from samples submitted by attending vets.

Investigations
Eruptions of serotype 3 in 2013 till 2017 was limited to the south of Israel and to sheep herds. In 2018, BTV-3 was instead found in the Israeli coastal area being one of the dominant BTV serotypes isolated from symptomatic sheep, cattle and goats.
BTV-8, closely related to the European strain, was introduced to Israel in 2008. It was at the center of BT outbreaks in 2010 and 2015–2016. In 2019 the 8-serotype isolate suggested the Israeli strain developed parallel to the European strain.
In 2019 outbreaks caused by BTV-1 and BTV-9 were reported, which previously had not been registered in Israel. BTV-1 caused a single-season outbreak, when positive cases were found at all over the country, probably causing mild infection in ruminants. Serotype 1 became the dominant isolation since 2021 and mainly this year. The clinical sings remain mild.
Considering outbreak caused by BTV-9 in 2019, the first detection was from sheep farm at North of Israel at the end of July. In general, BTV-9 was registered in 14 sheep and 14 cattle farms the main serious cases located at the Norden border of the country.

Discussion
Clinical signs in affected sheep flocks, ill animals demonstrated fatigue, facial edema, cyanosis of mucous membranes, serous or bloody nasal and oral discharges, eye discharge, abortions, fever, lameness or stiff gate, and acute death. In two dead sheep pulmonary artery hem-

orrhages were seen at post mortem examination. Confirmed positive abortion sheep cases were also detected. Clinical signs in milking cows included hypersalivation, fever, dyspnea, recumbency and milk reduction, and diarrhea.
Treatment is based mainly on quick detection and NSAIDs administration. According to our impression meloxicam gives the best results. Broad spectrum antibiotics are suggested due to complications. Insects' repellants are also advised.
Control measures are limited and related to beading managements, ventilators, preventive repellants and vaccination. The listed vaccines are serotypes 4 + 8 inactivated vaccine and serotype 3 autogenic inactivated vaccine. Those two options have limited success in complete protection however reducing clinical signs to our impression.

doi: 10.1016/j.anscip.2023.01.166

O-091
Serological study of FMD virus (serotypes A, O, Asia-1) and its associated risk factors in small ruminants

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Keywords: Seroprevalence; Smallruminants; Outbreak; Transboundarydisease

Introduction
Foot-and-mouth disease (FMD) is a highly contagious viral disease that affects multiple species of domestic and wild cloven-hoofed animals, and causes massive economic losses due to morbidity, mortality and trade restrictions. Although the disease is endemic in Pakistan, seasonal outbreaks occur across the country.

Material and methods
A serological survey was conducted in a typical small-scale livestock farming village in northern Punjab Province, Pakistan between December 2019 and November 2020 to look for antibodies against FMD virus and to find associations with various animal and husbandry factors. Samples were tested using competitive-ELISA kits (ID-Vet FMD Screen® Type Asia-1, A, O, Grabels, France).

Results and discussion
A total of 337 serum samples (Goat: 247; Sheep: 90) were tested. At the animal level, FMD seroprevalence was 23.4%. Seropositivity within herds ranged from 10 to 33%. We found serotype O (13%) as the most prevalent, followed by serotype A (7%) and Asia1 (1%). FMD seroprevalence was higher in goats (25.1%) than in sheep (18.8%). Females had higher seroprevalence (24.1%) than males (16.6%). Adult animals (>12 months) appeared to have of being seropositive than young animals. Young animals are often managed separately in the study areas and have less exposure to the disease. Animals that were grazed on common areas outside the farm, where presumably there was greater contact with livestock from other households, had twice the odds of being seropositive than animals managed at home (OR = 2.04, 95% CI = 1.15–3.59). The proportion of seropositive animals decreased from December and February (26.6%) to August (17.5%) before increasing in November (23.9%). Individual animals could not be reliably identified between sampling periods, so we could not verify whether these fluctuations were influenced by an increased incidence of infection in later 2020 or was otherwise associated with repeated sampling of some of the same animals. Nonetheless, this seasonal fluctuation could be associated with increased viral stability and transmission in cold and rainy weather, or seasonal changes in factors such as births or trading.

Conclusion and implications
Our research has shown that FMD is prevalent in sheep and goats in a typical village farming setting in Punjab. This work shows that further research and policy are required to address the impact of FMD on small ruminants, their role in transmission and disease in large ruminants, and the effect that including them in routine disease control would have for overall management of FMD in Pakistan and farmer livelihoods.

Acknowledgements and funding
This work was part of the project *LS-2018-105 Enhancing small ruminant production to benefit farming families in Punjab and Sindh*, supported by the Australian Centre for International Agricultural Research, implemented by the University of Melbourne and the University of Veterinary and Animal Sciences (Lahore).

doi: 10.1016/j.anscip.2023.01.167

O-092
A survey of anthelmintic resistance on sheep farms in south-east England

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Keywords: Sheep; Anthelmintic; Resistance; FECRT

Introduction
Parasitic gastroenteritis is the most expensive disease affecting the UK sheep flock; a cost increased by anthelmintic resistance. There have been no surveys of the prevalence of anthelmintic resistance in the south-east of England since 1984.
One suggestion for prolonging the efficacy of anthelmintics is the use of several different classes of actives simultaneously. The rationale is that while populations of nematodes with genes for resistance to one class of anthelmintic or another may exist on farm, the likelihood of any given nematode having genes for resistance to both classes is lower.
The aim of this study was to investigate the efficacy of levamisole and ivermectin, administered both alone and simultaneously, on sheep farms in south-east England.

Material and methods
Sheep flocks comprising at least 100 breeding ewes, that were the clients of two practices in the south-east of England, were offered the chance of enrolment in the study in July-September, 2021-22. Criteria for inclusion were a pooled worm egg count result of >200 epg in lambs, as determined by modified McMaster method, and no anthelmintic treatment within the past 4 weeks (longer if a persistent product had been used).
Once enrolled the farm was visited twice, 12-14 days apart. At the first visit lambs were individually faecal sampled, marked and dosed to weight: 10 each with levamisole, ivermectin, and both actives. At the second visit lambs were again individually faecal sampled.
Faecal worm egg counts were performed on the individual samples using the cuvette method (accurate to 1epg).
Efficacies for each treatment class for each farm were calculated using the formula: % efficacy = ((Mean FEC1 − Mean FEC2)/Mean FEC1) * 100.
Speciation was performed using PCR. Results are presented in full by Zahid et al. (Abstract no. 246).

Results and discussion
19 farms were enrolled, but on one farm pre-treatment counts were found to be too low to continue, so the trial was completed on 18 farms. Efficacy of >95% was found on 5/18 farms for levamisole, 3/18 farms for ivermectin and 11/18 farms for the combination. There were 5 farms where the efficacy of the combination was >95%, but the efficacy neither ivermectin nor levamisole was >95%.
These results suggest:

(1) the prevalence of anthelmintic resistancecontinues to increase despite efforts to promote sustainable nematode control practices.
(2) the efficacy of multiple anthelmintic classes administered simultaneously in the face of anthelmintic resistance to the particular classes individually is difficult to predict.

Pre-treatment worm populations were diverse; post-treatment populations were dominated by *Teladorsagia circumcincta*.

Conclusion and implications
Anthelmintic resistance continues to become more prevalent in south-east England.

Acknowledgements and funding
This study was supported by Chanelle Pharma.

doi: 10.1016/j.anscip.2023.01.168

O-093
Can individual Famacha© score history help in the identification of sheep resistant or susceptible to *Haemonchus contortus*?

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Keywords: Ewes; Anaemia; Breeding; Database

Introduction
Gastrointestinal endoparasites, especially *Haemonchus contortus*, have an important impact in worldwide sheep farming, being responsible for cases of anaemia in susceptible sheep. A well filled longitudinal records can help identify the susceptible sheep, since selection for resistant hosts can be considered as one of the sustainable control strategies. The aim of this study was to analyze the FAMACHA© (F) evaluations over 16 years of observations to identify resistant and susceptible ewes to *Haemonchus contortus* infection.

Material and methods
Classifications of F, varying from F1 to F5, and age data of an experimental sheep herd were recorded since August of 2006 until July of 2022 on a database, from the sheep farming sector of FEGA, city of Fazenda Rio Grande, state of Paraná, Brazil. F were periodically evaluated, weekly, fortnightly or monthly, depending on the animal category and time of the year.

Results and discussion
There were 25.780 data of F evaluation of 304 sheep. Each ewe had between 4 and 230 evaluations and has been part of the herd for up to 11 years (average of 1,325 days), in which 158 ewes (51.9%) had only F1 and F2, indicating they were more resistant. These ewes had, in average, 16,6 and 58,8 evaluations, respectively; 101 ewes (33.2%) had F1, F2 and F3, with an average of 109 evaluations. And only 14.1% (43) ewes reached the F4 classification, with an average of 151 evaluations, and they could be considered more susceptible ewes. From the 5,571 evaluations in which F changes were observed, 2,313 (42%) were from F1 to F2 and 2,281 (41%) from F2 to F1, which indicates that most ewes had variation in the degree of infection, but still in low levels of infection. Only in 483 evaluations (9%), ewes reached F3 or F4, and in 475 (8%) the classification was from F3 or F4 to F2 or F1, which would be indicative that they had recovered, mainly due to treatment with anthelmintics. In coprocultures, on average, 94% of the recovered larvae were *Haemonchus* sp.

Conclusion and implications
In many production systems, mainly where flock sizes are likely to be small, as is the case in the region where this work was done, selection on phenotype is likely to be the most feasible option to increase parasite resistance. These data show that it would be possible to adopt culling and selection criteria for ewes based on differences between individual FAMACHA© score history. Differences in the FAMACHA© classification can help identify the resistance or susceptibility of ewes to *H. contortus* infections.

doi: 10.1016/j.anscip.2023.01.169

O-094
Leishmania infantum seropositive in sheep from an endemic region of canine leishmaniosis

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Keywords: Sheep; ELISA; Leishmania infantum; Serology

Introduction
Leishmaniosis is a zoonotic disease with a worldwide distribution. Sandflies are the main vector of transmission of the parasite in endemic regions. Clinical disease associated to Leishmania spp. in sheep have been described in other countries different from european mediterranean countries including Ethiopia, South Africa, China or India. There is only limited information regarding the geographical distribution and epidemiological features of Leishmania infantum infection in sheep. The aim of the present epidemiological study is to investigate the presence of seropositive animals from an endemic area (Spain) of leishmaniosis due to *L. infantum*.

Material and methods
Serum samples were collected from September 2020 to October 2022 from 336 sheep (Rasa Aragonesa) in different flocks for Aragon Region (Spain). Separated sera were stored at −20 °C until processing. Detection of *L. infantum* antibodies were performed using a quantitative in-house Enzyme-Linked ImmunoSorbent Assay with some modifications to be performed in sheep. The cut-off was set to 0.38 optical density units, and results above this value were considered positive.

Results and discussion
In the serological study by the in-house Enzyme-Linked ImmunoSorbent Assay, a total of 29 positive animals were detected. All of the tested animals were females, adults and assessed as apparently healthy, with no evident systemic or dermatological signs found during the general physical examination prior to the blood extraction. The overall seroprevalence of *L. infantum* was 8.63%.

Conclusion and implications
Leishmaniosis is a very rare clinical condition in ruminant with a small number reports published in the scientific literature including different countries in Europe, Africa and Asia. In Europe, there are some evidence of the presence of seropositive animals in wildlife and domestic animals such as horse. This survey shows *L. infantum* infection in sheep exists in this Spanish region. In this study, we have detected the presence of antibodies anti-Leishmania infantum in sheep by an in-house Enzyme-Linked ImmunoSorbent Assay developed specifically to be carried out in this species. Therefore, sheep can be a potential reservoir of the parasite in endemic areas of Leishmania infection different from the traditional reservoir such dogs and cats. In conclusion, the detection of seropositive animal under natural conditions should be taken account from an epidemiological point of view. The presence of anti-Leishmania antibodies in blood from apparently healthy sheep could be considered as potential animal reservoir. Further studies are necessary to know the role of this reservoir should be investigated to clarify to what degree sheep are responsible for the maintenance of Leishmania infection in rural areas.

doi: 10.1016/j.anscip.2023.01.170

O-095
Tick-borne pathogens on sheep pasture in Norway

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Keywords: Ticks; Tick-borne infection; Pathogens; Anaplasma

Introduction
The aim of the study was to investigate the occurrence and severity of tick-borne pathogens, especially Anaplasma phagocytophilum, in ticks collected from pasture in Norway.

Material and methods
In September 2021, ticks collected by flagging in south-western areas of Norway were used in an experimental infection trial in sheep, including sixteen lambs (5–6 months old). The actual lambs were placed in four groups, each with four lambs. Lambs was infected/infested as follows: Group A: *Anaplasma phagocytophilum* i.v (day 0); group B: *A. phagocytophilum* (i.v.)(day 0) + ticks (day 4); Group C: Ticks (day 4); Group D: Controls. All lambs were followed daily from day 0 to 28 by clinical examination and collection of engorged ticks. Blood (serum and EDTA) were samples frequently for hematological analysis and identification of tick-borne pathogens both by PCR and serology (only *Anaplasma).* In addition, unfed and engorged/partly engorged ticks were investigated for the same pathogens.

Results and discussion
Altogether, more than 1100 nymphs and 110 adults *I. ricinus* ticks were collected from pasture. Of these ticks, 777 nymphs and 86 adults were allowed to feed on sheep. The total number of engorged /partly engorged ticks collected from these lambs were 341 nymphs and 31 adults. All lambs, except for the controls, reacted with fever and typical symptoms of an *A. phagocytophilum* infection, and the bacteria were also detected in the blood of these lambs together with seropositive antibodies. No other pathogens were detected in the blood. *A. phagocytophilum, Borrelia burgdorferi sensu lato, Borrelia miyamotoi, Rickettsia helvetica, Neoehrlichia mikurensis* and *Spiroplasma ixodetis* were detected in the ticks. *A. phagocytophilum, N. mikurensis* and *S. ixoditis* infection were more common in engorged compared to unengorged ticks, while less *B. burgdorferi* s.l. was detected in engorged ticks.

Conclusion and implications
Sheep seem to be an amplifying host for *A. phagocytophilum*, *N. mikurensis* and *S. ixodetis,* but a dead-end host for *B. burgdorferi* s.l.

doi: 10.1016/j.anscip.2023.01.171

O-096
Immune supression is genetically regulated in lambs during experimental infection with *Anaplasma phagocytophilum*

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Keywords: Ticks; Infection; Anaplasma; Immunology

Introduction
Tick-borne fever (TBF) is caused by *Anaplasma phagocytophilum* and has grave impacts on animal welfare, as lambs develop high fever (>41 °C), immune suppression and secondary infections that may result in crippling. Pyrethroids are widely used as prophylaxis against tick infestation and clinical cases of TBF are typically treated with tetracyclines. A vaccine against the disease has been requested by farmers and veterinarians for decades, and potential vaccine candidates have previously been explored by our groups. However, clinical protection has not yet been achieved. In the current study, we have used RNA sequencing in association with clinical data to study interactions between *A. phagocytophilum* and the regulation of immune responses during experimental infection in immune competent lambs.

Material and methods
Ten sheep were inoculated with a virulent strain of *A. phagocytophilum* (GenBank acc.no M73220) and observed for 22 days. Rectal temperatures were registered daily, and samples were collected on preselected timepoints for analysis of bacterial load (qPCR), hematology and expression of host mRNA (Next Generation Sequencing). Blood genomic expression profiles were generated for each animal at each time point along the experimental infection, and core genes were grouped according to biological functions based on significance in change of expression levels. Five sheep were included as uninfected, negative controls.

Results and discussion
All inoculated lambs developed clinical signs of TBF. Maximum rectal temperatures were observed on four days post infection (dpi), followed by a period of lymphocytopenia and neutropenia. Maximum bacterial loads were registered on six dpi. T-cells phenotyped as $CD4^+$-$CD25^+$, comprising activated T-cells and T-regulatory cells, were significantly reduced from 10 to 14 dpi compared with day zero which is reflected by the expression profile of genes involved in these cells pathways. The expression of core genes involved in mediation of inflammatory responses and genes associated with stimulation and regulation of neutrophil function were predominantly and significantly changing along the path of infection. Genes and gene pathways involved in unspecific B- and T-cell activation and regulation were also identified and significantly expressed during the infection trial. According to the identified gene regulatory pathways, an upregulation of T helper-1 associated genes and genes associated with cytotoxic T-cells, seem to be important responses to the infection. On the other hand, genes associated with antigen presentation and antigen activation of T-cells were downregulated and indicate defective adaptive responses to *A. phagocytophilum*. No clinical signs of TBF were detected in the negative control sheep.

Conclusion and implications
Our study reveals upregulation of pathways and genes associated with a Th1-immune response in the *A. phagocytophilum* infected hosts and a downregulation of other adaptive pathways. The results of this study may partly explain the immune suppression observed during infection.

doi: 10.1016/j.anscip.2023.01.172

O-097
Tick control prevents icteric carcasses condemnation associated with ovine anaplasmosis in lambs

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Keywords: Icteric carcasses in lambs; Ovine anaplasmosis; Sheep; Tick control

Introduction
Ovine anaplasmosis is an emerging disease in Europe caused by the bacteria *Anaplasma ovis* that has been spread quickly through Spanish sheep flocks. The disease is causing relevant economic losses in some farms suffering outbreaks of ovine anaplasmosis in lambs because of carcass condemnation due to jaundice produced by the generated anaemia. Although some studies have demonstrated that the use of antibiotics can reduce the number of icteric carcasses, it is necessary to find a preventive measure to avoid the outbreaks.
A field trial with topic antiparasitic products was performed by the Ruminant Clinical Service (SCRUM) on a sheep flock historically affected by anaplasmosis.

Material and methods
The affected farm was a 2000 sheep meat farm in an extensive production system located in the north of the Aragon region (Spain), which raised Rasa Aragonesa breed.
Initially, 360 third-term pregnant ewes were sampled to test *A. ovis* by PCR. Only 4 out of 360 animals were negative and excluded from the trial (98.8% individual prevalence). The first 250 ewes with their 336 newborn lambs were chosen for the study and randomly divided into five groups. Group A kept as control, and no treatment applied. Group B: lambs treated with deltamethrin the first week of life. Group C: lambs treated with cypermethrin the first week of life. Group D: ewes treated with cypermethrin one week before lambing. Group E: ewes treated with deltamethrin one week before lambing. All products were applied pour on at the recommended dose per kg of live weight.

Ticks were reviewed weekly and quantified in the 250 ewes for eight weeks. Whole blood samples were collected from the 336 newborn lambs, 21 and 42 days after birth, to perform a molecular PCR-RT test for *A. ovis*. In addition, all lambs were checked for ticks at these moment. Finally, 119 of these lambs were followed at the abattoir to check if icteric carcasses were condemned.

Results and discussion
A very low number of ticks in ewes and lambs was observed throughout the study, and no significant differences were observed between groups. In addition, only three lambs out of 336 analysed were positive for *A. ovis* by PCR (0.9%) in the whole study. Only one lamb was condemned at the abattoir due to jaundice out of the 119 analysed.

Conclusion and implications
No significant differences were shown between the groups treated with cypermethrin and those treated with deltamethrin, both in the ewes and in the lambs. Both products showed excellent efficacy against tick control. Although the untreated control group animals did not show ticks, this was probably due to the repellent effect produced in the entire flock because farmers and dogs suffered from a terrible tick infestation.

doi: 10.1016/j.anscip.2023.01.173

O-098
Icteric carcasses condemnation in lambs. A growing threat associated with Ovine anaplasmosis

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Keywords: Carcasses condemnation; Icteric carcasses; Lambs; Ovine anaplasmosis

Introduction
Ovine anaplasmosis is an emerging disease in Europe, especially in the Mediterranean area, caused by the bacteria *Anaplasma ovis*. anaplasmosis has recently been associated with an increase in the condemnation of icteric lambs. *A. ovis* can cause severe haemolysis in affected animals, leading to jaundice detected after slaughtering, although lambs do not seem to show clear clinical signs. During the last few years, an increase in the percentage of icteric carcasses has been observed at the abattoir, which has become a growing threat for sheep farmers. Due to this reason, some livestock cooperatives contacted the Ruminant Clinical Service (SCRUM) of the Veterinary Faculty of Zaragoza to analyse the data and try to find a possible solution.

Material and methods
Data of lambs slaughtered from different companies were recorded and analysed from January 2018 to December 2021 using IBM SPSS Statistics v.24 software (IBM, USA). Finally, 337,201 two to three months old lambs of different breeds present in Aragon were analysed. The studied data were the date of slaughtering, condemnation or not, cause of condemnation and percentage of icteric carcasses. Each cooperative was analysed separately and together.

Results and discussion
In total, 599 out of the 337,201 studied animals were condemned due to icteric carcasses. Although the global number is not high (0.18%), the data analysed annually show an apparent increase of icteric carcasses condemnation year after year: 0.07% in 2018, 0.13% in 2019, 0.23% in 2020 and 0.29% in 2021. A concerning increase is observed, quadrupling in just three years. Significative differences are observed between 2018 and 2020 and 2021 ($p < 0.001$ and $p = 0.028$ respectively). However, no differences were observed between cooperatives ($p = 0.387$).
In adition, a clear seasonality was perceived. In 2018, a slight increase was observed from March (0.05%) to a maximum peak in June (0.13%), while in 2019, the condemnation rate reached a maximum value of 0.27% in June. In 2020, this increase was also observed in May and June, getting even higher values (0.45%) and 2021 was a critical year due to the observation of a peak value of 1.10% in June, which is 8 times higher than the observed in 2018. Surprisingly, in 2020, an increase in autumn was also remarkable, getting values of 0.29%. Finally, jaundice is the main total carcasses condemnation cause in the studied period (32.71%).

Conclusion and implications
A significant increase was observed in the number of carcasses condemned due to jaundice, probably associated with ovine anaplasmosis over the years. These condemnations were concentrated in two specific moments: Spring, from May to June, and in autumn, in October. Further studies are needed to find a solution to this problem in order to reduce the economic losses associated with this disease.

doi: 10.1016/j.anscip.2023.01.174

O-099
Prevalence and aetiology of subclinical mastitis in sheep, as found in an extensive field investigation

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Keywords: Dairy sheep; Mastitis; Prevalence; Risk factors

Introduction
Objectives of the work presented herewith were to: (a) investigate prevalence of subclinical mastitis, (b) identify aetiological agents involved and (c) study factors potentially predisposing ewes to subclinical mastitis.

Material and methods
Milk samples were collected from 2198 ewes in 111 farms (total population: 35,925 animals); separate samples were collected from each mammary gland of each animal. Farms were located in all 13 administrative regions of Greece. Samples were obtained from clinically health animals (ewes with clinically detectable mammary abnormalities were not sampled) and were processed bacteriologically and cytologically by conventional techniques. Subclinical mastitis was defined in ewes in which a bacteriologically positive milk sample ([a] >10 colonies of the same organism and [b] no more than two different types of colonies) with concurrently increased CMT score (≥'1') plus neutrophil and lymphocyte proportion (≥65% of all leukocytes) was detected. Descriptive analysis was performed. Animals sampled were in 1st to 10th month post-lambing. Then, for assessment of the importance of predictors, initially cross-tabulation with the chi-square test was carried, which was followed by multivariable analysis with simple logistic regression without random effects.

Results and discussion
Prevalence of subclinical mastitis was 26.0% (95% CIs: 24.2–27.9%). Main aetiological agents were staphylococci: *Staphylococcus aureus* and coagulase-negative species (more frequent species: *S. chromogenes*, *S. epidermidis*, *S. simulans*), which accounted for 69.9% of all isolates recovered (17% of staphylococcal isolates were *S. aureus*, 83% of isolates were coagulase-negative species); prevalence of staphylococcal mastitis was 19.1% (95% CIs: 17.5–28.8%). In multivariable mixed-effects analysis, the primary factor found to be associated with increased prevalence of subclinical mastitis and staphylococcal subclinical mastitis was the management system practiced in flocks (in flocks under semi-intensive system, there was the highest prevalence; OR: 1.946 ($p = 0.008$)). Other factors found to be significant in multivariable analysis were stage of lactation period (ewes in 2nd month post-partum showed highest prevalence; OR: 1.533 ($p = 0.002$)) and the post-milking teat dipping (in farms where the practice was carried out, there was lower prevalence; OR: 1.504 ($p = 0.018$)). In contrast, the intramammary administration of antimicrobial agents at the end of a lactation period was not found to have an effect in the prevalence of subclinical mastitis.

Conclusion and implications
Results confirmed the significance of subclinical mastitis as frequent problem in ewes, with staphylococci as primary aetiological agent. Management system applied in farms was the most important factor for subclinical mastitis. Animal-related factors, e.g., stage of lactation period, may also play a role in development of mastitis. Application of targeted health management methods, e.g., post-milking teat dipping, may be associated with reduced prevalence of subclinical mastitis. The findings confirm the multifactorial nature of subclinical mastitis and indicate that its control should rely on many approaches.

doi: 10.1016/j.anscip.2023.01.175

O-100
Field evidence for association between increased gastrointestinal nematode burden and subclinical mastitis in dairy sheep

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Keywords: Meat sheep; Clinical mastitis; Incidence; Questionnaire

Introduction
Mastitis is an important disease in sheep flocks that causes economic and production losses to farmers. These losses are attributed to reduced milk production and consequent poor lamb growth, increased ewe and lamb mortality, ewe culling and replacement rate, and veterinary treatment. Although some of the mastitis repercussions and risk factors are known, the literature related with mastitis in meat pro-

ducing sheep is limited, and very few studies have evaluated its incidence and epidemiology. The objectives for this study are (1) to determine the incidence of clinical mastitis in meat sheep flocks, (2) assess variation in incidence between farm systems, geographical location and management practices, (3) describe the common practices used to diagnose, treat and manage cases of clinical mastitis and (4) identify potential risk factors and areas for further research.

Material and methods
An online questionnaire has been created using JISC online surveys service. The survey is divided in eight sections including introduction, consent form, description of the flock, performance figures, clinical mastitis (acute and chronic), weaning management, risk factors and final statement. There are 45 questions but only 31 are directly related with mastitis (number of cases, treatment, management, etc.). The other questions concern the farm system, lambing management, number and breed of the breeding ewes, etc. Most of the questions are closed or semi-closed with multiple choice, but few are short-answer open questions. The questionnaire was launched on the 21st of September and will close on 1st of January 2023. Email, social media and paper flyers have been used to distribute the questionnaire to meat sheep producing farmers and sheep vets in the United Kingdom and some European countries such as Netherlands, Spain and Ireland. The participants have been recruited through the RDSVS Farm Animal Practice, other UK veterinary practices, the European College of Small Ruminant Health and Management colleagues, British Sheep Veterinary Society members, British National Sheep Association members and Spanish Society of Sheep and Goats. The questionnaire was translated into Spanish and French to increase participation of non-English speaker farmers.

Results and discussion
The results will allow the estimation of clinical mastitis' incidence and its variation in between farm systems, countries and regions and management practices. The statistical analysis, results and conclusions will be presented and discussed in the ISVC 2023 Conference.

Conclusion and implications
Clinical mastitis in meat-producing sheep is considered common reason for treatment and culling on farms. The results of this survey will enable a greater understanding of the incidence of mastitis and treatments in sheep flocks.

doi: 10.1016/j.anscip.2023.01.176

O-101
Field evidence for association between increased gastrointestinal nematode burden and subclinical mastitis in dairy sheep

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Keywords: Co-infection; Mastitis; Nematode; Risk factor

Introduction
The objective of the present work was to evaluate, under field conditions, potential associations between gastrointestinal nematode parasitism and subclinical mastitis in ewes during the lactation period.

Material and methods
In total, 16 semi-intensively managed farms in Greece were included into the study and visited for collection of samples. In each farm, 15 clinically healthy ewes grazing for at least 8 hours daily and not treated for endoparasites during the last two months prior to the study, were sampled. Clinical examination of the udder (observation, palpation, comparison between glands) was performed to confirm lack of abnormalities. Milk samples were collected aseptically from both mammary glands of ewes. Faecal samples were also collected from the animals. Milk samples were examined by the California Mastitis Test and also were cultured by conventional microbiological techniques. Faecal samples were processed by relevant parasitological techniques for trichostrongylid faecal worm egg counts, for *Dicrocoelium dendriticum* faecal egg counting and for *Fasciola* spp. and helminths of the Paramphistomatidae family faecal egg counting. Subclinical mastitis was considered in ewes in which a bacteriologically positive milk sample ([a] >10 colonies of the same organism and [b] no more than two different types of colonies) with concurrently increased CMT score ($\geq$'1') and neutrophil and lymphocyte proportion ($\geq$65% of all leucocytes) was detected. Associations between presence of subclinical mastitis and parasitic infections were assessed on individual farm basis by use of Fisher-exact test.

Results and discussion
In the population sampled, prevalence of gastrointestinal nematode infection was 63.0%; mean faecal count was 357.7 ± 32.4 eggs per gram (epg); *Teladorsagia* spp. larvae were identified more frequently in coprocultures (median proportion among farms: 53.0%). The prevalence of subclinical mastitis was 22.6%; coagulase-negative staphylococci were identified more frequently as causal agents (64.7% of isolates recovered from cases of the disease). The prevalence of subclinical mastitis was found to be higher among ewes with gastrointestinal nematode infection than among ewes without: 26.4% *versus* 16.1% ($p = 0.047$), respectively. Further, the prevalence of subclinical mastitis

was higher in ewes with high (>357 epg) faecal epg: 31.1% *versus* 18.6% in ewes with low (<357 epg) faecal epg ($p = 0.027$). Mean epg counts in ewes with mastitis were significantly higher: 500 ± 84 (mean ± standard error of the mean), than epg counts in healthy ewes: 316 ± 36 ($p = 0.024$).

Conclusion and implications
The findings indicate gastrointestinal parasitic infections as potential risk factors for subclinical mastitis in dairy sheep. The findings also underline the importance of concurrent parasitic and bacterial infections. Moreover, the results also suggest the importance of complete health management in the farms as a means to prevent diseases and increase production of animals.

doi: 10.1016/j.anscip.2023.01.177

O-102
Bacteriological findings in milk samples from Norwegian white sheep after lambing

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Keywords: Mastitis; Bacteriology; Norwegian white; Ewe

Introduction
The Norwegian White Sheep is kept for production of meat and wool. Mastitis can reduce milk production, growth rate in lambs and is a common cause of culling of ewes. Mastitis thus has negative implications on economy and animal welfare.
Norwegian sheep farmers have reported that 6-7 % of the breeding ewes are affected by mastitis yearly (Hektoen et. al. unpublished data). About half of these cases are reported to occur in the summer when the animals are commonly grazing in mountain areas, and not diagnosed until chronic signs of mastitis are recognized after housing the animals in the autumn. *Staphylococcus aureus* is the most prevalent bacteria found in clinical cases of mastitis in Norwegian sheep the first weeks after lambing (Mørk et al., 2007). However, it is not known which pathogens are involved in mastitis in the grazing period or when the udder is infected. The aim of this study was to investigate if mastitis pathogens are present as subclinical infections when the sheep are moved to mountain grazing in early summer.

Material and methods
Milk samples were collected aseptically from 607 ewes in four sheep flocks in Trøndelag and Vestland counties, in May and June 2022. The ewes were randomly selected within the flocks. The samples were collected from two to eight weeks after lambing, shortly before the ewes and their lambs were moved to mountain grazing. The samples were frozen until September, transported to TINE Mastitis Laboratory, Molde, Norway, and analysed according to their routine protocol as described in Smistad et al. (2021).

Results and discussion
In total, 1168 individual milk samples from 607 ewes were collected. Milk could not be sampled from 36 mammary glands. In 920 samples, no bacteria were isolated. Thirty five of the samples were contaminated. Specific bacteria were isolated from 213 (18.2%) of the samples. *Staphylococcus aureus*, found in 3.9 % (46/1168) of the samples, was the most predominant bacteria isolated, followed by *Staphylococcus simulans* in 3.5% (40/1168), *Staphylococcus chromogenes in 3%* (35/1168), Coagulase-negative *Staphylococci* in 2.2% (24/1168) and *Staphylococcus warneri* in 2.1% (24/1168) *of the samples.*

Conclusion and implications
Staphylococcus aureus was the bacteria most commonly isolated, followed by other staphylococci. Milk samples from the same ewes were collected in the autumn 2022. These results will be compared to the results from early summer, together with clinical examinations of udder health and production data.

Acknowledgements and funding
The analysis were funded by The Norwegian Meat and Poultry Research Centre.

References

Mørk et al., 2007. Clinical mastitis in ewes; bacteriology, epidemiology and clinical features. Acta Vet. Scand. 49, 23. https://doi.org/10.1186/1751-0147-49-23.
Smistad et al., 2021. Distribution of somatic cell count and udder pathogens in Norwegian dairy goats. J. Dairy Science. 104, 11. https://doi.org/10.3168/jds.2021-20549.

doi: 10.1016/j.anscip.2023.01.178

O-103
The Diagnostic prominence of Procalcitonin, interferon-gamma, and neopterin in sheep with pneumonic pasteurellosis

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Keywords: Procalcitonin; Neopterin; Interferon gamma; Pneumonic pasteurellosis

Introduction
Pneumonic pasteurellosis can cause major economic losses in sheep flocks. Procalcitonin (PCT) is an acute phase protein delivered in the thyroid C cells and is a precursor of calcitonin hormone accountable for the homeostasis of calcium. PCT is measured as a measurable biomarker in bacterial and parasitic infections, due to its capability to increase rapidly after the production of certain cytokines. Neopterin (NPT) is a low molecular weight biomarker associated with cell-mediated immunity and produced by dynamic monocyte/macrophage. IFN-γ is a potential NPT trigger that increases the NPT levels in the body fluids. To the best of our knowledge, our data is the first to explore the levels and diagnostic accuracy of PCT, NPT, and IFN-γ in sheep with pneumonic pasteurellosis under field conditions.

Material and methods
The aim of this study was to evaluate the serum levels of procalcitonin (PCT), neopterin (NPT), and interferon-gamma (IFN-γ) in sheep with pneumonic pasteurellosis. Sheep with pneumonic pasteurellosis (n = 38) and healthy controls (n = 20) were selected for this study. Blood samples were collected from pneumonic and healthy sheep. Additionally, nasopharyngeal swabs and bronchoalveolar lavages were collected from all animals for bacteriological examinations. Sheep procalcitonin, neopterin (NPT), and interferon-gamma (IFN-γ) were tested in serum samples using ELISA Kit (MyBioSource, San Diego, CA, USA). Comparisons in mean were performed by Kruskal–Wallis ANOVA on Ranks followed by Dunn's multiple comparisons. The t-test was used to measure the differences between healthy and pneumonic sheep. Statistical analysis was performed using JMP software version 11.0.0 (SAS Institute, Cary, NC, USA). Spearman's rank correlation test was used to evaluate the correlation between parameters. Each assay's diagnostic accuracy was evaluated by creating the ROC (receiver operator characteristics) curve and determining the area under the curve (AUC). The different means were significant at $P < 0.05$.

Results and discussion
To the best of our knowledge, our data is the first to explore the levels and diagnostic accuracy of PCT, NPT, and IFN-γ in sheep with pneumonic pasteurellosis under field conditions. Pneumonic pasteurellosis was diagnosed based on clinical signs and the isolation of *Pasteurella multicda* in pneumonic cases. Serum PCT, NPT, and IFN-γ levels in pneumonic sheep were significantly higher than in the healthy controls. The receiver operating characteristic curve was used to assess the diagnostic performance of each biomarker. All tested parameters showed a high degree of positive correlation with case-control status.

Conclusion and implications
Procalcitonin (PCT), neopterin (NPT), and interferon-gamma (IFN-γ) could be useful biomarkers for pneumonic pasteurellosis in sheep.

doi: 10.1016/j.anscip.2023.01.179

O-104
Mycoplasma ovipneumoniae – Diagnostics and immunoprophylaxis of a neglected pathogen in sheep and goats

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Keywords: Mycoplasma ovipneumoniae; Diagnostics; Autogenous vaccines; Immunoprophylaxis

Introduction
Mycoplasma (Myc.) ovipneumoniae has been described as a causative agent of chronic non-progressive pneumonia (also known as atypical or enzootic pneumonia) in domestic sheep and goats as well as wild small ruminants. It is closely related to *Myc. hyopneumoniae* causing similar clinical symptoms in swine. *Myc. ovipneumoniae* infections are distributed worldwide and several countries, including Germany, see an increase in clinical cases during recent years. In general morbidity is variable and mortality rates are low. However, the pathogen is associated with substantial economic losses in terms of lower ewe productivity, lower growth rates in lambs and kids as well as higher costs for treatments. A high genetic diversity of strains has been described in literature which makes it hard to find a perfect candidate for commercial vaccine production. Trials on autogenous vaccines were successful in controlling the disease if certain criteria were fulfilled.

Material and methods
Diagnostics of *Myc. ovipneumoniae* including sample taking and shipment needs to be planned precisely to receive good results. Samples for bacteriological culture should be gained from the lower respiratory tract (lung or bronchoalveolar lavage fluids). For shipment, swabs containing special Mycoplasma-media (e.g., UTM) should be used and samples should be sent in via express shipment under cooled conditions. For bacteriological culture special enrichment media and know-how on Mycoplasma culture are needed. Usually, it takes 2-4 weeks until cultural investigations are finished. Besides proof and characterization of the pathogen in special bacteriological culture, molecular biological methods as real-time PCR are in place. Samples taken for PCR diagnostics are much easier to handle and the results will be available within 24 h after sample receipt.

Results and discussion
Several diagnostic methods for the proof of *Myc. ovipneumoniae* are in place and suitable for proper diagnostics. However, when it comes to the production of an autogenous vaccine, it is of utmost importance that invasive isolates from the lower respiratory tract from acutely diseased non-pre-treated animals are gained. The use of an autogenous vaccine is an option to fight the disease if certain criteria are implemented. Especially the genetic diversity of strains might be addressed with a herd-specific approach. Production steps of an autogenous vaccine as well as vaccination schemes will be highlighted.

Conclusion and implications
Clinical cases of *Myc. ovipneumoniae* infections are an increasing problem in many small ruminant rearing countries worldwide. Due to its economic impact on sheep and goat farming improvement in diagnostics as well as immunoprophylaxis need to be emphasized in the future. Using an autogenous vaccine is an important tool to reduce *Myc. ovipneumoniae* infections besides improvements in general management such as housing and ventilation.

doi: 10.1016/j.anscip.2023.01.180

O-105
Mycoplasma ovipneumoniae is present in Brazilian sheep herds: First isolation in healthy and sheep with respiratory disease

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Keywords: Mycoplasmas; Pneumonia; Ovine; Bacteria

Introduction
Respiratory diseases significantly impact animal welfare and result in economic losses. In sheep, this illness is associated with primary viral and/or bacterial infections, such as *Mycoplasma ovipneumoniae*. Although widely distributed, this microorganism has not been described in Brazil until now. Therefore, this research describes, for the first time, the isolation of *M. ovipneumoniae* from healthy sheep and sheep with respiratory disease in Brazil.

Material and methods
Tracheobronchial lavage samples were obtained from 99 male and female sheep, health (H; N=66) and unhealthy (UH; N = 33), from 12 sheep flocks in São Paulo (N = 06) and Rio de Janeiro (N = 06), Brazil, between 2017 and 2018. The respiratory health status of each animal was determined by a physical exam of vital parameters and the respiratory tract. *Mycoplasma* spp. was cultured and isolated using solid and liquid SP-4 media and incubated at 37°C in aerobiosis for 15 days. Fried egg-like colonies were characterized as *Mycoplasma* spp, and PCR was performed to confirm colonies as *M. ovipneumoniae* (McAuliffe et al., 2003). A positive herd was defined as having isolation from at least one animal. Results were described as relative and absolute frequencies.

Results and discussion
Tracheobronchial lavage samples were obtained from 63 animals in Rio de Janeiro (H = 43; UH = 20) and 33 in São Paulo (H = 24; UH = 09). Fifteen samples (15.2%; 15/99), produced fried egg-like colonies, mainly from São Paulo (18.2%; 06/33). All isolates were characerized as *M. ovipneumoniae* by PCR. Most herds from Rio de Janeiro (66.7%; 04/06) were positive, whereas only 33.4% (02/06) were positive in São Paulo. *M ovipneumoniae* was isolated from the respiratory tract of healthy (12.2%; 08/66) and unhealthy sheep (21.2%; 07/33), whose animals showed mild clinical signs, such as increased rectal temperature (38.5°C - 40°C), serous to purulent nasal discharge, presence or absence of cough, and crackles on pulmonary auscultation. The results showed that Brazil is not free of *M. ovipneumoniae*, and this microorganism might also cause respiratory disease in Brazilian sheep, as in other countries.

Conclusion and implications
The results indicate the dissemination of *M. ovipneumoniae* in sheep flocks of the Southeastern Brazilian region and reinforce that epidemiologic studies should be conducted in other Brazilian areas. Finally, this study will help the Brazilian small ruminants' diagnostic panel for respiratory disease.

Acknowledgements and funding
Authors thank CAPES, FAPESP, and CNPq. NCG and LG are research fellows of FAPESP (#2020/15008-0) and CNPq (#312249/2017-9), respectively.

Reference

McAuliffe, L., Hatchell, F.M., Ayling, R.D., King, A.I., Nicholas, R.A., 2003. Detection of M. ovipneumoniae in Pasteurella-vaccinated sheep flocks with respiratory disease in England. Vet Rec 153 (22), 687–688.

doi: 10.1016/j.anscip.2023.01.181

O-106
Pasteurellosis: Sheep versus goats

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Keywords: Pasteurellosis; Small ruminants; Respiratory disease; Pathology

Introduction
Respiratory infections are common in small ruminants. *Mannheimia haemolytica*, *Pasteurella multocida* and *Bibersteinia trehalosi* are the main causative agents of respiratory disease. It is generally regarded that sheep and goats have similar risk factors, the pathogenesis and pathology of respiratory disease in sheep and goats do not differ. Pathology and microbiology data are analysed to see if results do not differ as presumed not to be.

Material and methods
Results of routine post-mortem examinations of sheep and goats submitted to Royal GD in the period from 2012 to 2022 were extracted from the Laboratory Information Management System (LIMS) and analysed. Routine post-mortem investigation is performed according to standard procedures (van Engelen et al., 2014). In total 266 sheep and 471 goats were selected based on the main causative agents of respiratory disease. Additionally, results of bacteriological culture were collected from this system.
The data analyses of prevalence was calculated by comparing the occurrence of each bacterium species found per total number of animal cases. The age of the animal was based on Identification and Registration (I&R) and date of routine post-mortem examination. Analysing organ pathology datathe selection based on bacterium species was done in advance. Statistical analysis was done by a two sample test of proportion in STATA15.

Results and discussion
The three pasteurellosis bacteria were found in both animal species. In sheep, this was B. trehalosi in 26%, M. haemolytica in 79% and P. multocida in 15% of the cases. In goats this was 15%, 89% and 14% respectively. B. trehalosi was found significantly more in sheep and M. haemolytica in goats.
M. haemolytica and P. multocida were seen at any age of the animals but no B. trehalosi was cultured from sheep in the first two weeks of age. In contrast, this bacterium frequently caused sepsis in sheep (53%), in contrast to goats (3%) ($P<0,05$). Per animal different pasteurellosis bacteria species could have been involved in the infection. In those cases it is unclear to which extend the species contribute to the pathological lesions.

Conclusion and implications
The relative contribution of bacteria, involved in pasteurellosis, *M. haemolytica* and *B. trehalosi* differ between sheep and goats. If this is caused by strict host factors or that other factors like husbandry and epidemiology play a role, remains to be elucidated.

Acknowledgements and funding
The monitoring and surveillance system of small ruminant health is financed by the Ministry of Agriculture, Nature and Food Quality and the small ruminant farming industry by paying levies to the Animal Health Fund.

Reference

Van Engelen, E., Luttikholt, S.J.M., Peperkamp, N.H.M.T., Vellema, P., Van den Brom, R., 2014. Small ruminant abortions in the Netherlands during lambing season 2012–2013. Vet Rec. 174, 506.

doi: 10.1016/j.anscip.2023.01.182

O-107
Investigating the efficacy of an ovine respiratory vaccine in reducing mortality and pneumonia-associated morbidity and mortality in pre-weaned and post-weaned lambs

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Keywords: Sheep; Pneumonia; Vaccine; Randomized Control Trial

Introduction
Mortality rates of lambs in Canada range from 4.9-13.9% with pneumonia accounting for approximately 50% of deaths in feeder lambs (Van Donkersgoed et al., 2016). There is currently no approved respiratory vaccines for sheep in Canada.
The objective of this study was to determine the efficacy of an imported respiratory vaccine (Ovipast Plus®, Merck Animal Health/Intervet) in reducing crude mortality rates and pneumonia-specific morbidity and mortality rates in pre-weaned and post-weaned lambs.

Material and methods
Ewes were enrolled weekly (~260-300), systematically randomized into 2 groups, and either vaccinated with Ovipast Plus® bacterin (Merck) at approximately 6 and 2 weeks before their lambing dates or they were negative controls. After revaccination, ewes were housed according to vaccine status. Barn staff who did daily health checks and treatments were blinded to vaccination status. Postmortems were performed on all dead ewes and lambs.
To evaluate vaccine efficacy, four multi-level logistic (LOR) and linear (LIR) regression models were developed, with pen as a random effect: (1) overall mortality (LOR), (2) pneumonia-associated mortality (LOR), (3) pneumonia related-morbidity (LOR), and (4) average daily gain (LIR).

Results and discussion
A total of 3619 (1812 unvaccinated, 1807 vaccinated) ewes were inducted into the vaccine field trial conducted on a Canadian sheep operation (Nov 2021-Oct 2022). Of the total ewes enrolled, 2612 weaned lambs (1295 unvaccinated, 1317 vaccinates). A total of 5057 perinatal lambs were inducted into the trial (2544 unvaccinated, 2506 vaccinates). A total of 713 lambs died between birth and weaning; 352 unvaccinated (13.8% crude morality rate), and 361 vaccinates (14.4% crude mortality rate). There was no statistical difference between overall death rates ($P = 0.639$) and withdrawal rates ($P = 0.078$) between unvaccinated and vaccinated lambs.
In all four models, a clear sex effect was seen with rams having higher overall mortality rates (OR = 1.34, $P < 0.001$), pneumonia related mortality (OR = 1.92, $P = 0.021$), risk of being treated for pneumonia (OR = 1.22, $P = 0.004$), and ADG by 10.64 g/day ($P < 0.001$). Although no sparing effect of the vaccine was observed on crude mortality rates or pneumonia morbidity or mortality rates, vaccination significantly improved ADG (4.10 g/day, $P = 0.032$).

Conclusion
Based strictly on pre-weaning data analysis, there were no statistical differences ($P > 0.05$) in crude mortality rates and pneumonia specific morbidity and mortality between lambs vaccinated with Ovipast Plus® and unvaccinated controls. Post-weaning data will be available in January 2023 where further conclusions about the bacterins efficacy can be made.

Reference
Van Donkersgoed, J., Ravi, M., Smith, K., Silasi, L., Zeldenrust, L., Elliot, L., Perrin, N., Hart, S., Becker, L., Patel, J., 2016. Strategic research and development program final report: Causes of mortality in Alberta feedlot lambs.

doi: 10.1016/j.anscip.2023.01.183

O-108
Profitability of two vaccines against *Mannheimia haemolytica* on a lamb feedlot

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Keywords: Mannheimia; Lamb; Vaccine; Profitability

Introduction
Ovine respiratory syndrome (ORS) is an emerging pathology, largely due to the new Veterinary Medicinal Products Regulation (**(EU) 2019/6),** that makes the restriction of the use of antibiotics necessary. This situation makes the implementation of prophylactic measures crucial. Vaccines containing the leukotoxin of *Mannheimia haemolytica* appear to be the best option for controlling ORS.
The aim of this study was to evaluate the profitability of two vaccines against *M. haemolytica* through the study of production parameters on a lamb feedlot, such as average daily gain (ADG), mortality, feed conversion rate (FCR), and number of animals in the sick pen. The return on investment (ROI) of vaccination with a leukotoxoid-based vaccine (Pasterbact®) was also calculated.

Material and methods
The study was performed in a lamb feedlot located in Baza (Granada, Spain) and 440 lambs with an average weight of 25 kg were included. The animals were homogeneously separated into two groups: Group A (N = 220) was vaccinated with a leukotoxoid-based vaccine (Pasterbact®), and Group B (N = 220) was vaccinated with another *M. haemolytica* bacterin-based vaccine (vaccine B). In both groups, the animals were vaccinated with a single 2-ml dose upon arrival at the feedlot.
The duration of the study was 76 days, and the weight of the lambs (average by group) was measured every 10-11 days. The number of animals in the sick pen with respiratory signs was also reported, as well as the number of deaths.
A descriptive study of the productive parameters was conducted, and a proportion test was performed to compare the morbidity and mortality between both groups. Statistical analysis was carried out using the R software v4.0. A p-value < 0.05 was chosen as the limit for statistical significance. The differences of profitability were shown through a ROI, with the extra cost of the leukotoxoid-based vaccine (Pasterbact®) being the investment. The costs of the lambs, vaccines, feed consumption, and meat produced were considered.

Results
This trial resulted in a higher average final weight (+878g) and ADG (+13g/day), and a lower average FCR (-0,157) in Group A compared to Group B.
The leukotoxoid-based vaccine (Pasterbact®) showed a 12% reduction of morbidity and a 50% reduction of mortality compared to Vaccine B (p-value > 0.05).
Considering all the above parameters, Group A presented a positive benefit of +3.21€ per lamb compared to Group B.
Taking into consideration the extra cost (+0.30€) of the leukotoxoid-based vaccine (Pasterbact®), the ROI was of 1:10.7.

Conclusion
The leukotoxoid-based vaccine (Pasterbact®) demonstrated a greater improvement of the productive parameters (Average Daily Gain and Feed Conversion Rate) and health of the lambs compared to the bacterin-based vaccine (Vaccine B). It is cost-effective and reduces the impact of ORS in lamb feedlots.

doi: 10.1016/j.anscip.2023.01.184

O-109
Associations of the quality of bulk-tank raw milk from sheep farms with climatological factors

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Keywords: Climate; Mastitis; Rain; Somatic cell counts

Introduction
The work studies associations between climate and quality of sheep milk in Greece. The objective to investigate the effects of climatological factors on somatic cell counts and presence of staphylococci in bulk-tank raw milk.

Material and methods
Throughout Greece, 325 dairy sheep flocks were visited for collection of milk samples for somatic cell counting and microbiological examinations. Conventional methodology was used for cell counting; staphylococci in the samples were identified by MALDI-TOF. Data on farm location were collected using Global Positioning System Garmin units. The geo-references were resolved to farm level. Climatic variables were derived from 'The POWER Project' (NASA Langley Research Center, USA), which provides meteorological datasets for agricultural needs. Data for the following parameters were extracted: temperature at 2 m, temperature of Earth skin, minimum temperature at 2 m, maximum temperature at 2 m, temperature range at 2 m, relative humidity at 2 m, precipitation and wind speed at 10 m. Data were obtained for the 7 days and the 15 days prior to the visit and sampling at each farm. Univariable analyses of associations were performed by using analysis of variance or analysis of correlation, as appropriate and according to the type of data. Subsequently, multivariable models were constructed using mixed-effects logistic regression.

Results and discussion
The average precipitation for the 15 days prior to the sampling emerged in the multivariable analysis as the only significant factor associated with somatic cell counts ($p = 0.009$). In contrast, the average precipitation for the 7 days prior to the sampling ($p = 0.11$) and the other climatological parametres ($p > 0.08$) were not significant. The somatic cell counts in the 163 farms with the highest precipitation (>1.20 mm daily, average: 2.64 mm) were significantly higher than the somatic cell counts in the 162 farms with the lowest precipitation (<1.20 mm daily, average: 0.72 mm): 0.540×10^6 *versus* 0.436×10^6 cells mL^{-1}, respectively ($p = 0.006$). Moreover, the average precipitation in farms from the milk of which staphylococci were recovered, was significantly higher than the average precipitation in farms from the milk of which staphylococci were not recovered: 1.78 *versus* 1.54 mm daily ($p = 0.04$). It is postulated that, in rainy weather, bacterial populations increase due to the favourable conditions and disseminate more easily; thus, they cause more intramammary infections to ewes; this results in higher somatic cell counts in the bulk-tank raw milk produced in the farm.

Conclusion and implications
The results have provided evidence that climatological factors may influence the quality of milk produced in sheep farms. Thus, predictive models can be developed to take into account climatological factors for incorporation into the health management of farms.

Acknowledgements and funding
Eleni I. Katsarou receives a scholarship from Unit of Research, Innovation and Excellence of University of Thessaly.

doi: 10.1016/j.anscip.2023.01.185

O-110
Growth of *Staphylococcus epidermidis* on the surface of teatcups from milking parlours

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Keywords: Biofilm; Mastitis; Milking parlour; Teatcup

Introduction
The objective of the current work was to evaluate the differences in the growth of *Staphylococcus epidermidis*, a confirmed mammary pathogen for cattle and sheep, on teatcups used in milking parlours on farms with these animals.

Material and methods
Growth of two *Staphylococcus epidermidis* isolates (one biofilm-forming and one not) on teatcups for cattle (made of rubber) or sheep (made of silicone) were assessed in nine multiplicates for 24 h post-smearing on the teatcup surface. Staphylococci were smeared on an area of 0.0003142 m^2 on the material and their growth and expansion further on were monitored for 24 h, by obtaining swab samples from the material every 3 hours. Models of linear dissemination of the bacteria on the material were constructed for progressive 1.5 h time slots after smearing. The average speed of the linear dissemination of the bacteria was then calculated. It was thus possible to calculate an estimate of the length of time necessary for full coverage of the material, as well as the proportion of the material that had been covered at various time-points post-smearing. There were no differences in the frequencies of staphylococcal recoveries among the nine multiplicates during the evaluation of the same staphylococcal isolate assayed on the same material ($p > 0.98$), hence results of all multiplicates were considered together. Frequencies were compared by use of Pearson chi-square test. Differences in the speed of linear dissemination and surface covered were compared by using the Kruskal–Wallis test.

Results and discussion
There were no differences in the frequency of recoveries between the two isolates: 1110/1728 (64.2%) *versus* 1112/1728 (64.4%) ($p > 0.82$). However, there were more recoveries from sheep teatcups than from cattle teatcups: 1280/1728 (74.1%) *versus* 942/1728 (54.5%), for both isolates ($p < 0.0001$). Significance was observed for 6 h to 15 h after smearing ($p < 0.0001$), whilst in samplings that were made 3 h, 18 h, 21 h and 24 h after smearing, no such difference was evident. The median speed of linear dissemination of the isolates was 0.00000021 m s^{-1} on cattle teatcups and 0.00000033 m s^{-1} on sheep teatcups ($p < 0.0001$).

Conclusion and implications
The results have provided evidence that isolates of *S. epidermidis* have increased growth and dissemination on teatcups for sheep (silicone) than on teatcups for cattle (rubber). The increased growth and faster expansion of staphylococci on silicone teatcups raise important points from a clinical viewpoint. The findings underline the importance of correct post-milking cleaning of the milking parlour in order to fully eliminate any staphylococcal foci thereon. The model could be used in the testing of staphylococcal growth in the material of milking parlours.

Acknowledgements and funding
Eleni I. Katsarou receives a scholarship from Unit of Research, Innovation and Excellence of University of Thessaly.

doi: 10.1016/j.anscip.2023.01.186

O-111
Use of omics technologies for the investigation of bacterial populations in the milk of ewes

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Keywords: Genomics; Milk; Proteomics; Sheep

Introduction
Sheep milk has a high nutritional value and, among its characteristics, the high protein and fat content stand out. That makes it ideal for manufacturing of cheese and other dairy products with increased commercial values. Sheep milk may contain microbial load, consequently to contamination by various bacteria. These can be of animal (e.g., shedding of mastitis pathogens), human or environmental origin and can occur during production (i.e., during milking), transport or storage of the milk. Potentially, milk (and consequently the manufactured dairy products) may also harbour antibiotic resistance genes that might possibly interact with the gut microbiome of consumers of such dairy products. 'Meta'-omic studies aim to identify panels of microbial organisms, genes, variants, pathways or metabolic functions characterising microbial communities populating uncultured samples. Objective of this presentation is to highlight results from omics works, regarding bacterial populations in sheep milk, in order to compare them and to enhance the idea of applying multi-omics technologies.

Material and methods
The presentation includes two parts. The first refers to single-omics approaches, namely (meta)genomics, (meta)transcriptomics, (meta) proteomics and metabolomics, which have been applied in the study of bacterial communities, with the aim to studying bacterial genes, mRNAs, proteins and small metabolites, respectively. The second refers to presenting and discussing the significance of multi-omics techniques, which combine the various omics technologies and highlight the advantages in analysing ovine milk.

Results and discussion
The ubiquity and complexity of the microbial communities in milk have been studied for long and advances in high-throughput technologies have provided new tools that can supplement conventional, culture-based approaches, both in the molecular details provided and in the dissemination of results to a broad scientific community. The focus of metagenomics and metatranscriptomics includes the prediction of the abundance of functional gene families present in microbial communities, the identification of microorganisms at species level based on metataxonomic and metagenomic characterization and the identification of antimicrobial resistance genes in raw milk. With regard to resistance genes, proteomics work can evaluate potential translation to proteins, as, ultimately, these are the real effectors. Moreover, through metabolomics, metabolic changes are measured by the profiling of enzymes and molecules. On the other hand, multi-omics technologies can elucidate the role, origin, diversity and function of the microbial species involved in the complex system of dairy production.

Conclusion and implications
This study unveils the participation of various bacteria and the metabolites produced by bacteria, applying high-throughput technology, in the dairy production industry. In this role, meta-omics research and multi-omics technologies provide a novel understanding in the analysis of ovine dairy production and potential improvement strategies for higher production efficiency and sustainable ovine production.

Acknowledgements and funding
Maria V. Bourganou receives a scholarship from Averofio AgroFood Technological Park of Thessaly.

doi: 10.1016/j.anscip.2023.01.187

O-112
Bacterial entry into the teat of dairy ewes during the milking process

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Keywords: Dairy sheep; Mastitis; Milking machine; Teatcup

Introduction
The general objective of this work was the evaluation of possibility for bacterial dissemination during the milking process.

Material and methods
Four dairy sheep farms, with 830 ewes, were enrolled into the study. Each farm was visited for sampling thrice: 1, 4-5 and 8-10 months after start of the milking period. In the milking parlour, three different teatcups were selected at random (random selection in every visit) and swab samples were collected from the upper part (up to 1 cm from edge) of these before and after milking of ewes throughout a milking session. Moreover, milk samples and samples of teat duct material (taken by means of sterile plastic Abbocath catheters cut at a length of 2 mm) were collected from all the mammary glands that were milked into these teatcups throughout a milking session (i.e., from all respective ewes); two samples were collected from each gland: before and after completion of milking of each mammary gland in the teatcup. Samples were processed bacteriologically (milk, teat duct material, teatcup swabs) and cytologically (milk) by using standard techniques. In data analysis: (a) milk and teat duct material from which bacteria were recovered before milking, were deemed to be infection sources for the subsequent animals to be milked in the same teatcup and (b) teatcup and teat duct material after milking were deemed to be contamination targets. Subclinical mastitis was defined as the concurrent bacterial isolation and the presence of increased inflammatory cell content (CMT score $\geq$1 and neutrophils+lymphocytes $\geq$65% of all leukocytes) in the milk of animals.

Results and discussion
In total, 429 mammary glands were sampled and 339 (79.0%) were identified as potential sources of infection; among these, 21 glands had subclinical mastitis and all (100%) were considered as potential sources of infection. Then, 117 cases of subsequent contaminated targets were detected (i.e., from 34.5% of potential sources); among these, there were 16 cases from mammary glands with subclinical mastitis (i.e., from 76% of potential sources). There was a 7-time higher odds ratio for contaminated targets from glands with subclinical mastitis ($p = 0.0002$). Sources of potential infection were identified more frequently (92%, $p = 0.0002$) during the second sampling occasion. Throughout the study, staphylococci were the bacteria with potential for infection.

Conclusion and implications
Animals with subclinical mastitis are more likely to disseminate bacteria in the milking parlour. The increased rate of infection in the middle of the lactation period might be associated with a longer period of teatcup attachment on the udder, due to higher milk production at that stage.

Acknowledgements and funding
Dimitra V. Liagka receives a scholarship from Averofio AgroFood Technological Park of Thessaly.

doi: 10.1016/j.anscip.2023.01.188

O-113
Extensive countrywide field investigation of somatic cell counts and total bacterial counts in bulk-tank raw milk in sheep flocks

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Keywords: Bulk-tank; Mastitis; Raw milk; Staphylococcus

Introduction
The present study refers to an extensive countrywide investigation performed in dairy sheep flocks throughout Greece. The objectives of the study were (a) to investigate somatic cell counts (SCC) and total bacterial counts (TBC) in the raw bulk-tank milk of sheep flocks in Greece, (b) to study factors potentially influencing increased SCC and TBC in the bulk-tank milk of sheep and (c) to evaluate possible associations of SCC and TBC with milk content.

Material and methods
Throughout Greece, 325 dairy sheep flocks were visited for collection of milk samples for somatic cell counting, microbiological examinations and chemical composition measurement. Conventional cytological, microbiological and chemical techniques were employed. The outcomes of 'increased SCC in bulk-tank milk' (i.e., above 1.0×10^6 cells mL^{-1}) and 'increased TBC in bulk-tank milk' (i.e., above 1500×10^3 cfu mL^{-1}) were considered. Univariable analyses of associations were performed by using Pearson's chi-square test or analysis of variance, as appropriate and according to the type of data. Subsequently, multivariable models were constructed using mixed-effects logistic regression.

Results and discussion
Geometric mean SCC of bulk-tank milk among all flocks in the study were 0.488×10^6 cells mL^{-1}; geometric mean TBC were 398×10^3 cfu mL^{-1}; 228 staphylococcal isolates were recovered form 206 flocks (63.4%). Multivariable analyses revealed the annual incidence risk of clinical mastitis, the age of the farmer and the month into the lactation period (among 53 variables) to be significant for SCC $>1.0 \times 10^6$ cells mL^{-1} and the month the into lactation period at sampling and the presence of ventilators in the farm buildings (among 58 variables) to be significant for TBC $>1500 \times 10^3$ cfu mL^{-1}. Negative correlation of SCC with fat, total protein and lactose and positive correlation of SCC with added water were found. The correlation of somatic cell counts with total bacterial counts was $r = 0.269$ ($p < 0.001$). With SCC $>1.0 \times 10^6$ cells mL^{-1}, significant reduction of protein content (2%) was observed, whilst in flocks with SCC $>1.5 \times 10^6$ cells mL^{-1}, significantly lower annual milk production per ewe (42.9%) was reported. In total, 22 different *Staphylococcus* species were identified in the samples, recovered from 63% of the flocks. Some of these species are not confirmed mammary pathogens, thus indicating their potential origin in the environment of the respective farms.

Conclusion and implications
The results of the study, performed throughout Greece, indicate that with regard to somatic cell counts and total bacterial counts, the milk can be considered in general of good quality. The findings also underline the fact that mastitis remains the main factor adversely affecting SCC, whilst non-infection related parameters appear to exert a less significant influence. An adverse correlation between SCC and milk production parameters was also shown, which underlines the adverse financial effects of increased SCC.

doi: 10.1016/j.anscip.2023.01.189

O-114
Serological Survey of CCPP and its associated risk factors in Small Ruminants

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Keywords: Contagious Caprine Pleuropneumonia (CCPP); Enzyme-linked immunosorbent assay (ELISA); Transmission; Prevalence

Introduction
Contagious Caprine Pleuropneumonia (CCPP) is a fatal transboundary disease of small ruminants caused by the fastidious bacterium *Mycoplasma capricolum* subspecies *capripneumoniae* (Mccp). It is a major threat to small ruminants, causing significant economic loss. Infections can cause 60-80% mortality and 80-100% morbidity. Although the disease is reported worldwide, outbreaks are more common in Asia and Africa. Currently, the prevalence of CCPP in many African and Asian countries is unknown because of scarcity of diagnostic facilities. This study was aimed to determine the prevalence of CCPP in a small-scale village setting to assess distribution of the disease in a typical small ruminant farming system.

Material and methods
A serological survey was conducted between December 2019 and November 2020 (four sampling visits; Dec, Feb, Aug and Nov) in a village in northern Punjab, Pakistan. Up to 10 serum samples (5 from adults, 5 from young <1 year old) were collected at four sampling visits (Dec, Feb, Aug and Nov) from a semi-convenience sample of households raising goats and sheep in the village. The samples were analyzed by Contagious Caprine Pleuropneumonia ELISA Kit (Abexxa®, UK). Numbers of seropositive animals in different stock classes and at different times of the year were compared with the *Chi Square* test, using an alpha level of 0.05 for all analyses.

Results and discussion
A total of 300 animals were sampled (65 sheep and 235 goats), with 19% (n = 57; 95% CI 15–24%) positive for CCPP. Seroprevalence was significantly greater in sheep (36.4%) than goats (14%; $p < 0.01$). The prevalence of CCPP was statistically in similar in males and females. The prevalence of disease in adults (22.8%) was significantly ($P < 0.05$) greater than young animals (23% vs 13%, respectively; $p = 0.03$). The

proportion of seropositive animals increased significantly ($p < 0.01$) from December (11%) through February (17%) and to August (38%), and then decrease occurred in November (15%).

Conclusion and implications
This small, preliminary study suggests that CCPP is a common disease in a typical small-scale village farming scenario in Punjab. Existing knowledge of CCPP would suggest that this kind of disease incidence will likely have significant local impact for farmers and their animals, and significantly reduce the potential productivity and income of small ruminant farming for village farmers. Further studies of the distribution, transmission and impact of CCPP are needed to identify where and how to more effectively address this disease and its effects in Pakistan.

Acknowledgements and funding
This work was part of the project *LS-2018-105 Enhancing small ruminant production to benefit farming families in Punjab and Sindh*, supported by the Australian Centre for International Agricultural Research, implemented by the University of Melbourne and the University of Veterinary and Animal Sciences (Lahore).

doi: 10.1016/j.anscip.2023.01.190

O-115
A new approach to the diagnostics of small ruminant lentivirus infection?

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Keywords: SRLV; Diagnostics; Saliva; Feces

Introduction
ELISA tests are the mainstay of diagnostics of small ruminant lentivirus (SRLV) infection. However, there is still a need for quick and simple field diagnosis. The development of a rapid diagnostic test for milk and blood samples is a aim of ICRAD CAE-RAPID project run by our team. However, collection of faecal and saliva samples is easiest and can be performed by a non-qualified persons and regardless of the physiological state of animals. The aim of this study was to determine whether these specimens can replace traditionally used milk and blood samples. We were aware that especially investigating the feasibility of using faecal samples is quite ambiguous. However, we decided to confirm this experimentally.

Material and methods
An indirect commercial ELISA test based on the mixture of synthetic viral peptides (ID Screen MVV-CAEV Indirect Screening test, ID.vet Innovative Diagnostics) was used.
The study was carried out in herds whose health status had been monitored for many years. Positive and negative animals were serologically tested at least three times at one year intervals and the results were consistent.
Fecal samples were collected from 7 seropositive and 5 seronegative animals and treated with protease inhibitors. Saliva samples came from 20 seropositive and 20 seronegative animals.
The optical density (OD) of the tested samples was determined and used for statistical analysis. The median and the interquartile range (IQR) were calculated and compared using Mann-Whitney U test ($\alpha = 0.05$).

Results and discussion
OD values of fecal samples coming from seropositive animals (median 0.047, IQR 0.046 – 0.056) were generally very low and similar to that coming from seronegative animals (median 0.051, IQR 0.046 – 0.052). The same was found in terms of OD values of saliva samples (median 0.106, IQR 0.079 – 0.144 and median 0.100, IQR 0.080 – 0.136, respectively).
The idea of using faecal samples for diagnosing SRLV infections was strange from the very beginning. Therefore, the results did not surprise us and confirmed our expectations. It does not seem possible to use this material in the future in diagnosing SRLV infection.
The situation is different in the case of saliva. Saliva is gaining in popularity as a sample in the diagnostics of viral diseases in humans. However, the results of our study did not confirm this assumptions. Perhaps the higher concentration of viral antigen for coating ELISA plates is needed.

Conclusion and implications
Unfortunately, we must state that we were not able to confirm the usefulness of fecal and saliva samples for diagnosing SRLV infections in goats.

Acknowledgements and funding
This research was funded by the ICRAD CAE-RAPID grant no. ICRAD/I/CAE-RAPID/02/2021 and the Ministry of Science and Higher Education of the Republic of Poland grant no. 16/491568/SPUB/SP/2021.

doi: 10.1016/j.anscip.2023.01.191

O-116
Development of a multiplex immunoassay to detect antibodies against maedi-visna virus in sheep

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Keywords: Ovine; Lentivirus; Diagnostic test; Multiplex

Introduction
Maedi-visna virus (MVV) is a small ruminant lentivirus, infecting sheep and goat. There is no treatment nor vaccine, therefore culling of infected animals is the primary means of control. In Norway, maedi-visna is a notifiable disease, and eradication is a national goal. Through the national surveillance program, MVV was detected in sheep in 2019, 14 years after the last detection. Genetic analysis indicates persistence of the virus in the sheep population, despite continuous surveillance. Two ELISA tests in serial interpretation are currently used in the surveillance program. However, false positive and false negative results occur. Crossreactive substances in serum and high antigenic heterogeneity of local strains may be sources for the false test results. Bead-based multiplex immunoassays are relatively new methods that can detect and differentiate a large number of different analytes in one sample. When developing a multiplex assay for antibody detection, one can evaluate the relevance of each antigen and exclude those most likely causing false positive results. Furthermore, many different antigens can be included, making it possible to include antigens based on the circulating viral strain. Our study aims to develop a multiplex immunoassay that can be used to improve the Norwegian national surveillance program.

Material and methods
Microspheres (MagPlex®-C) were coupled to three different viral antigens (obtained from In3diagnostic) using a coupling kit (Bio-Plex Amine Coupling Kit) according to the manufacturer's instructions. Furthermore, we plan to include antigens based on sequencing of the Norwegian viral strain. For assay optimisation and validation, we are using serum samples from the 2019 outbreak with known commercial ELISA test results (ID Screen® MVV/CAEV Indirect kit and IDEXX MVV/CAEV p28 kit Ab Verification Test) and samples from a sheep immunized with recombinant antigen from an Italian viral strain. We will use Bayesian latent class modelling to determine the optimal cut-off value for each antigen and estimate test characteristics.

Results and discussion
The three viral antigens (matrix/capsid, transmembrane and capsid) coupled to beads are referred to as antigen A, B and C respectively. When antigens A and C were tested against serum from immunized sheep, high signal compared to the ELISA negative control pool was seen. Interestingly, pooled and individual ELISA positive outbreak samples have a high signal only towards A and B compared to negative control pool. Preliminary results indicate that there are strain differences, which is important to consider when developing the assay.

Conclusion and implications
In order to improve the surveillance program better diagnostic tests are needed. Developing a multiplex assay enables us to investigate the antibody response to several antigens simultaneously, making the testing regime more efficient. In addition, the assay will be customised using a panel of immunodominant regions derived from the Norwegian viral strain.

doi: 10.1016/j.anscip.2023.01.192

O-117
Follow-up scenario's, including retrospective bulk milk testing, after loss of caprine arthritis encephalitis virus (CAEV) herd accreditation in commercial dairy goat farms

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Keywords: Caprine arthritis encephalitis virus; Goat; Herd accreditation; Bulk milk testing

Introduction
A caprine arthritis encephalitis virus (CAEV) herd accreditation program, based on sample size screening of randomly collected goat sera for specific antibodies, has been in place for several decades in the Netherlands. Involuntary loss of herd accreditation can be devastating, especially in commercial dairy goat herds. Herd characteristics and specific follow-up scenarios, including (retrospective) bulk milk testing of cases of herds with loss of accreditation over the last decade are described.

Material and methods
Information on 38 herds in the period between 2012 and 2022 has been collected. Herd characteristics were obtained from the legally required national identification and registration database and GD's customer relationship management system. From six farms monthly bulk milk samples from the preceding year were analysed to identify the tipping point between the last favourable surveillance outcome and the unfavourable results. The Elitest MVV/CAEV antibody ELISA was used (sera/(bulk) milk) according to manufacturer's instructions, except for a lower cutoff (S/P 0.1) for milk samples.

Results and discussion
Herd size varied from approximately 400 to 4600 adult goats. In the majority of cases, route of introduction remained unclear, although purchase of goats from infected herds was the most likely in at least six cases. In five cases, this was contact with unaccredited/known infected herds. Other potential suggestions were: a substantial spill over from the milk truck which had just come from a farm with known CAEV infection, and the goat buyer who backed-up his trailer into the stable with a truckload of unaccredited goats. A huge range existed in the number of test positive goats varying from a confirmed single reactor to over hundred. In mainly indoor housing systems with high stocking densities, infection can rapidly spread as shown by these numbers and supported by the Röst Freed Model. The change-over demonstrated by retrospective bulk milk testing showed seroconversion has taken place four to seven months earlier. The three main chosen goals leading up to tailor-made approaches after detection of infection are: A) doing nothing and start living with CAEV, B) accept being non-CAEV-accredited, and keep infection pressure low, and C) aiming at regaining CAEV-accreditation. Several options are discussed including: total herd replacement, artificial rearing of kids, test and cull of positive goats, as well as a combination of these options.

Conclusion and implications
Direct contact with CAEV infected animals seems the most likely route of introduction of this virus. Keeping a keen eye on contact structures, with proper biosecurity measures, quarantine and additional testing before adding animals to the own herd, reduces the risk of CAEV introduction. Monthly BTM testing has additional value in a system where accreditation is based on annual blood sampling and follow-up of animal movements.

doi: 10.1016/j.anscip.2023.01.193

O-118
Characteristics of SRLV genotypes circulating in Polish goat population

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Keywords: Caprine arthritis-encephalitis; Goat; PCR; Small ruminant lentivirus

Introduction
Caprine arthritis-encephalitis (CAE) in goats and maedi-visna disease in sheep are widespread infectious diseases caused by small ruminant lentivirus (SRLV). SRLV is classified into 5 genotypes (A-E) of which A and B are widespread. Both have been reported from Polish goat population, however only small-scale studies were carried out. We aimed to estimated herd-level prevalence of SRLV genotypes.

Material and methods
The study was carried out in years 2021–2022. Twenty goat herds were randomly selected from 100 herds known to be seropositive for SRLV infection. This sample size allowed herd-level prevalence estimation assuming expected prevalence of 50% and 20% precision. The herds were located in 10 provinces of Poland. They counted from 10 to 500 adult goats (median – 30 goats). All adult goats (>1 year-old) in these herds were blood sampled and screened using an indirect commercial ELISA coated with the panel of synthetic peptides from SRLV structural proteins (ID Screen MVV-CAEV Indirect Screening test, France). Then, the herds were revisited and blood was collected from seropositive goats – all if the number of seropositive goats was below 12, otherwise from 12 randomly selected. This sample size ensured detection of a given genotype if it was present in at least 25% infected goats in a herd. Blood was collected to 10-ml tubes with EDTA, centrifuged (10 min at 3000 rpm), buffy coat harvested and erythrocytes lysed using RBC Lysis Buffer. Then, leukocyte pellets were

stored at -20°C until testing. DNA from leukocyte pellets was extracted and the material was tested using a two-stage real-time nested PCR (RT-nPCR) which distinguishes between SRLV genotype A and B. In total, blood samples from 145 seropositive goats were tested using RT-nPCR – from 2 to 12 goats (median – 7 goats) from a herd.

Results and discussion
The within-herd seroprevalence of SRLV infection ranged from 10% to 96% (median – 36%). Both genotypes were identified – genotype A in 18 herds (90%; CI 95%: 70% – 97%), genotype B in 8 herds (40%; CI 95%: 22% – 61%). Concomitant infection with 2 genotypes was detected in 6 herds (30%; CI 95%: 15% – 52%). Of 145 seropositive goats 123 were positive in RT-nPCR (85%; CI: 95%: 78% – 90%): 95 goats were infected with genotype A (77% of 123 goats), 20 goats with genotype B (16%), and 8 goats with both genotypes (7%).

Conclusion and implications
Both genotypes A and B of SRLV are responsible for CAE in Polish goats. Genotype A is more prevalent and concomitant infection with both genotypes is not uncommon both at the herd- and animal-level.

Acknowledgements and funding
The study was financed by the ICRAD CAE-RAPID grant no. ICRAD/I/CAE-RAPID/02/2021.

doi: 10.1016/j.anscip.2023.01.194

O-119
First report of the occurrence of SRLV genotypes A and B in Lithuanian goat population

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Introduction
Caprine arthritis-encephalitis (CAE) and maedi-visna (MV) are persistent lentivirus infections of goats and sheep. They are often grouped together as the small ruminant lentivirus (SRLV) infetion. There are five recognized SRLV genotypes (A-E), but genotypes A and B are widespread. No study of prevalence of SRLV genotypes in Lithuania was performed before and that was the purpose of this study.

Material and methods
The study was carried out in years 2021–2022 and 10 of 17 herds from various regions of Lithuania known to be seropositive for SRLV infection were enrolled. All adult goats (>1 year-old) in these herds were blood sampled and screened using an indirect commercial ELISA coated with the panel of synthetic peptides from SRLV structural proteins (ID Screen MVV-CAEV Indirect Screening test, ID.vet Innovative Diagnostics, Grabels, France). Then, the herds were revisited and blood was collected only from seropositive goats. Blood was collected to 2-ml tubes with EDTA anticoagulant, mixed with Ficoll to isolate peripheral blood mononuclear cells (PBMC) from whole blood using density gradient centrifugation. After buffy coat was harvested, it was washed and centrifuged with PBS. Then, leukocyte pallets were stored at -20°C until testing. DNA from leukocyte pellets was extracted (DNeasy Blood & Tissue Kit, Qiagen, Germany) and the material was tested using a two-stage real-time nested PCR (RT-nPCR) which distinguishes between SRLV genotype A and B. In total, blood samples from 27 seropositive goats from 10 goat herds were tested using RT-nPCR.

Results and discussion
Twenty two of 27 seropositive goats (82%) tested positive in RT-nPCR. The goats came from 9 of 10 tested herds (90%). Both SRLV genotypes were identified - 8 goats were infected with genotype A (MVV) and 14 goats were infected with genotype B (CAEV). No concomitant infection were detected.

Conclusion and implications
Both SRLV genotypes (A and B) are widespread in Lithuanian goat population.

Acknowledgements and funding
The study was financed by the ICRAD CAE-RAPID (PL grant no. ICRAD/I/CAE-RAPID/02/2021, LT grant no. ID: 39).

doi: 10.1016/j.anscip.2023.01.195

O-120
Detection and characterization of *Dichelobacter nodosus* and *Treponema sp*. involved in clinical cases of lameness in small ruminants

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Keywords: Footrot; Dichelobacter-nodosus; Serogroup; Treponema

Introduction
Footrot is a highly contagious foot disease of sheep and goats caused by *Dichelobacter nodosus* (DN), an anaerobic Gram-negative bacterium. DN is subdivided into 10 serogroups (A-I and M) and there is no cross-immunity among them. This work aims to establish the use of qPCR for the typification of DN strains, but also clinical samples. The results of DN serogroups obtained in clinical samples were compared with those obtained in DN strains. qPCR assay was also used to detect other infectious agents causing lameness, as *Treponema* clusters considered the aetiological agent of Contagious Ovine Digital Dermatitis (CODD).

Material and methods
Samples from 79 different interdigital dermatitis clinical cases from Spain (n = 69) and Portugal (n = 10) were analysed during the 2019-2022 period. A complete hoof profile was performed by qPCR to identify the following pathogens: DN, DN virulent strain, *Fusobacterium necrophorum*, *Treponema* sp., *Treponema pedis*-like, *Treponema phagedenis*-like and *Treponema medium*-like. DN serogroup test was performed by qPCR in clinical samples and strains. Moreover, in 30 cases, the isolation of DN was performed on Hoof Agar medium.

Results and discussion
59.5% of evaluated clinical cases were positive to DN and from those, 97.5% contained virulent strains, therefore, considered as virulent footrot cases. 70.2% of farms had only one circulating serogroup of DN, whereas 19.14% had two serogroups, 8.51% had three and 2.12% had four. Isolation was positively performed in 53% of the cases with only one serogroup identified in each case which coincided with the most prevalent serogroup detected by qPCR in the clinical sample. The DN serogroups found were D (23.4%), B (21.3%), C (14.9%), A (12.7%), E (10.6%), M (8.5%), F (4.2%), H and I (2.1%). M serogroup was only identified in Portugal; it should be highlighted that this serogroup is not detected by conventional serotyping PCR protocols. Moreover, 21.5% of the cases were positive for at least one of the three *Treponema* clusters which are considered pathogenic, suggesting those cases as CODD positive. 2.5% of the cases were negative for all the pathogens studied.

Conclusion and implications
This study showed a wide combinatorial diversity of DN serogroups across the Iberian Peninsula. Although in 70% of the cases only one serogroup was detected by qPCR, the remaining 30% showed circulation of more than one serogroup, which would not have been detected by culturing due to the low sensitivity of the method. It is remarkable that isolated strains had always the same serogroup as the main serogroup identified by qPCR in mixed infections. Another important result was the detection for the first time of the three pathogenic *Treponema* clusters associated to CODD in small ruminant, at the moment mainly studied in cattle.

doi: 10.1016/j.anscip.2023.01.196

O-121
The severity of footrot lesions induced by *aprV2* positive strains of *Dichelobacter nodosus*

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Keywords: Footrot; aprV2; Sheep; Australia

Introduction
The AprV2 protease is required for elastase activity and the development of underrun foot lesions, however, correlations between the presence of *aprV2* positive strains of *D. nodosus* and clinical disease have been inconsistent. The virulence of three aprV2-positive field isolates

of *D. nodosus* was evaluated in sheep using a pasture-based experimental infection model. The ability to eliminate benign and intermediate strains of *D. nodosus* was examined as they are reported to be difficult to eliminate.

Material and methods
In this study the virulence of three *aprV2*-positive field isolates of *D. nodosus* which had benign or intermediate phenotypes, and an *aprV2*-positive virulent reference strain was evaluated in sheep using a pasture-based experimental infection model. A clinical examination of each animal was conducted on days 4, 8, 14, 18, 22 and 25. A restricted maximum likelihood (REML) in a linear mixed model analysis was used to compare the total weighted foot scores (TWFS). In the second phase of the study, treatments including foot bathing and a long-acting antibiotic were administered to the trial groups and their efficacy was evaluated.

Results and discussion
Severe underrun (score 4) lesions developed in the sheep infected with the virulent reference strain but not in those infected with the field isolates in which lesions were mild (score 2 or 3). Foot scores differed significantly over time as the clinical disease developed ($P < 0.001$) and differed between groups ($P < 0.001$) but the differences between groups varied at different times due to differing rates of disease progression leading to a significant interaction ($P =< 0.001$). The three field isolates and the virulent reference strain of *D. nodosus* were eliminated by intensive foot bathing and antibiotic therapy in combination with housing the animals in dry conditions post-treatment. There is a discrepancy between clinical outcome and the *aprV2* genotype of *D. nodosus*, because severe disease did not occur in 3 out of 3 groups of sheep exposed to *aprV2* positive field isolates.

Conclusion and implications
Strains of *D. nodosus* that possess the *aprV2* allele may not always be capable of inducing severe clinical disease and that and that the virulence of *D. nodosus* may be governed by other genomic virulence factors as well as the well-accepted host and environmental factors. This suggests that the presence of *D. nodosus* strains which are *aprV2* positive may not be a reliable indicator of virulence and that further investigation of the factors that determine virulence is required.

Acknowledgements and funding
This work was supported by NSW sheep producers (through NSW Rural Assistance Authority). The authors would like to acknowledge Natalie Schiller, James Dalton, and Nobel Toribio for their technical assistance.

doi: 10.1016/j.anscip.2023.01.197

O-122
The impact of veterinarian-farmer engagement on sheep lameness: A clinical impressions study

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Keywords: Lameness; Footrot; Clinical Impressions; Vet-farmer engagement

Introduction
Lameness in sheep is a major welfare and production issue, estimated to cost between £3.90 to £6.35 per ewe per year[1]. The objective of the study was to engage veterinarians and farmers with reducing sheep lameness in UK flocks and to increase implementation of the 'Five Point Plan' (5PP), which has been adopted as the UK national strategy for tackling lameness in sheep.

Material and methods
Between January and June 2020 veterinary practices across the UK were approached by convenience sampling to assess interest in participation in this clinical impressions study. Veterinarians were required to carry out a visit to each farm to conduct a 5PP and identify measures to reduce lameness on an individual flock basis. An assessment of lameness prevalence was undertaken and where possible, farm medicine and treatment records consulted to establish antibiotic usage. Individual flock-level data were retained by the veterinarian to maintain confidentiality. Farms were provided with a primary course of Dichelobacter nodosus vaccine (Footvax®, MSD Animal Health) to be administered to each animal in the flock. A subsequent visit was carried out by the veterinarian to reassess lameness, medicine and treatment records. An anonymised questionnaire was distributed to all participants to gain feedback on farmer perceptions of the impact of the study on lameness in their flocks.

Results and discussion
27 veterinary practices were recruited, who enrolled a total of 70 farms. Average flock size was 630 (range 60-2300 breeding ewes). In total 44,000 sheep were vaccinated. During the study, average flock lameness decreased from 13% (range 3-40%) to 5% (range 1-15%). Among the participating farmers, 33% were previously unaware of the 5PP, while 54% considered there were difficulties in implementing parts of the 5PP on their farm.

The majority of participating farmers (97%) said they found the project and subsequent veterinary engagement useful and 95% said they would continue to implement the 5PP. 82% of farmers stated that they would continue to vaccinate their sheep against footrot.

Conclusion and implications
Significant gains can be made in a short period of time with concentrated focus between vet and farmer on lameness in sheep flocks. The 5PP has been demonstrated to be a highly effective way in which to reduce lameness and this study demonstrates that farmers value veterinary engagement in this area. It highlights a simple, significant opportunity for veterinarian-farmer engagement to increase the use of the 5PP and reduce lameness on sheep farms.

Acknowledgements and funding
Vaccines were provided by MSD Animal Health. The authors are grateful for the participation of all vets and farmers involved with the study.

Uncited reference
Winter and Green (2017).

Reference

Winter, J.R., Green, L.E., 2017. Cost–benefit analysis of management practices for ewes lame with footrot. Vet. J. 220, 1–6.

doi: 10.1016/j.anscip.2023.01.198

O-123
Efficacy of serogroup-specific *Dichelobacter nodosus* vaccines for treatment and control of footrot in merino sheep

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Keywords: Sheep; Footrot; Efficacy; Vaccines

Introduction
Comparative studies of commercial multivalent vaccines and mono and bi-valent serogroup (strain) specific footrot vaccines have found that the specific vaccines are more efficient in treatment and control of footrot in sheep and goats. Use of these vaccines have been tested in a few countries and successfully used to control and eliminate the disease from affected flocks. The objective of this study was to evaluate the efficacy of these vaccines for treatment and control of footrot in Merino sheep in New Zealand farming conditions.

Material and methods
Five merino sheep farms were selected based on footrot disease prevalence. In four of the farms (A, B, C and D) 2-year-old ewes ranging from 850 to 2000 animals with some level of footrot present were used for trial. The vaccines applied to each farm were based on the specific serogroup/s of footrot bacteria *Dichelobacter nodosus* identified. The trial mobs were vaccinated with either mono or bi-valent vaccines appropriate to the flock. The response to vaccination was monitored by comparing pre and post vaccination footrot severity and prevalence. On farm F with multiple serogroups a paired, case-control study with negative control group was undertaken.

Results and discussion
In 3 farms (A, C and D) post vaccination footrot disease prevalence reduced significantly (12% to 4%; 26%to 0.5%; and 50 to 4.8%, respectively). Despite ideal environmental conditions for footrot transmissions on these farms during the trial period there was no significant spread of the disease or new infections. Other control measures such as foot bathing was minimal to none. Self-cure effects were apparent but not absolute, with a residual of active footrot infection remaining at low levels in trial mobs. On flock B, footrot prevalence was the same at the start to the finish of the study period, 4% prevalence was low to begin with and did not increase despite ideal conditions on irrigated pastures. On the multi-serogroup flock (farm F), the rounds of bivalent vaccine did not produce a satisfactory reduction in disease prevalence levels.

Conclusion and implications
Efficacy of mono and bivalent vaccines in treatment, control and prevention of footrot is very significant if there are only 1 -2 serogroups present and no new serogroups are introduced. Better treatment effects and prolonged protection achieved with customised vaccines can improve the production and welfare outcomes of merino sheep in New Zealand conditions.

Acknowledgements and funding
Gordon McMaster Trust for funding the project.
Participating farms and staff for their voluntary participation and support.

Uncited references
Dhungyel et al. (2013), Dhungyel et al. (2014).

References

Dhungyel, O. et al., 2013. Outbreak-specific monovalent/bivalent vaccination to control and eradicate virulent ovine footrot. Vaccine 31 (13), 1701–1706.
Dhungyel, O. et al., 2014. Footrot vaccines and vaccination – Review. Vaccine 32, 3139–3146.

doi: 10.1016/j.anscip.2023.01.199

O-124
Impact of bivalent and multivalent footrot vaccines on antibiotic usage for lameness in breeding ewes

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Keywords: Vaccination; Sheep; Antigenic competition; Dichelobacter nodosus

Introduction
Footrot is the most common cause of lameness in sheep flocks in England and lameness accounts for two thirds of antibiotic use in the sheep sector. UK industry recommended control measures for lameness include vaccination with a multivalent footrot vaccine (Footvax®). The multivalent vaccine (MV) is only partially protective, consequently prompt treatment of sheep lame with footrot with antibiotics is also recommended to control lameness. The nine serogroups in the MV are thought to cause antigenic competition, which reduces its efficacy. The aim of our study was to determine whether a flock specific, bivalent serogroup vaccine (BV) against footrot was more effective than Footvax: reducing the incidence of lameness and consequently the usage of antibiotic.

Material and methods
Three commercial suckler flocks, totalling 568 crossbred ewes, were enrolled in a blinded clinical trial. Within each flock ewes were randomly assigned to three groups and received two doses, four weeks apart, of the MV, a BV containing two of the most prevalent *Dichelobacter nodosus* serogroups in that flock, or a negative control (saline). Ewes from all three treatment groups were kept together. All ewes were scored for locomotion once a week for 24 weeks, lame ewes were examined and lesions on the foot or leg were diagnosed visually and recorded. Infectious causes of lameness, including footrot of any severity, were treated to a strict protocol with a parenteral and topical antibiotic. The proportion of ewe-weeks at risk in which an antibiotic treatment was given was tested for equality by treatment group for each flock using Pearson's chi-squared tests. The period between week 7 and 25 was compared, when full immunity from vaccination was anticipated.

Results and discussion
The incidence of lameness from week 7-25 in flock 1 was 6.4 cases/100 ewe-weeks and the incidence of footrot was 3.9 cases/100 ewe weeks; BV and MV groups were treated with 4.1 and 4.0 antibiotic treatments/100 ewe-weeks respectively, 33% fewer than the negative control group (6.1 treatments/100 ewe-weeks, $p = 0.04$). The incidence of lameness in flocks 2 and 3 was 1.9 and 6.7 cases/100 ewe-weeks, and the incidence of footrot was 0.8 and 1.6 cases/100 ewe-weeks respectively. The difference between treatment groups in number of antibiotic treatments was not significant ($p > 0.05$) in these flocks.

Conclusion and implications
We conclude that both vaccines significantly reduced the usage of antibiotics in flock 1 where footrot was the main cause of lameness. If the results from this trial are generalisable to other flocks, vaccination against footrot would reduce the usage of antibiotics on sheep farms where the main cause of lameness is footrot.

Acknowledgements and funding
This study was funded by the Biotechnology and Biological Sciences Research Council and the Agriculture and Horticulture Development Board.

doi: 10.1016/j.anscip.2023.01.200

O-125
Vaccination against ovine footrot in lactating ewes has only a transient effect on milk production

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Keywords: Ovine footrot; Vaccination; Lactation; Transient effect

Introduction
A vaccine against ovine footrot (Footvax®, MSD Animal Health) is indicated for the active immunization of sheep against footrot caused by *Dichelobacter nodosus*. The need of a non-restrictive claim on lactating ewes becomes obvious to reduce the use of antibiotics, to avoid milk discard in relationship with milk antibiotic residues and to avoid footrot related discomfort. The study aim was to assess the impact on milk production of vaccination against footrot in lactating ewes.

Material and methods
Forty-four lactating ewes were included and randomised (milk production) in one farm without history of footrot. Twenty-two ewes were vaccinated with the vaccine (Footvax®, MSD Animal Health) on D0 and D28 and twenty-two received a saline solution (negative control group) . During the period following the vaccine injections, milk production was individually measured daily for 42 days after the first injection. Superiority testing was performed using an ANCOVA model with mean daily milk yield during the pre-vaccination period as a covariate. H0 hypothesis was absence of difference between groups. Threshold for the p value was 0.05.

Results and discussion
First administration of the vaccine (D0):
Cumulative milk yield was 2.9% lower in the vaccinated group (39 ± 4.9 L and 40 ± 6.1 L respectively) from D0 to D14. Moreover, both groups showed similar time curve of mean milk yield during the first 2 days after product administration. After that, the average daily milk yield in the vaccinated group was slightly below the average daily milk yield in the control group until D12 when milk production was recovered in the vaccinated group compared to the control group.
Second administration of the vaccine (D28):
Time curve of mean milk yield in the vaccinated group decreased sharply the day after product administration until D31 (i.e. 3 days after vaccination) compared to the curve in the control group. There was a significant decrease in milk yield of 8.8% in the vaccinated group compared to the control group from D28 till D42. The milk yield in the vaccinated group increased to the same yield of the control group from D32 to D39, demonstrating once again that vaccination led only to transient milk reduction and was fully recovered 11 days after vaccination.
The booster 4 weeks after the first injection is a worst-case safety scenario as the basic full vaccination (2 doses) is usually done before lambing.

Conclusion and implications
Vaccination against ovine footrot in lactating ewes led to a transient and slight decrease in milk production which recovered around 11 days after the first administration. The milk loss due to vaccination is very moderate compared to potential footrot related negative consequences such as economic impact, extra antimicrobial use and extra labour.

doi: 10.1016/j.anscip.2023.01.201

O-126
Evaluation of a novel method of lamb castration and tail docking in reducing behavioural pain responses in lambs aged <1 week or 5-6 weeks

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Keywords: Castration; Tail-docking; Pain; Behaivour

Introduction
Castration and tail-docking of lambs, without anaesthesia and analgesia, is still permitted in many countries. The most used method, application of a rubber ring around the neck of the scrotum or the tail, does, however, cause significant pain. In this study we investigated the efficacy of a novel method, 'ClipFitter': a device which applies a disposable plastic clamp to the scrotum or tail which achieves the desensitising effect of crushing the nerves to the scrotum or tail as with Burdizzo castration, especially when combined with a rubber ring.

Material and methods
Two studies, 1) young lambs (<7 days of age), 2) older lambs (5-6 weeks), were conducted to assess the impact on quantitative and qualitative behavioural assessment of pain as follows: Young twin Scottish Blackface lambs (8 per group): RR (castration with a rubber ring, no anaesthetic or analgesic); BPC ('Best Practice' veterinary-advised rubber ring castration following administration of local anaesthetic and an NSAID); CFC (castration with ClipFitter); BPTD ('Best Practice' tail docking after LA and NSAID as above for castration); CFTD (tail-docking with ClipFitter); H (handled only); Older lambs, twin and single crossbred Mule lambs (8 per group): BPC (Burdizzo with local anaesthetic and NSAID), BPTD, CFC, CFTD, and H. Quantitative data for acute pain behaviours (REQ) were collected for 60 minutes after treatment. Two-minute video segments were also used for Qualitative Behavioural Assessment (QBA) using a fixed list approach.

Results and discussion
In **young lambs**, RR and BPC lambs had a significantly higher frequency of expressing REQ behaviours (mean frequency: 185.4 and 135.9, respectively) than H and CFC lambs (means: 17.3 and 6.3; $F_{3,18.6} = 12.50$, $P < 0.001$), which did not differ significantly from one another. BPTD and CFTD lambs had similar REQ responses which were greater than for H (medians: BPTD = 32.5; CFTD = 37.5, H = 13.0, P = 0.043). In **older lambs**, CFC lambs had higher REQ (mean frequency = 22.4) than BPC or H lambs (means 3.6 and 4.5 respectively; P = 0.002).BPTD and CFTD lambs had higher REQ values than H lambs and did not differ significantly from one another (medians: BPTD = 33.5; CFTD = 23.0, H = 8.0; P = 0.012). QBA analysis suggested that young lambs castrated by RR or BPC had more negatively valenced responses than CFC and H lambs ($P < 0.001$). In older lambs CFC lambs were more negatively valenced than BPC or H lambs (P = 0.032).

Conclusion and implications
Overall, the data suggest that ClipFitter was able to mitigate pain responses associated with castration in young lambs to a level indistinguishable from uncastrated lambs, and tail docking responses to those achieved with use of local anaesthetic in both young and older lambs. Although pain responses of older lambs castrated with ClipFitter were greater than H, they were lower than has been seen with RR alone.

Funding
Defra grant AW0303.

doi: 10.1016/j.anscip.2023.01.202

O-127
Sheep Lentivirus Infection in different production systems

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Keywords: Sheep; Lentivirus; Seroprevalence; Risk factors

Introduction
Small ruminant lentiviruses (SRLV) are a group of viruses that infect and transmit among ovine species. SRLV infection inflict progressive and longstanding infections, the majority as asymptomatic or developing late onset clinical signs. SRLV infection is a serious problem on ovine production, not only for animals' wellbeing as well to the herd efficiency. Among other exams, laboratorial methods, essentially, are used for the diagnosis. Raising small ruminants has a great social and economic impact, being produced in different manners going from intensive to extensive care. The main aim of this research was quantifying the seroprevalence and associated risk factors to small ruminant lentivirus infection in different production systems.

Material and methods
This cross-sectional study was among ovine flocks in Portugal to assess seroprevalence status in small ruminant lentivirus infection. Flocks were randomly selected, and shepherds were invited to enrol the study. According to the total number of animals in each herd, between 14 and 19 blood samples were collected. To determine the seropositivity/negativity status of each sample, an indirect ELISA test was per-

formed (ID Screen® MVV/CAEV Indiret). For statistical analysis and odds ratio for risk factors calculation JMP® was used. The p value < 0.05 was considered statistically significant.

Results and discussion
We collected samples from a total of 120 ovine flocks of which 106 (88.3%) had had at least one seropositive animal. From 2072 individual blood samples, 804 (38.8%) were seropositive to SRLV.
Risk factors associated with SRLV infection were: animals older than 2 years old (OR = 2.27 – IC95%: 1.86-2.77); herds for dairy production (OR = 1.48 – IC95%: 1.22-1.80); intensive system (OR = 2.52 – IC95%: 1.57-4.06); commercial herds (OR = 1.89 – IC95%: 1.42-2.52); participation in livestock competitions (OR = 1.42 – IC95%: 1.03-1.84). There was no statistical association (p > 0.05) in relation to the animal's gender, separation of unhealthy animals and different methods of breastfeeding.

Conclusion and implications
We found a high seroprevalence of small ruminant lentivirus infection in ovine flocks in Portugal. Risk factor analysis contributed to a better understanding of the disease in the herds studied. This knowledge empowers the implementation of effective preventive measures. Overall, biosecurity measures should be promoted and implemented to aim reducing viral transmission, with the main goal of reducing the prevalence of this disease. Completely, we understand that government authorities should promote and audit voluntary control and eradication programs in sheep herds in Portugal.

Acknowledgements and funding
Projeto: 0687_OVISPID_2_E POCTEP – Programa de Cooperação Transfronteiriço Portugal – Espanha.
This work was supported by the project UIDB/CVT/00772/2020 funded by the Portuguese Foundation for Science and Technology (FCT).

doi: 10.1016/j.anscip.2023.01.203

O-128
Risk factors for lentivirosis: Preliminary results from a questionnaire

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Keywords: Maedi; Risk factors; Prevalence; Questionnaire

Introduction
In 2019, lentivirosis (maedi-visna-virus infection) was detected in a sheep flock in Trøndelag in Norway by the surveillance programme for lentivirosis. With the aim of monitoring the disease in the area, around 23,000 blood samples from more than 600 sheep flocks were collected and analysed in 2019 and 2020. Lentivirosis was diagnosed in nine flocks. The within-flock prevalence varied from 2% to 90%. Six of the flocks had high prevalence, above 30%. The objective of the study is to investigate factors associated with the prevalence of lentivirosis.

Material and methods
Serum samples were analysed for antibodies against small ruminant lentiviruses using ID Screen® MVV/CAEV Indirect ELISA or ID Screen® MVV/CAEV Indirect ELISA Verification kit and IDEXX MVV/CAEV p28 Ab Verification Test. Diagnosis in flocks with seropositive animals was confirmed with histopathology and PCR, or by direct epidemiological link to a flock with such confirmation.
A survey was sent out to the owners of flocks that were positive for lentivirosis in the outbreak in 2019-2020 (n = 8) and to four control flocks for each of the positive flocks (n = 32). In the survey, there were questions about the flock and the individuals, including housing, management routines and livestock movements.

Results and discussion
As of November 2022, seven out of eight of the owners of the case flocks and 21 of 32 of the control flock owners have answered the survey. This leaves us with an overall response rate of 70%, and to a ratio of one to three for cases versus controls. Efforts are made to include answers from all flocks.
In the following a selection of preliminary results for size, sheep purchase and housing type for the flocks in the survey are presented. The average size of all study flocks in March 2019 was 104 ewes and 3 rams. Three of the seven positive flocks (43%), and six out of 21 control flocks (29%), had increased their flock size with purchase of ewes during the last decade.
About half of all flocks in both groups were held on straw bedding, and the other half used different types of slatted floors. In six out of seven positive flocks, the rams were housed together in the same pens as the ewes during the mating season, but held in separate pens for the rest of the housing season. For the control flocks, this was the case in about half of the flocks.

Conclusion and implications
These and many other results from the survey will be used to identify significant risk factors associated with the prevalence of lentivirosis. An improved understanding of the infection dynamics may help us develop more targeted recommendations to prevent future outbreaks.

doi: 10.1016/j.anscip.2023.01.204

O-129
Occurrence and risk factors associated with small ruminant lentivirus infection in goat and sheep herds

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Keywords: Lentivirus; Virology; Small ruminants; Clinics

Introduction
The caprine arthritis encephalitis virus and Visna Maedi virus are currently referred to as Small Ruminant Lentiviruses (SRLV) for their phylogenetic correlation and interspecies transmission. It is a cosmopolitan disease that negatively affects the international trade, leading to economic losses. The disease is easily distributed from one animal to another and there is no curative therapy or preventive vaccination to break the chain of infection. Disease control consists of periodic serological tests in the herd and the adoption of management practices that reduce seroprevalence.

Material and methods
The study aimed to evaluate the occurrence of risk factors associated with SRLV infection in goat and sheep herds in Brazil. Blood samples were collected from 708 animals (236 sheep and 472 goats) in 21 herds in the states of Pernambuco and São Paulo. The serological diagnosis was determined by agar gel immunodiffusion techniques (Biovetech Kit, Recife, PE, Brazil) and/or Screening ELISA (EradikitTM SRLV Screening Kit, IN3 Diagnostics, Torino, Italy). All serological techniques were performed following the recommendations of the manufacturers. A questionnaire with closed questions and a physical examination were made in order to obtain information related to the management and health parameters of the animals, respectively. The risk factors were determined by binary logistic regression by univariate analysis by Pearson Chi-square or Fisher Exact test, considered as dependent variable the seropositivity for SRLV. Variables without absence of collinearity and with $p < 0.2$ were selected and included in the multivariate logistic regression model.

Results and discussion
Seropositivity was 25.0% (118/472) in goats and 1.3% (03/236) in sheep, and 47.3% (10/21) of the farms had at least one seropositive animal. Goats and sheeps that were kept together in small mixed herds (odds ratio = 6.35; 95%CI = 3.67-11.01; p = 0.001), Saanen breed (odds ratio = 8.37; 95%CI = 2.45-28.61; p = 0.001), presence of animals with arthritis (odds ratio = 6.60; 95%CI = 2.43 = 2.00017 were identified as risk factors associated with the occurrence of SRLV, while the practice of disinfection of blood contaminated instrument (odds ratio = 0.145; 95%CI = 0.084-0.249; p = 0.001) were considered as protective factors for the disease.

Conclusion and implications
The disinfection or discard of sharp instruments used for vaccination and placement of earrings, for example, is considered an essential sanitary measure to prevent mechanical transmission by infected blood from one animal to another. The results of the present study reinforce the need for inclusion of the sheep species in the SRLV control program and discard of animals with arthritis.

Acknowledgements and funding
I would like to express my very great appreciation to Capes/Brazil.

doi: 10.1016/j.anscip.2023.01.205

O-130
Challenges in communication of small ruminant health surveillance results to stakeholders in modern society

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Keywords: Surveillance; Monitoring; Small ruminant health; Communication

Introduction
Small ruminants are known to host several zoonotic diseases of which a large proportion is related to infectious causes of abortion. Nowadays, surveillance results of zoonotic diseases are of great interest, particularly within the One Health-concept. Funded by both industry and government, monitoring and surveillance of small ruminant health is performed by Royal GD as a statutory task since 2021. In addition to the main objectives of this system, providing feedback of findings and results to different stakeholders is an essential element. After the implementation of the surveillance system in 2003, the industry's profession has changed. Currently, the majority of the approximately forty thousand Dutch small ruminant farms is small-scale, of which a considerable part has a public function. In addition, developments in communication in modern society request for an evaluation of current approaches and research into more appropriate techniques to improve communication towards stakeholders and the public. To effectively inform all stakeholders concerned, it is expected that different approaches in communication are required.

Material and methods
In this study, all stakeholders of the monitoring and surveillance system have been identified by performing an extensive stakeholder analysis. Subsequently, a tailor-made approach regarding communication with all stakeholders has been established.

Results and discussion
The stakeholders analysis showed that small ruminant farmers, veterinary students and professionals, consultants and suppliers, physicians, policymakers, and the general public are considered important groups to inform about small ruminants surveillance results. Each stakeholder group enquires specific communication to ensure successful information. Nevertheless, also within stakeholder groups different approaches of communication can be necessary due to differences in age or professional background. Currently, limited distinction is made in communication techniques between stakeholder groups. Although communication frequently receives attention in consultation with funders and stakeholders, data regarding its effectiveness are lacking. Therefore, more data are needed to assess and improve the effect of communication.

Conclusion and implications
For decades, written publications and oral presentations were appropriate tools for communication of small ruminant surveillance results, however, times are changing rapidly. In contemporary society, people gather information from a wide variety of sources, which makes informing stakeholders and public even more challenging. Concluding, universally informing different audiences about surveillance results is not effective as it might be inappropriate for certain stakeholders groups, however, a tailor-made approach for each specific group of stakeholders contributes to successful communication. To achieve improvement, systems must be implemented that structurally collect data about the effect of communication.

Acknowledgements and funding
The monitoring and surveillance system of small ruminant health is funded by the Ministry of Agriculture, Nature and Food Quality and the small ruminant farming industry.

Uncited reference
Dijkstra et al. (2022).

Reference

Dijkstra et al., 2022. Monitoring and Surveillance of Small Ruminant Health in the Netherlands. Pathogens 11 (6), 635. https://doi.org/10.3390/pathogens11060635.

doi: 10.1016/j.anscip.2023.01.206

O-131
Understanding Northern Irish sheep farmers' engagement with NSAID use: A mixed methods approach

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Keywords: Non-steroidals; Sheep; Farmers; Veterinarian

Introduction
Sheep suffer numerous painful conditions where their welfare can be improved by efficacious analgesia. Specifically, sheep benefit from analgesia following surgery, assisted parturition, mastitis and lameness. Non-steroidal anti-inflammatory drugs (NSAIDs) have been proven to provide rapid, efficacious and long-lasting analgesia, in a range of food-production animals, that can be administered as needed and by farmers. However, in many countries there are few, or no, NSAIDs authorised for use in sheep. To further improve sheep welfare, greater understanding is needed of the current level of NSAID use and effective drivers for increasing their use.

Material and methods
A mixed methods approach was used to understand farmers' opinions of, and behaviours related to NSAIDs as part of a wider study considering medicine use in the Northern Irish sheep flock. Qualitative data was obtained through semi-structured interviews with 27 farmers and 15 veterinarians, and discussion groups involving sheep-sector stakeholders. Farm medicine records from 52 farms were also analysed. From this quantitative data the quantity of NSAID purchased was calculated and compared with farm antibiotic use and flock size.

Results and discussion
Seventy three percent (38/52) of the farmer medicine records indicated NSAID use. However, uptake of NSAIDs on these farms was highly variable. There was a five-hundred-fold range between the lowest and highest user on a $mgPCU^{-1}$ basis (0.00156 - 0.79365$mgPUC^{-1}$). Medicine records indicated that 16 farmers (31%) purchased NSAIDs by the bottle, rather than prescribed individual animal doses. Fourteen (27%) purchased 10ml or less over a one-year period. Meloxicam was the most commonly used NSAID (96%), with small quantities of flunixin (2.6%) and ketoprofen (1.4%) also used. The qualitative data highlighted uncertainty among farmers regarding which medicines provided analgesia. Veterinarians saw potential for increased NSAID use following parturition to displace habitual antibiotic administration, by some farmers, to sheep appearing dull without obvious evidence of infection.
The veterinarians thought that they had a significant role in encouraging farmers to use NSAIDs, particularly in leading by example, despite concerns about the lack of an authorised NSAID for sheep. Some farmers reported observing a positive effect in survival, appetite and speed of recovery, and indicated they would use NSAIDs for future cases. However, not all veterinarians were convinced that farmers perceived a benefit from NSAID use, a view supported by the scepticism expressed by some of the farmer interviewees.

Conclusion and implications
The critical role of the veterinarian as an advocate for the welfare of the sheep and the benefits of NSAIDs has been demonstrated. There remains significant opportunity to increase the use of NSAIDs. An authorised product, with a defined dose schedule and withdrawal period, may further enhance uptake and make promotion of NSAID use simpler.

Acknowledgements and funding
Paul Crawford's PhD scholarship is funded by DAERA, UK.

doi: 10.1016/j.anscip.2023.01.207

O-132
Sheep farmer engagement with flock health plans and planning in Northern Ireland: Where are we now?

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Keywords: Health planning; Sheep; Farmers; Veterinarians

Introduction
Flock health planning should be a cyclical process of assessment, evaluation, action and re-assessment. The intention being to improve stockmanship and the use, and stewardship, of veterinary medicines. Done effectively, this should improve animal health and welfare as well as farm productivity and financial returns.
The health plan (HP) became a central facet of the quality assurance schemes (QAS), introduced by the agri-food industry in the United Kingdom in the early 1990s, in response to demands for greater transparency and accountability in food production. While farmers were initially rewarded with bonus payments for QAS membership, within ten years membership become essential for many farmers simply to gain market access. Little is known about the current views of farmers about, and the impact of, HPs, yet HPs continue to be heavily promoted to Northern Irish (NI) sheep farmers.

Material and methods
A mixed methods approach was used to explore farmers' and veterinarians' opinions and behaviours related to QAS and HP as part of a wider study of medicine use in the NI flock. Data was obtained through an online scoping questionnaire, semi-structured interviews with 27 farmers and 15 veterinarians, and discussion groups with wide-ranging industry stakeholders. The association between a farm having a HP and implementation of 12 industry-recommended flock health activities was considered using the Fisher's exact test.

Results and discussion
Of the recommended activities, only '*Treating cases of footrot promptly with an injectable antibiotic*' was statistically associated with a farm having a HP ($P < 0.001$); however, this association was negative, meaning farmers with a HP were less likely to follow best practice. Farmers reported a reluctance to pay for veterinary advice, while some veterinarians reported a lack of time to develop HPs for farmers.
Farmers predominantly saw the HP as a static physical document rather than a proactive, reflective and collaborative planning process. The perceived quality of their flock's HP varied, and farmers reported it had limited impact on their management practices.

Veterinarians tasked with completing HPs felt restricted by inadequate and incomplete flock production data, a lack of confidence in the accuracy of farm medicine records and limited knowledge of farm practices; this led some to believe that the HP may fail to address critical issues.

Conclusion and implications
If the HP is to achieve its potential, new ways to engage farmers and veterinarians in an active flock health planning process need to be identified. The focus needs to be shifted from a static, physical document to the intended process of reflective health planning. To facilitate this, user-friendly data capture tools for sheep farmers are needed, as well as sufficient veterinary resources for sustainable active engagement to happen.

Acknowledgements and funding
Paul Crawford's PhD scholarship is funded by DAERA, UK.

doi: 10.1016/j.anscip.2023.01.208

O-133
A unique quality assurance and herd health programme for Finnish sheep herds

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Keywords: Herd; Health; Quality; Sustainable

Introduction
Animal diseases and deficiencies in animal husbandry weaken the productivity and profitability of farming and endanger animal welfare. In addition to acute diseases, like parasitic gastroenteritis, coccidiosis, perinatal lamb mortality, mastitis and disturbances in calcium and energy metabolism, subclinical problems occur. Our aim was to draw up quality assurance programme to prevent animal diseases, improve treatment and husbandry practices by influencing the root causes of the problems in a typical Finnish herd with 100 – 600 ewes. Program helps farmers to do right things at the right time with the herd in sheep shed and on different kind of pastures.

Material and methods
To the programme, we applied some of the HACCP principles. Initially, we described the events of the ewe production year and constructed a unified lamb breeding process. We set perspective on ewe, on the assumption that ewe's health and wellbeing form the basis of healthy lambs. We assessed which supportive functions in sheep farming, are necessary to management the production process and for which good practice guidelines (GMP) can be drawn up. Thirdly, we assessed what kind of indicators producer needs to monitor the management of the process.
We identified six stages of production in ewe's production year, which can be treated as sub-processes of lamb husbandry and for which it is possible to establish control points to manage the process. Production stages were named and their outputs were defined: (1) Selection of ewes (2) heat synchronisation; (3) Ewe clinic (scanning, health check, groupping); (4) Feeding in late pregnancy (5) Maintenance of good lactation (6) Weaning lambs (steadily growing lambs). In addition, we identified the necessary support functions, related to the sub-processes, for example, condition scoring, farm biosecurity and feeding plan based on analysed silage. Thirdly, we selected and drew up three types of indicators for producers: Indicators describing the state of the process at key control points (e.g. the length of the tupping period); Indicators describing the utilisation of key support measures (e.g. the use of adaptable pen structures); Indicators describing the success of production (e.g. lamb mortality).
We allso compound to health program Finnish model to control gastrointestinal roundworms (EMOP XII.Turku.2016). Model includes grazing plans for farms. Plans are based on pastures history, their risk assessments in relation to gastrointernal parasites, regular FEC monitoring, lamb weights. Grazing plan is integrated to farms cultivation plan. Now, even advices about regenerative grazing are included, to promote healthy soil and versatile nature.

Conclusion
Quality assurance program we have drawn up (Sheep Health 2020) creates good qualifications for comprehensive management of animal disease risks and compliance with good practices in sheep herds. Instead of partial optimisation, it is more profitable to avoid underperformances an any individual production stage.

doi: 10.1016/j.anscip.2023.01.209

ISVA: Miscellaneous

O-134
Efficiency of different infection routes for the experimental reproduction of contagious ecthyma in lambs

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Keywords: Orf virus; Experimental infection; Contagious ecthyma; Lambs

Introduction
Contagious ecthyma (CE) is caused by the orf virus (ORFV),a parapoxvirus. CE mainly affects sheep and goats, causing proliferative lesions in the mouth, lips, udders and hooves that evolve to papules, pustules and scabs. Mortality caused by CE rarely exceeds 1%, but morbidity may reach 90%. The disease is responsible for economic losses in all countries. In Spain and other countries, a vaccine for this disease is not available and treatment involves standard hygiene practices and the use of antibiotics to control secondary infections. Alternative treatments are needed and to properly assess their efficacy requires experimental reproduction of CE. In this work, we performed an experimental orf infection and assessed the evolution of the disease using three different infection routes.

Material and methods
Nine, 15-day-old Lacaune lambs were divided in three experimental groups and inoculated in the lips with 5x104 TCDI50/animal of orf - virus using three routes: intradermally (Group 1), subcutaneously (Group 2) and by scarification (Group 3). A clinical examination was performed daily, during 20 days. Before the experimental infection (T0) and days post-infection (dpi) 1, 5, 12 and 18 (T1 to T4), blood samples were obtained for haematological analysis anddetection of serum orf antibodies. Additionally, swabs from proliferative skin lesions were taken for viral load determination by real-time PCR. At the end of the experiment, muzzle skin, lip, palate and tongue samples were obtained for histopathological analysis.

Results and discussion
Lesions consisted on a focally extensive, proliferative and necrotizing dermatitis/stomatitis with histopathological degeneration of the epidermis and eosinophilic intracytoplasmic viral inclusion bodies. Severity of lesions was similar between groups 1 and 3. Interestingly, lesions in Group 1 (intradermal infection) were observed in multiple locations including muzzle skin, lip, tongue, and palate whereas in Group 3 (scarification), lesions only occurred on the muzzle, in the area where the scarification had taken place. In Group 2 (subcutaneous infection) almost no lesions were observed, with the exception of a very minor skin nodule in one of the lambs. At T4, viral load was significantly higher ($p < 0.05$) in group 1 compared with group 2. In general, a significantly higher number of lesions (positive correlation = −0.490 and $p = 0.002$) correlated with a higher viral load. All groups were seronegative throughout the entire experiment.

Conclusion and implications
Finally, it can be concluded that the intradermic injection was the most efficient experimental infection route for reproducing orf virus pathology and reproduced standard contagious ecthyma lesions.

doi: 10.1016/j.anscip.2023.01.210

O-135
Integrative therapeutic approach in sheep lymphoma model

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Keywords: Homeopathy; Ovine; Treatment; Viscum album

Clinical history
A Santa Inês ewe (5 years old) presented progressive weight loss, low appetite and persistent diarrhea.

Investigations
In clinical examination, thinness (BCS: 2.5), dehydration and pasty stools with streaks of live blood were observed. In complementary exams, normocytic and normochromic anemia (7.2×10^6 RBC/μL), hypohemoglobinemia (8.4 g/dL), thrombocytopenia (180×10^3 platelets/μL), inversion of the N/L rate (1.51), lymphopenia (1.697 lymphocytes/μL), 50 eggs per gram, no changes in serum biochemistry and mesenteric and perirenal lymph node hyperplasia by ultrasound (US) were found. A fine-needle aspiration puncture and US-guided biopsy were performed in perirenal lymph node being compatible with lymphoma by cytopathological and histopathological evaluations. Treatment with homeopathic complex (twice a day, nasal spray), *Viscum album* D3 (once a day, SC) and *Arsenicum album* D9+D35 (every 48 h, SC), autohemotherapy (10 mL; once a week, IM) and ADE vitamins (2 mL; once a month; SC) was started. After 30 days, improvement in ewe's body weight (44 to 47 kg), coat appearance, appetite and lymphocytes normalization (2.730 cells/μL) were obtained. There was a gradual growth in mesenteric and perirenal lymph nodes seen by US. After 75 days, the onset of liver metastases was observed by US. After 90 days, the ewe started to lose body weight and there was seen metastasis in right kidney by US. After 100 days, there was increase in AST values (77 to 171 IU/L) and decrease in total plasma proteins (6.7 to 5.5 g/dL) and albumin. After 121 days, the animal died. In these last days, the animal showed more difficulty getting up off the ground, although maintained a good appetite and ruminal movements. Necroscopic examination revealed increase in size and presence of nodules in mediastinum, hepatic, mesenteric and perirenal lymph nodes, as well as in diaphragm, pancreas, liver, middle jejunum, right kidney and a great mass in mesenteric chain ($55.0 \times 8.0 \times 3.0$ cm; 1.7 kg). Histopathological analysis was compatible with the diagnosis of diffuse small cell lymphoma with several metastatic processes.

Differential diagnosis
ELISA and qPCR were performed for enzootic bovine leukosis with non-reactive and negative results.

Discussion
Reports of sheep lymphoma are scarce being described as findings in slaughterhouses and experimental infections on Enzootic bovine leukosis inducing neoplasia. Interestingly, recent studies showed that chronic persistent inflammation, such as fasciolosis, may induce irreversible changes in immune cell populations, thereby causing a lymph node neoplasm. US scan for diagnostic support is highlighted in this case, as well as the clinical, laboratory and US description from ewe's diagnosis to death. Likewise, integrative therapeutic tools can be adopted aiming at quality and extension of the patient's life.

doi: 10.1016/j.anscip.2023.01.211

O-136
Arboviral disease in south-eastern Australia

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Keywords: Arbovirus; Bluetongue; Australia; La nina

Introduction
Australia is an island continent straddling the 40th parallel (Tropic of Capricorn). Above that line lies tropical rainforest, an ecological continuum with south-eastern Asia resulting in a constant influx of arboviruses. Included is Bluetongue virus, with 16 of the 24 serotypes now recognised in northern Australia; meanwhile, disease is not recognised in Australia, as sheep production occurs in the more temperate, southern zones.
The climate of the southeastern region is attributed to the El Nino – Southern Oscillation (ENSO); the climate pattern resulting from the movement of cold water east- or west- across the Pacific Ocean. This leads to extreme weather oscillations approximately every seven years, from droughts in the *El Nino* phase to flooding rains in the alternate *La Nina* phase, interspersed by several years of average rainfall and weather.
The native flora and fauna of Australia have adapted to these extremes: river fish having mechanisms to survive in a dry riverbed, while kangaroos and waterbirds breed multiple times in the good seasons. Then the Murray-Darling Basin, draining southwest off the coastal mountains, floods in these wet springs and summers; the abundant free-standing waters result in large increases in insect activity, including midges and mosquitoes, extending their tropical range southwards, well below the 40th parallel.

Discussion
Australia's National Arbovirus Monitoring Program (NAMP) uses insect trapping and serological testing of sentinel cattle to describe the range of the main Australian vector of Bluetongue virus, *Culicoides brevitarsis*. This extends southwards into New South Wales intersecting

with large populations of grazing sheep, increasing the possibility of Bluetongue disease. Fortunately, *C.brevitarsis* has poor efficiency as a vector of BTV; but is more effective at transmitting Akabane virus, resulting in periodic outbreaks of Akabane disease in the wet seasons in southeastern Australia. Bovine Ephemeral Fever also occurs in such years.
La Nina phases can last between one to three years, with the colder winters resulting in seasonal decrease of insect populations. This results in a different arbovirus causing disease in different species in each of these *La Nina* years. The drying and *El Nino* phases then lead to a loss of herd immunity and population turnover; it may be several ENSO cycles before the same disease recrudesces. The parallel fluctuations in populations of the native reservoirs of arboviruses (when applicable) also influences disease expression.

Conclusion and implications
This sporadic and episodic nature of these disease outbreaks, occurring over a large geographical area, may lead to them going unrecognised. Only wide-ranging, coordinated surveillance efforts will ensure that such disease incursions can be recognised; in the meantime, veterinarians working in SE Australian sheep flocks should be alert to unusual disease manifestations in those years of high spring-summer rainfall and insect activity.

doi: 10.1016/j.anscip.2023.01.212

O-137
Campylobacter as a cause of ovine abortion

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Keywords: *Campylobacter*; Pathology; Ovine; Abortion

Introduction
Campylobacter species are widely distributed among different animals, and fecal contamination of feed or the sheep environment can lead to abortions. First introduced to the flock, *Campylobacter* can be very contagious and lead to abortion storms.

Material and methods
During the sheep season of 2022, we investigated all submitted aborted fetuses, stillborn or weakly born lambs with special emphasize on *Campylobacter* sp., in addition to standard abortion diagnostics that included full necropsy and bacteriology. Histology and *Toxoplasma*-PCR were included in selected cases based on history, post mortem findings and the submitters specific request. *Campylobacter* diagnostics included incubation of abomasal content and/or cotyledon on CCDA (Charcoal Cefoperozone Deoxycholate Agar) and Skirrow plates. Colonies with characteristic growth were examined by phase contrast microscopy and further identified by Matrix-Assisted Laser Desorption Ionization - Time of Flight (MALDI-ToF). DNA was isolated from the same material and qPCR targeting *Campylobacter fetus*, *C. coli* and *C. jejuni* was performed.

Results
Of material from 43 flocks (130 lambs), only one flock was found positive by incubation on selective *Campylobacter* media. From this flock we necropsied nine cases, and we isolated *C. jejuni* from eight of these cases. Material from the first case was not grown on selective media and *Campylobacter* was not isolated from this case. In total, approximately 22–25% of the winter-fed ewes aborted or had stillborn lambs in this flock. Necropsied lambs had several postmortem findings. Two lambs were near full term, the other were earlier abortions in the third trimester. Two of the lambs were weakly born with partially air-filled lungs. The other seven lambs had moderate to large autolytic changes. Most of the lambs had accumulation of subcutaneous fluid and blood-stained fluid in the abdomen and thorax. Two animals had a fibrinous peritonitis and one a fibrinous pleuritis. One lamb had a few liver necroses. There were hemorrhages in several organs in three lambs. The fetal membranes were reddish, some had hemorrhages and a few dull beige areas in-between the cotyledons. Feces from 11 ewes that had aborted were cultured and we identified *Campylobacter* from eight of these ewes. Some of the ewes had aborted several weeks earlier. PCR results will be presented at the conference.

Conclusion and implications
Campylobacter is not a common cause of ovine abortion in Norway, but when it is introduced, it can cause heavy losses. The pathological findings were variable and indicative of an infectious cause, but not a specific pathogen. *Campylobacter* was isolated from feces from most of the ewes that had aborted showing that strict sanitary precautions and isolation are necessary to diminish the extent of abortions.

doi: 10.1016/j.anscip.2023.01.213

O-138
Bilateral otitis media in a six-month-old lamb

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Keywords: Lamb; Otitis; Media; Bilateral

Clinical history
The lamb was submitted to the ruminant clinic at the Veterinary Faculty at the University of Zaragoza because of ill thrift, leading to weight loss. After the initial clinical examination, it was diagnosed with respiratory disease. In addition, it had a skull deformity with uneven positioning of the orbitae and eyes. After one month in the service, the lamb's condition worsened, and the new clinical examination now also revealed neurological signs.

Investigations
During the clinical examination, mixed dyspnea was detected on auscultation with a productive cough. Haematology showed normal parameters in the red series and slight neutrophilia without leukocytosis. Ultrasound revealed increased echogenicity in the cranial areas of both lungs.
In the neurological examination, a slight head tilt to the right side was observed. Pathological nystagmus was evident while in a supine position. The right eye showed ventromedial strabismus. The lamb had impaired responses in all the right postural reactions. There was no evidence of facial paralysis on either side. After the examination, the right medial-internal ear location was pointed out as all the signs signalised a right peripheral vestibular syndrome. The CT scan with a soft tissue filter showed medium-density material (pus) filling both the tympanic bullae and the auditory canal in the right ear. The lamb was not treated with systemic antibiotics, but euthanised, and a full necropsy was performed. Mucopurulent exudate was evident in the nares and upper airways. There was chronic pleuritis on both sides and chronic bronchopneumonia with abscessation involving the frontal and middle lobes. Both middle ears contained purulent exudate, and the surface of the bullae was hyperemic. *Trueperella pyogenes* was cultured from the right middle ear and *Acinetobacter pseudolwoffii* was cultured from one of the lung abscesses.

Differential diagnosis
The clinical findings of right peripheral vestibular syndrome and the disease history focused the diagnosis on medial or internal otitis. However, other diseases, such as infectious meningoencephalitis or neoplasia, could present similar clinical signs.

Discussion
This lamb had a long disease history with deterioration and, most likely, immunosuppression. Otitis media is an uncommon finding in lambs, and usually presents as a unilateral finding. It is usually associated with facial paralysis that could not be observed in this lamb. In calves, uni- and bilateral otitis media have been connected to pneumonia caused by *Mycoplasma bovis*. Airway infections could reach the middle ear by the Eustachian tube, but otitis media could also be found as a part of generalised infection.

Uncited reference
Suwanruengsri et al. (2021).

Reference
Suwanruengsri, M., Uemura, R., Izzati, U.Z., Kanda, T., Fuke, N., Yasuda, M., Hirai, T., Yamaguchi, R., 2021. *Mycoplasma bovis* may travel along the Eustachian tube to cause meningitis in Japanese Black Cattle. J. Comp. Pathol. 188, 13–20. https://doi.org/10.1016/j.jcpa.2021.08.001.

doi: 10.1016/j.anscip.2023.01.214

O-139
Two clinical cases of facial squamous cell carcinoma in sheep

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Keywords: Computed Tomography; Sheep; Squamous Cell Carcinoma; Tumours

Clinical history
Two ewes from different herds were simultaneously referred to the Ruminant Clinical Service (SCRUM) of the University of Zaragoza. Both animals presented similar clinical signs: a fast growing, remarkably erosive, enlarged mass around the eye. In addition, both animals showed nasal discharge. Therefore, both animals were submitted to the same diagnostic procedures to analyse the origin and aetiology of the mass.

Investigations
Clinical examination revealed no important findings other than the obvious masses. Haematology tests were also carried out, revealing a non-regenerative mild anaemia, as well as a neutrophilia and lymphopenia. Additional imaging diagnostic tests were performed, including computed tomography (CT) scan and thermography. CT scan was particularly helpful for diagnosing. One of the animals had a tumour-like retrobulbar lesion that reached both the earlobe and the cheek, even penetrating the ethmoid turbinate. The second ewe had a tumour-like lesion just spread around the eye, causing pressure and damage in the orbit. Thermography showed a vascularised inflammatory mass in both animals. Histopathological examination defined both masses as tumours, specifically as squamous cell carcinomas (SCC).

Differential diagnosis
The appearance of facial tumours in sheep is an uncommon clinical manifestation in sheep. Despite the small number of cases described, some studies have shown that the most frequent one is squamous cell carcinoma (SCC), followed by papilloma, melanoma and basal cell tumour. SCC is a malignant neoplastic disease, more frequently found in white-coated animals. Some studies conducted in other species have demonstrated the relationship between this type of tumour and UV radiation, especially with sun exposure, which is an unavoidable factor in sheep herds when they go out for grazing. Due to the location of the masses in both cases, the Enzootic Nasal Adenocarcinoma (ENA) could also be possible as a differential diagnosis. However, the origin of the mass was not located inside the nasal cavity, something that was clarified by CT scan images and corroborated by histopathology.

Discussion
Squamous Cell Carcinoma (SCC) is an unusual pathology in sheep that only affects a very low number of ewes. Nevertheless, it is a highly aggressive tumour that causes severe discomfort to the affected animal and a poor prognosis, which eventually makes euthanasia a necessary procedure. Although other disorders in the sheep's face are more frequent, the SCC must be always a differential diagnosis.

doi: 10.1016/j.anscip.2023.01.215

O-140
Effect of injectable eprinomectin on milk production and quality of dairy ewes reared semi-intensively and naturally infected with gastrointestinal nematodes

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Keywords: Dairy sheep; Eprinomectin; Milk yield; Efficacy

Introduction
Dairy ewes in Greece face a continuous challenge of gastrointestinal nematodes. There are a few antiparasitic drugs available for use during lactation, but require milk withdrawal.

Material and methods
One-hundred and fifty clinically healthy adult lactating ewes from 3 flocks were included in the study. On day −7, ewes of each flock were randomly allocated in 2 groups of 25 ewes: Control (group C) and Treated (group T). Groups were balanced for faecal egg count (FEC), milk yield record and Maedi-Visna seropositivity. On day 0, T ewes received a single injection of eprinomectin (0.2 mg/kg BW, *"Eprecis"* 20 mg/mL). C ewes were left untreated during the whole experiment. T ewes with a FEC > 300 eggs/g on day +60 were given a second treatment. Faecal samples were individually collected on days −7, 0, +30, +60, +90, +120 for FEC and coprocultures. On days −7, 0, +30, +60 and +90, individual milk yield (MY) was recorded. Moreover, individual milk samples were collected for chemical composition and somatic cells counts (SCC). Energy corrected milk yield (ECMY) for 6% fat was also calculated. On each test-day, individual fat and protein yield (FY and PY) were calculated. Total lactation MY (TMY), total ECMY (TECMY), total FY (TFY) and total PY (TPY) were computed according to ICAR

recommendations. The effect of treatment on FEC and milk parameters were assessed with mixed models for repeated measures accounting for the random effect of each ewe and each farm. Last, the effect of treatment on TMY, TECMY, TFY and TPY was assessed with general linear models accounting for the random variation within each farm. All analyses were performed with IBM SPSS v.25 (Armonk, NY: IBM Corp.).

Results and discussion
The most prevalent parasite was *Haemonchus spp*. Treatment had a significant effect ($P < 0.001$) on FEC reduction throughout the trial (overall efficacy on +30 and +90 was 97.27% and 98.80%, respectively). Estimated marginal means showed an average benefit of *ca.* 105 mL more milk per test-day for treated ewes compared to untreated ones. No significant effects of treatment were observed on the other parameters, although values were constantly numerically higher for treated ewes compared to control ones. T ewes produced 5.7% more milk (308.8 L vs. 292.1 L, $P = 0.158$), 4.6% more fat-corrected (6%) milk (311.7 L vs. 298.1 L, $P = 0.236$), 2.4% more fat (15.2 kg vs. 14.8 kg, $P = 0.557$) and 6.4% more protein (11.8 kg vs. 11.1 kg, $P = 0.115$) across the whole lactation compared to untreated ones.

Conclusion
In this field trial, injectable eprinomectin had a high overall efficacy against gastrointestinal nematodes. Treatment had a beneficial effect on daily milk yield and potentially could lead to higher milk, fat and protein yield during a whole lactation.

doi: 10.1016/j.anscip.2023.01.216

O-141
Lack of efficacy of topical administration of eprinomectin against gastrointestinal nematode in a French dairy sheep farm

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Keywords: Sheep; Eprinomectin; Gastrointestinal nematode; Bioavailability

Clinical history
In the dairy sheep breeding areas of southern France, the control of gastrointestinal nematodes (GIN) during lactation requires the use of eprinomectin, which is the only anthelmintic in the market with a zero-day milk withdrawal period. Two formulations are available: topical and injectable. In a Blond-Faced Manech breed farm, the farmer and his veterinarian noticed signs of anemia in lactating ewes and a decrease in body condition despite recent administration of an anthelminthic.

Investigations
A Fecal Eggs Count Reduction Test (FECRT) was performed according to the WAAVP guidelines, with three groups of 12 ewes: an untreated group (C), an eprinomectin-treated group with topical formulation (E-To, 1 mg/kg bodyweight) and an eprinomectin-treated group with the subcutaneaous formulation (E-Sc, 0.2 mg/kg bodyweight). Fecal samples were individually collected at the day of treatment (D0) and after fourteen days (D14). Composite larval cultures were made for each group at D0 and D14 to identify three main GIN species by real-time PCR: *Haemonchus contortus*, *Teladorsagia circumcincta* and *Trichostrongylus colubriformis*. Individual blood samples were collected from both eprinomectin groups (E-To, E-Sc) at day 2 (D2) and day 5 (D5) and subsequently analysed by HPLC method to determine plasma concentrations of eprinomectin.

Differential diagnosis
The FECRT revealed an efficacy of 86.1% and 99.6% for E-To and E-Sc formulations, respectively. Predominant species in all group at D0 was *H. contortus*. At D14, no larvae were obtained in the group treated with E-Sc. In the group treated with E-To, *H. contortus* and *T. colubriformis* were identified. Mean eprinomectin plasmatic concentrations observed were 7.44 ng/mL at D2 and 1.91 ng/mL at D5 in E-Sc group and 1.26 ng/mL and 1.12 ng/mL at D2 and D5 respectively in E-To group.

Discussion
In this case report, ewes treated with E-To showed a reduced efficacy while a high efficacy was observed for ewes treated with E-Sc. This result is not consistent with the hypothesis of GIN resistance to eprinomectin, as eprinomectin injectable formulation was found fully effective, despite a concentration of eprinomectin five times lower than the eprinomectin topical formulation. The hypothesis of under-exposure of GIN to eprinomectin was confirmed by plasma concentrations for the topical formulation: the minimal active concentration of 2 ng/mL was not reached in this group. This study suggest that these two formulations do not have the same bioavailability and that lack of efficacy of anthelmintics is not always synonymous with GIN resistance: it may originate from an insufficient exposure of worms to the drug.

Acknowledgements and funding
We thank the breeder for his involvement in the protocol. This investigation was self-funded by the UMT Pilotage de la Santé des Ruminants without any funding from private companies.

doi: 10.1016/j.anscip.2023.01.217

O-142
Key risk factors of emergence or spread of eprinomectin resistant *Haemonchus contortus* in dairy sheep farms according to field experts

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Keywords: *Haemonchus contortus*; Risk factors; Resistance; Eprinomectin

Introduction
Eprinomectin-resistant populations of *Haemonchus contortus* are increasingly reported in dairy sheep farms in Southwestern France. Although some risk factors of anthelmintic resistance are well-known in scientific publications, it is of particular importance to study the awareness to and the understanding of this phenomenon by local experts, veterinarians, engineers and technicians. This was the purpose of this study.

Material and methods
A score grid was developed based on risk factors of resistance identified from scientific publications. 25 risk factors were selected for this study and separated into four domains (“use of eprinomectin”, “breeding practices”, “host characteristics” and “parasite characteristics”). Each risk factor was divided into 3 or 4 practices (more or less at risk). 13 experts (9 veterinarians, 2 engineers, 2 technicians), working on parasitic issues in the *Pyrénées Atlantiques* department in France answered the questionnaire. Each expert had to score the practice from 1 (less important) to 4 (more important), then to rank each risk factor in the domain and finally to rank each domain. Domains and risk factors scored above 10 were considered of interest. Practices were ranked from the one that could maximise the risk of resistance development to the less important ones.

Results and discussion
2 domains out of 4 were scored above 10: “use of eprinomectin”, and “breeding practices”. Risk factors of interest (scores above 10) were those linked with “rotation of anthelminthics family”, “treatment frequency”, “appropriate dosage”, “grazing management”, “grazing under 5 cm”, “time spend to graze during one-year”, “mixed grazing with ewes from other farms”, “refugia”, “weather conditions”, “criterion of treatment” (body score, clinical signs).
Practices at risk for the development and spread of eprinomectin resistance were “use of the same anthelminthic family during several years”, “More than 3 treatments per year”, “Grazing grass less than 5cm high”, “Grazing all year long”.
Most of the results are coherent with the literature, such as treatment frequency and grazing management. However, some risk factors identified with field data such as the age at first delivery or transhumance were not considered as important risk factors by fields experts. It may be of interest to discuss these points altogether and further study them. The route of drug administration was not identified as an important risk factor by field experts whereas pour on route of administration is clearly associated with low exposure of worms to the drug. However, local veterinarians have already switched from a pour on administration to oral or subcutaneous routes for eprinomectin.

Conclusion and implications
Some important risk factors were clearly identified by field experts in this study. However, it seems that some points are still to be discussed and analysed like the age of primo parturient ewes or administration routes.

doi: 10.1016/j.anscip.2023.01.218

O-143
Resistance to eprinomectin in gastro-intestinal nematodes of dairy sheep: What part do breed and summer pastures play?

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Keywords: Eprinomectin; Summer pastures; *Haemonchus contortus*; Dairy

Introduction
Among the various drivers of genetic diversity in the gastro-intestinal nematode (GIN) *Haemonchus contortus*, environmental change and exposure to anthelmintic (AH) molecules might be those provoking the steepest changes. Multi-resistance of *H. contortus* to AH is an increasingly global threat to grazing sheep, and local agricultural systems are facing the double challenge of dealing with increasing rates and gravity of haemonchosis, with a diminishing pool of molecules. Resistance of *H. contortus* to the only zero milk withdrawal period AH molecule, eprinomectin (EPN), has been increasingly diagnosed since 2019 in the two main french dairy sheep regions. Of these, the Ossau-Iraty production area (the *Pyrénées Atlantiques*) where sheep usually graze almost year round, is especially concerned.

Material and methods
Information regarding strongylosis and general farm management gathered in a 2019 questionnaire was used to identify differences between farms facing EPN resistance and farms that could still rely on this molecule for GIN management in the *Pyrénées Atlantiques*. Efficacy of EPN was evaluated using a Fecal Egg Count Reduction Test (31 farms) conducted by a research team, or using a post-treatment fecal egg count (16 farms) done by the farm's practicing veterinarian.

Results and discussion
Of these 47 farms, 62% had mainly basco-béarnaise (BB) dairy sheep and the remaining 38% worked with blond faced Manech (BFM) dairy sheep. Of the 29 farms working with the BB breed, 22 (76%) were facing resistance, and of these 21/22 (95%) used mainly collective summer pastures. Of the 18 farms working with BFM, 7 (39%) faced EPN resistance and of these 5 (71%) did not use summer pastures. Farms working with BB sheep are over-represented in our data, and this breed is historically and geographically very linked to the high-altitude summer pastures. These results suggest that breed and exposure to summer pastures play a role in the development and/or spread of resistance to EPN. However, presence of EPN-resistance in BFM and BB farms that remain in the valley indicates other risk factors should be investigated. On an epidemiology scale, the number of recruited farms is limited, and data was not collected to study local prevalence. Yet this data represents a considerable collective effort to characterize an emerging phenomenon in a field where no molecular technique is available for larger scale data collection.

Conclusion and implications
Our data will be reinforced with a Factor Analysis of Mixed Data and a marginal model to further identify variables of interest in studying EPN resistance in a mountainous grazing area, where effects of climate change are rapidly modifying parasite species distribution and population dynamics.

Acknowledgements and funding
The authors wish to thank Ceva Santé Animale and F2E Carnot for their funding, and the farmers and veterinarians for their participation.

doi: 10.1016/j.anscip.2023.01.219

O-144
Description of milk production patterns for the first two lactation periods in intensively reared Lacaune ewes in Greece

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Keywords: Ewe; Primiparous; Lacaune; Lactation

Introduction
Although Lacaune dairy breed is the most popular for intensive production systems in Greece, there is a lack of information regarding their production performance during complete lactation periods.

Material and methods
Milk performance records from the first two lactation periods of 436 primiparous Lacaune ewes from 4 dairy commercial farms (A: n = 230, B: n = 59, C: n = 90, D: n = 57) in central Greece were collected (2020 to 2022). Milk yield (MY) was recorded at the morning milking, from the 8th week of lactation on a monthly basis. Ewes included in the study had at least 4 measurements for each period. Total milk yield (TY) was calculated according to the simplified method of recording milking yield from a single test at monthly intervals (ICAR, 1992). Estimates of MY to 180 d were used to standardize the length of lactation for all ewes and to avoid potential biases. Descriptive data were processed using Python. K-means algorithm was used to identify the cluster membership by TY increase between the first and second lactation of each animal.

Results and discussion
The coefficient of determination (r^2) for 180 days milk yield between the two consecutive lactations was 0.34. Mean TY was increased by 9% at the 2nd lactation. Three clusters were identified; In cluster 1 (n = 233) TY increased by 13.16%, in cluster 2 (n = 131) TY decreased by 35% and in cluster 3 (n = 68) TY increased by 53%. Moreover, the variation (%) of TY increase in the second lactation, according to TY of the

first period, is described by the following pattern; 150–200 lt: +66%, 200–250 lt: +40%, 250–300 lt: +20%, 300–350 lt: +14%, 350–400 lt: +10%, 400–450 lt: 6% and 450–500 lt: −1.5%.

Conclusion and implications
Ewes with a high level of milk production in their 1st lactation showed a lower margin of TY increase in their 2nd lactation. The above results could help farmers to detect ewes with low MY potential early in lactation. Further studies are needed to evaluate factors that may affecting yields of primiparous ewes (eg. age at first lambing or different management practices).

doi: 10.1016/j.anscip.2023.01.220

O-145
Evaluation of efficacy of a biofilm-embedded bacteria-based vaccine against staphylococcal mastitis in sheep – A randomized, placebo-controlled field study

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Keywords: Biofilm formation; Slime; Subclinical mastitis; Udder health

Introduction
The objective of the study was to evaluate efficacy of a vaccine against staphylococcal mastitis in ewes under field conditions. The staphylococcal antigen in the vaccine was based on a bacterin of *Staphylococcus aureus* strain, expressing the exopolysaccharide poly-N-acetylglucosamine (PNAG), which is involved in biofilm formation by staphylococci.

Material and methods
The work was performed in five dairy sheep farms and included 316 ewes in group V(accinated) and 307 ewes in group C(ontrol). The animals were monitored throughout a lactation period. Two administrations of the vaccine, 3-week apart, were performed during the last stage of pregnancy of ewes. Starting 15 days after lambing and at monthly intervals thereafter, the farms were visited for examination of animals and collection of samples; in total, up to nine visits and samplings were performed during the study. Milk samples were collected for bacteriological and cytological examinations, performed by established techniques. Further, staphylococcal isolates recovered from milk samples, were examined for biofilm formation. Blood samples were collected for measurement of IgG poly-N-acetylglucosamine (PNAG)-specific antibodies, performed by ELISA.

Results and discussion
The most frequently isolated bacteria were staphylococci: 56.4% and 76.1%, respectively, of total bacterial isolates recovered from milk samples from ewes of group V and C, respectively; staphylococci as causal agents of mastitis were isolated less frequently from V (5.3%) than in ewes in C (10.3%). Among mastitis-associated staphylococcal isolates recovered from V ewes, a smaller proportion was biofilm-forming than among ones from C: 53.2% versus 74.9% of isolates; biofilm-forming staphylococci as causal agents of mastitis were isolated less frequently from ewes in group V (2.3%) than in ewes in group C (6.0%). Anti-PNAG-specific antibody values increased in V ewes and were higher than in C; a greater proportion of ewes with low antibody titres developed staphylococcal mastitis (41.4%) than of V ewes with high antibody titres (17.0%). Incidence risk of mastitis, staphylococcal mastitis and biofilm-associated staphylococcal mastitis was smaller in V than in C: 36.7%, 17.1% and 8.0% versus 44.3%, 30.9% and 18.9%, respectively. The first case of staphylococcal mastitis occurred later in V than in C: 3rd versus 2nd sampling point. Overall, efficacy of the vaccine was 44.6% for staphylococcal mastitis, 57.7% for biofilm-associated staphylococcal mastitis, 33.1% for staphylococcal intramammary infection and 51.5% for biofilm-associated staphylococcal intramammary infection.

Conclusion and implications
The results indicate efficacy of the evaluated vaccine against staphylococcal mastitis in ewes. Nevertheless, vaccination should not be the only means for controlling mastitis; other udder health management measures should be included therein to improve control of the infection.

doi: 10.1016/j.anscip.2023.01.221

O-146
Detection of cathelicidin-1 in the milk as an early indicator of mastitis in ewes

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Keywords: Biomarker; Diagnosis; Subclinical mastitis; Somatic cell counts

Introduction
The objective of the study was to investigate the presence of cathelicidin-1 in milk, after experimental mammary infection with two prominent bacterial pathogens, for potential use as an early indicator (biomarker) for the diagnosis of mastitis in sheep. The use of experimental models allowed full control over mastitis development and accurate recognition of the disease.

Material and methods
In two experiments, after bacterial inoculation into the mammary gland of ewes (experiment 1: *Mannheimia haemolytica*, experiment 2: *M. haemolytica* and *Staphylococcus chromogenes*), conventional bacteriological and cytological examinations of milk samples were performed to monitor the establishment and the course of the infection. Moreover, proteomics examinations, specifically two-dimensional gel electrophoresis analysis (2-DE) and matrix-assisted laser desorption/ionization time-of-flight mass spectrometer (MALDI-TOF MS) analysis, were also performed sequentially in the collected milk samples. Cathelicidin-1 was detected and spot densities obtained from PDQuest v.8.0 were recorded. Associations were calculated between cell content and spot densities, as well as between the presence of mastitis in a mammary gland at a given time-point and the detection of cathelicidin-1 in the respective milk sample.

Results and discussion
All inoculated mammary glands developed mastitis, as confirmed by the consistent bacterial isolation from the mammary secretion samples and the increased leucocyte counts in these samples. The spot density of cathelicidin-1 on gels produced from mammary secretion samples from the inoculated glands increased as soon as 3 h post-inoculation; moreover, the spot density of cathelicidin-1 on gels produced from samples from the inoculated glands was higher than in samples from the uninfected control mammary glands. There was evidence of correlation between the cell content in the mammary secretion samples and the cathelicidin-1 spot densities on gels from those secretion samples. There was also significant association between the presence of mastitis in a mammary gland and the detection of cathelicidin-1 in the respective mammary secretion sample; the overall accuracy was 81.8% - this was significantly higher during the initial 24 h after challenge (90.3%) than after the first day (70.4%).

Conclusion and implications
The presence of cathelicidin-1 was detected in mammary secretion samples earlier than the increased cell content and was also highly associated with the development of mastitis in the ewes. The associations were stronger during the initial 24 h after infection. The results support the potential use of cathelicidin-1 as a biomarker for mastitis in sheep. Moreover, cathelicidin-1 has the advantage that it can be a non-specific biomarker, as simply a ‘positive’ / ‘negative’ assessment would be sufficient, which is simpler that the measurement (i.e., quantification) required for somatic cell counts.

doi: 10.1016/j.anscip.2023.01.222

O-147
Dynamics of palpable udder half defects in early lactation in non-dairy ewes

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Keywords: Defect dynamics; Diffusely hard udder; Non-dairy ewe; Udder lump

Palpable udder defects in ewes increase the odds of mortality and reduce growth rate in their pre-weaned lambs. The prevalence of udder defects has been reported to be as high as 7.5% in early lactation. A study where multiple udder examinations of ewes in a single flock were undertaken during lactation and pregnancy showed changes in the percentage of udder defects; however, very limited data is available on udder defect change over time. The objective of this study was to assess weekly changes in udder half defect status (hard, lump, and normal) in the first six weeks of lactation. Udder halves from 46 Romney ewes (92 udder halves), who had a two-year history of either no udder half defects (n = 22 udder halves) or history of having had udder half defects (n = 70 udder halves) were palpated and scored prior to mating and then once weekly for the first six weeks of lactation. Descriptive statistics and plots were used to visualize the changes in udder half defect status over time, and multinomial logistic regression was used to analyse the transitional probability of udder half defect occurrence. On day 7 of lactation, 34.5% of udder halves were categorised as hard, 4.8% as lump, and 60.7% as normal. Overall, the percentage of defective udder halves decreased as the days in lactation increased; however, the percentage of udder half defects, and their persistence, appeared to be variable each week. Forty-one percent of the udder halves with no previous history of defects were normal throughout all examinations whereas only 19% of those with a history of defects exhibited no udder half defects throughout the six-week study period. Weekly udder half defect category transitions (e.g., transitions from day 7 to 14, or day 35 to 42) exhibited all possible transitions (e.g., hard to lump, hard to normal, etc). The weekly transitional probability of udder halves categorized as hard changing to normal was high (>80%) in the first 21 days and then declined. In contrast, the weekly transitional probability of udder halves categorised as lump remaining as lump increased from less than 1% on day 7 to 62% on day 35. Three udder halves were categorized as hard at premating and none of these expressed milk during lactation, while udder halves categorised as lump at pre-mating were four times more likely ($p < 0.05$) not to express milk, compared to udder halves categorised as normal at pre-mating. The results show that udder half defects are dynamic and change over time in both defective (hard or lump) and normal udder halves.

doi: 10.1016/j.anscip.2023.01.223

O-148
Effect of vaccination against biofilm-producing *Staphylococci* on milk production and individual and bulk tank somatic cell counts in Assaf sheep in Spain

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Keywords: Mastitis; Vaccination; Staphylococcus; Biofilm

Introduction
Staphylococci are the main pathogens causing subclinical mastitis in sheep. Their primary pathogenic factor is the biofilm.
This study assesses the efficacy of vaccination against staphylococci biofilm (VIMCO®, HIPRA) by measuring reductions in somatic cell count (iSCC and bSCC) and gains in production.

Material and methods
This study was conducted in an Assaf sheep flock with approximately 2,500 female breeding animals located in Torres del Carrizal (Zamora, Spain).
Vaccination (VIMCO®) began in March 2020: animals received a 2 ml dose twice, 5 and 2 weeks before the expected lambing date. In March 2021, all animals in production had been vaccinated at least once.
Data was collected within 3 years: one year before vaccination (2019) and 1st and 2nd year of vaccination (2020 and 2021). Individual production and iSCC were collected monthly, and total production and bSCC daily.
Data was analysed in R statistical software using a linear mixed model with period of vaccination as a fixed effect and days in milk, season, and number of lactations as covariates. The outcomes of the study were logiSCC, milk yield and percentage of fat and protein. In the bSCC the covariate was the month. The percentage of sheep with SCC higher than a million was analysed through a logistic mixed model with binomial distribution and the same covariates.

Results
A population of 1,097 dairy sheep ewes in lactation was included for the analysis during the year before vaccination (2019), and 947 and 895 ewes in lactation for the 1st and 2nd years of vaccination, respectively.
Regarding iSCC, the pre-vaccinated group had a geometric mean of 204,000; the 1st year of vaccination iSCC were improved to 200,000 (p = 0.013), and the 2nd year they were improved to 170,000 ($p < 0.001$).
Vaccination improved the probability of SCC higher than 1 million in the 2nd year in the entire population (OR: 0.81, $p < 0.001$) but not in the 1st year (OR: 1.015, $p = 0.68$).
Regarding bSCC, the pre-vaccinated group had a mean of 967,050 while in the 1st year 1020,72 (+5.55%, $p = 0.01$), but an improvement was seen in the 2nd year, rising to 823,760 (−14.81%, $p < 0.001$).
Regarding milk yield, controls had a mean of 2.52 kg, and this was improved after vaccination, reaching 2.6 kg (3.2%, $p < 0.001$) for the 1st year and 2.71 kg (7.5%, $p < 0.001$) for the 2nd year.

Protein plus fat in pre-vaccinated group was 11.05%; in the 1st year of vaccination this increased by 0.5% ($p < 0.001$) and the 2nd year by 1.9% ($p < 0.001$).

Conclusion
Vaccination against staphylococci biofilm contributed to decrease iSCC, bSCC and increase milk production once the hole herd has been immunized.
Vaccination is an effective tool in controlling subclinical mastitis caused by staphylococci and improve the profitability of dairy sheep farms.

doi: 10.1016/j.anscip.2023.01.224

O-149
Plasmin-plasminogen system and physicochemical traits of milk and their association with the stage of lactation, age, and somatic cell counts in Chios and Frizarta ewes

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Keywords: Plasmin; Plasminogen; Dairy sheep; Physicochemical traits

Introduction
The objective was to study the plasmin-plasminogen (PL-PG) system and the physicochemical traits of milk and evaluate their association with the lactation stage, age, and the somatic cell counts in Frizarta and Chios ewes.

Material and methods
A total of 52 purebred milking ewes (26 Frizarta and 26 Chios), from two intensive dairy sheep farms were used for the study. In each sampling, during the 3rd, 5th, and 6th month post-lambing, daily milk yield (DMY), body condition score (BCS) and lactation number were recorded and the PL and PG values, electrical conductivity, refractive index, pH, and SCC were measured. SPSS v23 was used for the data analyses which included descriptive statistics (mean ± SD), one-way analysis of variance for the assessment of differences of PL-PG system and physicochemical traits between the two breeds, and mixed linear regression models to assess the effects of the stage and number of lactation, DMY, and the SCC on the PL-PG system and the physicochemical traits of milk.

Results and discussion
Mean ± SD of PL values during the 3rd, 5th, and 6th month post-lambing were 0.03 ± 0.016, 0.04 ± 0.017, and 0.05 ± 0.017 ΔA/h and 0.04 ± 0.020, 0.05 ± 0.029, and 0.03 ± 0.017 ΔA/h for Frizarta and Chios ewes, respectively. The respective means for the PG values were 0.04 ± 0.019, 0.07 ± 0.033, and 0.08 ± 0.027 ΔA/h and 0.07 ± 0.030, 0.08 ± 0.045, and 0.05 ± 0.032 ΔA/h. PL, PG, and PL+PG values were significantly higher in Chios ewes during the 3rd month post-lambing ($P < 0.05$, $P < 0.01$, and $P < 0.01$, respectively) and in Frizarta ewes during the 6th month post-lambing ($P < 0.001$, $P < 0.01$, and $P < 0.001$, respectively). Refractive index was significantly increased in Frizarta ewes' milk during the 3rd month post-lambing ($P < 0.001$) and electrical conductivity during the 3rd and the 6th month post-lambing ($P < 0.001$). pH was significantly increased in Chios ewes' milk during the 5th month post-lambing ($P < 0.001$) and significantly decreased during the 6th month post-lambing ($P < 0.001$). SCC was significantly higher in Frizarta ewes' milk during the 6th month post-lambing ($P < 0.001$). PL to PG ratio were not significantly different between the two breeds at any given time-point.
Lactation stage had a significant effect on PL, electrical conductivity, refractive index and pH in both breeds ($P < 0.05$), whereas, its effect on PG was significant only in Frizarta ewes ($P < 0.01$). Age was negatively associated with PL value in Frizarta ewes ($P < 0.05$). SCC was positively associated with electrical conductivity and pH ($P < 0.01$) in both breeds, and negatively associated with refractive index ($P < 0.05$) in Frizarta ewes.

Conclusion and implications
PL-PG system patterns and physicochemical traits of milk display breed-specific differences across lactation in intensively reared Chios and Frizarta ewes.

Acknowledgements and funding
This research was funded by the Agricultural Cooperative 'Agrinio Union' within the Regional Operational Program 'Western Greece 2014-2020-RIS3', Project code: MIS-5040306, Project name: Feed for milk.

doi: 10.1016/j.anscip.2023.01.225

ECSRHM (European College of Small Ruminant Health Management)

O-150
Effectiveness of anthelmintic treatments on sheep and goat farms in Germany

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Keywords: Anthelmintics; Treatment failure; Small ruminants; *Haemonchus contortus*

Introduction
Anthelmintic resistance is an increasing threat to small ruminant health and production. This field study was undertaken to assess the success of farmer-led anthelmintic treatments on sheep and goat farms throughout Germany.

Material and methods
Diagnostic faecal samples were examined between September 2019 and December 2020. Participants submitted three pooled faecal samples from five individual animals per pool. Each pool was examined individually using a modified McMaster method to determine strongylid eggs per gram faeces (epg). Any animal groups with group average results exceeding 200 epg were eligible for follow-up examination should the farmer wish to perform anthelmintic treatments. Samples >200 epg were also subjected to peanut-agglutinin fluorescence microscopy to determine the percentage of *Haemonchus contortus* eggs. Anthelmintic treatments were chosen and performed by the farmer in co-operation with their local veterinarian, and farmers were asked to collect corresponding post-treatment samples 10–14 days following treatment. All follow-up samples were subjected to both examination methods described above. Data regarding date of treatment, type of anthelmintic product and dose rate used were collected by questionnaire. Inclusion criteria for post treatment assessment of drench effectiveness were: >200 epg in initial submission, correct dose rate, and corresponding follow-up sample collection between 7 and 21 days post treatment. Faceal egg count reduction (FECR) was calculated based on the egg counts in the pre- and post-treatment submission, and FECR $\geq$95% was classified as successful.

Results and discussion
Samples from 192 sheep flocks, 29 goat herds and 2 mixed flocks met the inclusion criteria. As some farmers used different products in different management groups, 253 distinct treatments were performed in these 223 flocks. Moxidectin was used for 86 ovine and 14 caprine treatments, followed by benzimidazoles (44 ovine, 12 caprine treatments), levamisole (ovine: 41, caprine: 3), monepantel (ovine: 25, caprine: 3), closantel & mebendazole (ovine: 17, caprine: 0) and avermectins (ovine: 5, caprine: 3). Unsuccessful treatments were observed for all anthelmintic classes and in both species. Due to low numbers of caprine cases, detailed analyses are only presented for sheep. Treatments were unsuccessful in 60% (3/5) of ovine cases for avermectins, 52.3% (23/44) for benzimidazoles, 45.3% (39/86) for moxidectin, 14.6% (6/41) for levamisole, 12.0% (3/25) for monepantel and 11.8% (2/17) for closantel & mebendazole. In case of closantel & mebendazole, all unsuccessful treatments involved non-*Haemonchus* genera as the surviving helminths. *Haemonchus contortus* was however most frequently identified as the surviving species following unsuccessful treatments with moxidectin, and in varying percentages for the other anthelmintic classes.

Conclusion and implications
The effectiveness of anthelmintic treatments performed in the field was compromised for all anthelmintic classes, and particularly concerning for avermectins, benzimidazoles and moxidectin. *Haemonchus* and non-*Haemonchus* species were both associated to varying degrees with this suspected anthelmintic resistance.

doi: 10.1016/j.anscip.2023.01.226

O-151
Artemisia cina y *Tagetes lucida* sinergistic effect on *Haemonchus contortus* infective larvae

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Keywords: Larvae mortality; Bioactive plants; Gastrointestinal nematode; Sheep

Introduction
Artemisia cina is a widely studied plant, of which artemisinin has been identified as the metabolite responsible for said activity against nematodes including *H. contortus* that affects ruminants. *Tagetes lucida* is used as an antidiarrheal and antispasmodic. The aim of the present study was determine the synergistic activity of *Artemisia cina* and *Tagetes lucida* against *Haemonchus contortus* nematode.

Material and methods
A serial of combinations of the extracts using several proportions against *H. contortus* infective larvae (L3) were tested. The larvicidal activity in both plants was performed using the mortality test. Several combinations from an *A. cina* n-hexanic extract and from a *T. lucida* ethyl acetate extract were tested as follow: 100:0, 0:100, 50:50, 75:25, 25:75 at different concentrations (20, 10 y 5 mg mL^{-1}). Additionally, ivermectin (at 5 mg mL^{-1}) was used as positive control and distilled water and methanol (at 3%) were used as negative controls. Data were subjected to variance analysis using the statistical program R study and the means were compared using the Tukey tests at 0.05 of significance.

Results and discussion
Results indicated that the highest mortality percentages were observed in the 50:50 and 0.00:100 combinations ($p < 0.05$). Meanwhile, the combination with the lowest larvicidal effect was observed in the combination 100:00. It eas concluded that could be exist a possible synergic effect between the extracts *A. cina* and *T. lucida* used at same proportions.

Conclusion and implications
Artemisia cina and *Tagetes lucida* have anthelmintic compounds against *H. contortus* larvae, but the synergism were found at 50:50 relation.

Uncited references
Granados et al. (2019), Higuera et al. (2020), Ventura et al. (2020).

Acknowledgements and funding
To the COMECYT EDOMEX Researchers program who provided financial support through a Chair from June 1, 2022 to May 30, 2023 under the advice of Dr. Rosa Isabel Higuera Piedrahita and Dr. Agustín Olmedo Juárez.

References

Granados, G.M., Olmedo, J.A., Estrada, F.J.G., González, C.M., Mendoza, de G.P., Reyes, G.D.E., Delgado, N.E.J., 2019. Actividad ovicida de un extracto hidroalcohólico de *Tagetes lucida* contra *Haemonchus contortus* bajo *condiciones in vitro*. Reunión Nacional de Investigación Pecuaria Memoria. Chiapas 2019, 500–503.
Higuera, P.R.I., López, A.M.E., López, A.R., Cuenca, V.C., Cuéllar, O.J.A., 2020. *Artemisia cina* 30 CH homeopathic treatment against *Haemonchus contortus*. Rev. Mexicana Ciencias Pecuarias 11 (2), 342–354.
M.R. Ventura L.G.E. Angeles T.M.E. González O.F. Carrasco M.D. Campos Study of antispasmodic and antidiarrheal activities of *Tagetes lucida* (Méxican tarragon) in experimental models and its mechanism of action Evid.-Based Complem. Altern. Med. 2020 2020

doi: 10.1016/j.anscip.2023.01.227

O-152
The prevalence and risk factors for gastrointestinal nematodes infestation in goats from smallholder farms

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Keywords: Parasites; Small ruminants; Asia; Fecal Egg Count (FEC)

Introduction
Gastrointestinal nematode (GIN) infestation represents an important health problem for goats. Goats in the tropics are prone to infestation year-round due to the warm and humid climate, yet there was no existing data for Hong Kong goat farms. The objectives of this study were to (i) establish prevalence and genera composition of GIN infestation in Hong Kong goats; and (ii) investigate the risk factors associated with the prevalence and fecal egg count (FEC).

Material and methods
Fecal samples were randomly collected from goats ($n = 63$) from two smallholder farms for FEC in January 2022. Goat body condition score (BCS), sex and age were also recorded. Fecal cultures were performed to yield L3 for genera identification. Statistical analysis were conducted with SPSS. A Chi-square test was conducted to evaluate the correlation between the prevalence and sex or age. The mean FECs between sex and age groups were compared with independent sample *t*-test. A Kruskal-Wallis test was used to investigate the difference in FEC among BCS groups.

Results and discussion
Out of 63 samples, 57 (90.5%) were positive for nematode eggs. The mean FEC was 278 (S.D. 214.7). *Strongyles, Strongyloides*, and *Trichuris* eggs were identified. Goats with a BCS of 2.5 had a significantly higher FEC than those with a BCS of 3.5. The differential count for L3 was the highest for *Trichostrongylus* (65.0%), followed by *Strongyloides* (16.8%), *Oesophagostomum* (7.5%), *Haemonchus* (5.5%), and *Teladorsagia* (5.3%).
The prevalence of GIN was high but the FEC were lower than previously reported overseas. This may be due to drier and cooler weather during the sampling period. The present study found no significant difference in FEC between sex and age groups. At the time of sampling, no goats were pregnant, therefore females were not affected by the periparturient rise in FEC. The lack of age difference may be explained by breed differences and housing systems of the Hong Kong smallholder farms.
The genera recovered were comparable to overseas literature, although previous work found *Haemonchus* or *Teladorsagia* to be the most abundant. The fecal culture temperature in this study may have favoured the development of *Trichostrongylus*. Additionally, as anthelmintics were not routinely used on these farms, selection pressure may not have been applied to the different genera, as has been observed overseas.

Conclusion and implications
The present study found high GIN prevalence in Hong Kong goats with genera of economic importance recovered. The FEC and genera composition provided a baseline for local farmers. These values can be compared with those in summer to determine the need for anthelminthic intervention in smallholder farms in the tropics.

doi: 10.1016/j.anscip.2023.01.228

O-153
Prevalence of gastrointestinal helminths in sheep, as assessed by microscopy and droplet digital PCR

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Keywords: Sheep; Helminths; Nematodes; Prevalence

Introduction
Gastrointestinal helminths (GIH) have a major impact on production, health, and welfare of sheep in Europe. Norway is no exception, however, there are few studies on the prevalence of GIH in Norwegian sheep. This was previously investigated in 2013, of which *Teladorsagia*, *Haemonchus*, and *Nematodirus* were found to be the most prevalent nematode genera (Domke et al., 2013). The last decade has been characterized by increasing stocking rate/high intensity farming of sheep, as well as environmental climatic changes. This study investigated the current prevalence of key helminths in sheep flocks in Norway.

Material and methods
Fecal samples were collected from flocks in 2021 (n = 30) and in 2022 (n = 138). These flocks were randomly selected from four geographical regions: northern (n = 33), mid (n = 7), inland (n = 41), and coastal (n = 87). In each flock, individual samples from 10 randomly selected ewes (spring) and 10 lambs (autumn) were pooled. Nematode eggs were concentrated by sieving and centrifugation of fecal-water mixture from the pooled samples. DNA was then extracted and further analyzed by droplet digital PCR (ddPCR). This included the detection of key nematode genera (*Haemonchus*, *Trichostrongylus*, and *Teladorsagia*). The fractional abundances for each genera were assessed by running duplex assays with universal Strongylid and specific primer/probes.
Furthermore, an assay for detection of *Fasciola hepatica* by ddPCR have been established. In addition, the occurrence of *Nematodirus battus* eggs was investigated by regular fecal egg count (i.e., McMaster method).

Results and discussion
Preliminary results show that the prevalence of *Trichostrongylus* (96% (26/27)), *Haemonchus* (73% (22/30)) and *N. battus* (65% (17/26)) were high in 2021, compared to earlier findings (Domke et al., 2013). However, few flocks from the northern and coastal areas were included in the first year of sampling. The analyzing of samples is currently ongoing.

Conclusion and implications
Initial results indicate that *Haemonchus* has become more widespread in Norway and appears to be a common nematode in the inland area. More details, including results from the 2022 sampling, as well as result from the *F. hepatica* assay, will be presented at the conference.

Acknowledgements and funding
We would like to thank Norwegian University of Life Sciences and Animalia for funding this project. A special thanks to all farmers contributing with samples from their respective flock.

Reference

A.V. Domke C. Chartier B. Gjerde N. Leine S. Vatn S. Stuen Prevalence of gastrointestinal helminths, lungworms and liver fluke in sheep and goats in Norway Vet. Parasitol. 194 2013 40 48

doi: 10.1016/j.anscip.2023.01.229

O-154
Vertical transmission of *Anaplasma phagocytophilum* in sheep under field conditions

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Keywords: *Anaplasma phagocytophilum*; Sheep; Vertical transmission; Tick borne disease

Introduction
Anaplasma phagocytophilum, the causative agent of Tick Borne Fever (TBF), is shown to be able to vertically transmit from ewe to lamb under experimental circumstances (Stuen et al., 2018). Because TBF causes significant health and welfare issues in different countries it is important to know if *A. phagocytophilum* is vertically transmitted under field conditions as well, and whether or not this is of clinical importance.

Material and methods
Two flocks with a history of clinical TBF (confirmed by PCR on blood samples) were enrolled in the study. The flocks were sampled during lambing seasons; the first flock in 2017, the second flock in 2018 and 2019. The lambing seasons coincided with the non – tick questing period of the year. Several weeks before lambing the ewes were housed indoors.
Ewes and lambs were blood sampled once, within 0–12 hours from birth. During the lambing season of 2019, the lambs were sampled another 4 times until day 21. On all lambs that were born dead or that died within 2 weeks of life, post-mortem examination was performed and liver and spleen samples were collected. All blood and tissue samples were tested for with PCR targeting *msp2*. Lambs were all weighed at the first blood sampling.

Results and discussion
Out of the 120 ewes, 20 were PCR positive at time of lambing. These infections were considered to be persistent, as recent tick contact was unlikely. Out of the 134 lambs born alive, no blood samples were ever positive. Out of the 10 organ samples from lambs that were either born dead or had died within two weeks, one liver sample tested PCR positive. This lamb had died on day 4 and had been tested PCR negative in blood within 12 hours after birth. It is possible that the load of bacteria in the bloodstream was below the detection limit at that time. There was no significant difference between the birth weights of lambs born from PCR positive ewes compared to lambs born from PCR negative ewes. In 2019, the proportion of still born lambs from PCR positive ewes (n = 12) was 0.17, whereas for PCR negative ewes (n = 36) this was 0.03. This difference was however not significant (p = 0.089).

Conclusion and implications
This work shows that vertical transmission of *A. phagocytophilum* occurs in a field environment. The relative role of vertical transmission on the epidemiology within these two flocks therefore seems limited. These findings do underline the need to confirm findings from experimental settings within a field environment.

Reference

Stuen, S., Okstad, W., Sagen, S.M., 2018. Intrauterine Transmission of *Anaplasma phagocytophilum* in Persistently Infected Lambs. Vet. Sci. 5 (1), 25. https://doi.org/10.3390/vetsci5010025.

doi: 10.1016/j.anscip.2023.01.230

O-155
Psoroptic mange in sheep: A re-emerging disease in Germany

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Keywords: Sheep; Mange; *Psoroptes ovis*; Treatment failure

Clinical history
In July 2021, four rams were imported by an owner of 1,400 ewes. The new sires were kept on a pasture together with 25 other rams. They were introduced to the ewes for mating in 9/2021. In 1/2022 individual sheep lost large areas of wool and showed moderate to severe pruritus. *Psoroptes ovis* and *Chorioptes bovis* were detected in skin scrapings. None of the ectoparasitic products licensed for the German market were available in sufficient quantities to treat the Psoroptic mange at that time. Alternatively, Moxidectin (MOX) (Cydectin® 10% LA, Zoetis) and Eprinomectin (EPM) (Eprecis® 20 mg/ml, Ceva) were available, but MOX and EPM are only licensed for treatment of *Sarcoptes scabiei var. bovis* in cattle, and EPM is only approved in sheep for the treatment of endoparasites.

Investigations
Ten ewes and one ram with clinical mange were housed in our clinic to evaluate the treatment success. Five ewes and one ram were treated with EPM at a dose of 0.2 mg/kg bwt. s.c., and five ewes were treated with MOX 1.0 mg/kg bwt. s.c.. The sheep were observed daily for 15 minutes, and the number of scratching actions was counted [= scratch index (SI)]. Skin scrapings were taken from all 11 animals at 3-, 7-, and 10 days post treatment (dpt), and examined for living mites under the stereomicroscope and for mites after heating in 10% KOH solution.
Living mites were found in two skin scrapings from EPM treated ewes 7 dpt. After 10 dpt the animals were treated again with the same agent, and 7 animals were re-introduced into the flock of origin. Two animals from each treatment group remained in our clinic for further observations. After the second treatment with EPM, one living *Psoroptes* mite was detected on one sheep. This ewe showed SI >5 up to 31 dpt, while SI declined to zero in all other sheep within 12 dpt. The EPM treated ram showed again slight pruritus 109 dpt. and a living *P. ovis* mite was detected in a skin scraping of a small hairless skin area at the base of the tail.

Differential diagnosis
Originally the flock suffered from a *Bovicola bovis and Chorioptes ovis* infestation, and therefore the owner did not pay attention to the pruritic sheep.

Discussion
This case shows that the spread of *Psoroptes ovis* within a flock can remain undiscovered for a very long time, and subclinical sheep may maintain the infection. Moreover, biting lice and other causes of pruritus might mask clinical signs of mange. Overall, biosecurity measures have to be implemented on sheep farms to prevent the introduction of *Psoroptes ovis*, which is a re-emerging disease in Germany.

doi: 10.1016/j.anscip.2023.01.231

O-156
Exploring variation in ovine gastrointestinal nematode community composition: A multi-method approach

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Keywords: Nemabiome; Nematode; Co-infection; Sheep

Introduction
Gastro-intestinal nematode infections are one of the greatest constraints on sheep production globally. The emergence and spread of anthelmintic resistance necessitates the development of management strategies that go beyond broad-spectrum nematode suppression and consider the interactions between co-infecting nematode species of varying pathogenicities. The potential to study coinfecting nematode community compositions has been advanced enormously by the development of a meta-barcoded deep-amplicon ITS-2 sequencing platform (the nemabiome); however, it can be challenging to disentangle interactions between concomitantly infecting species from temporal and spatial variation in species-specific infection pressures. Here we describe a multi-method approach aimed at tackling this challenge and present the first results from a systematic review and meta-analysis of *in vivo* co-infection experiments (A), and a large-scale longitudinal analysis of individual nemabiomes in unmanaged Soay sheep (B).

Material and methods
(A) A systematic review of ovine nematode coinfection studies was performed according to PRISMA guidelines. Post-mortem worm counts were extracted from screened search results and Hedge's *g* calculated to allow comparisons across studies. These effect sizes were then analysed using a mixed model approach. (B) Longitudinal faecal samples were obtained from c.200 wild Soay sheep on St Kilda at 15 time-

points across 4 years, from which nematode species compositions were quantified using the nemabiome platform. These were then analysed using Bayesian generalised linear mixed models to account for repeated measures and an extensive array of host metadata.

Results and discussion
(A) The systematic literature review yielded 4847 studies, of which 20 were judged suitable for data extraction. Analysis of the effect sizes obtained from these studies suggest negative interactions between co-infecting nematodes, with further analysis assessing the impact of anatomic co-localisation on these effects. (B) Mixed model results show evidence of population-level seasonal changes in nemabiome composition and changes in composition associated with the periparturient relaxation in immunity in ewes. Further analysis explores the impact of nemabiome composition within an individual on the individual's future nemabiome composition. Interrogation of the co-infection relationships within and between anatomic sites further links these findings to the results of the meta-analysis.

Conclusion and implications
These results demonstrate the power of this multi-method approach and provide insight into variation in the ovine nemabiome. Subsequent work within this project will examine host spatial patterns and their associations with variation in nemabiome composition and aims to develop a high-throughput technique for quantifying spatial variation in infection pressures. The examined relationships between co-infecting nematodes also raise questions about niche construction, cross-species immunity and inter-nematode competition, which will be addressed through controlled infection experiments refined by the outcomes presented here.

Acknowledgements and funding
This work was funded by a large NERC grant (NE/R016801/1). ME is supported by the Wellcome Trust and University of Edinburgh's ECAT programme.

doi: 10.1016/j.anscip.2023.01.232

O-157
Leishmania infantum seropositive in goats from an endemic region of canine leishmaniosis

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Keywords: Goat; ELISA; *Leishmania infantum*; Serology

Introduction
Leishmaniosis is a vector-borne zoonotic disease caused by different *Leishmania* species with a worldwide distribution. In Europe, the most prevalent species is *Leishmania infantum*, being the dog the peridomestic reservoir of the human infection. Caprine leishmaniosis has been described in other regions different from Europe. The aim of this study was to investigate the seroprevalence of *L. infantum* in apparently healthy goats in an endemic region of canine leishmaniosis (Spain) using an Enzyme-Linked ImmunoSorbent Assay as reference test.

Material and methods
Serum samples were collected from April to September 2021 from 212 goats (Murciano-Granadina goat) in five different flocks from Spain. Separated sera were stored at −20 °C until processing. Detection of *L. infantum* antibodies was performed uses a quantitative in-house ELISA with some modifications to be performed in goat. The cut-off was set to 0.26 optical density units, and results above this value were considered positive.

Results and discussion
In the serological study by the in-house Enzyme-Linked ImmunoSorbent Assay, a total of 8 positive animals were detected. All of the tested goats were females, adults and assessed as apparently healthy, with no evident systemic or dermatological signs found during the general physical examination prior to the blood extraction. The overall seroprevalence of *L. infantum* was 3.77%. By contrast, in other published study carried out in Greece, none of the 179 goats were positive to *L. infantum* by ELISA.

Conclusion and implications
To the author's knowledge, this report described the first serological study of leishmaniosis in goats in Spain with the presence of apparently healthy seropositive animals (8/212). The presence of anti-*Leishmania infantum* antibodies can be detected with the adaptation from dogs and cats to small ruminants. The validation and adaptation of each serological technique to the animal species and reagents employed to perform the technique requires the use of antisera specific to the animal species analysed. In areas where *L. infantum* infection is present, this pathogen should be ruled out because this pathogen could cause clinical signs. However, the susceptibility of goats to *L. infantum*, the clinical pictures, management and treatment of infected animals are poorly understood, and there is not description in the literature. Furthermore, it is necessary the possibility to perform xenodiagnoses to evaluate the infectiousness of domestic goats to the vector and the

possibility that infected domestic goats could represent an additional domestic reservoir for the parasite impelling the study and detection of clinically affected and subclinically seropositive domestic goats.

doi: 10.1016/j.anscip.2023.01.233

O-158
Perceptions and interventions of Dutch sheep farmers concerning coccidiosis

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Keywords: Coccidiosis; Diagnosis; Therapy; Overuse anticoccidial drugs

Introduction
Coccidiosis in sheep is a protozoan disease of mainly one to two months old lambs caused by eleven species of *Eimeria* of which only two species, *E. crandallis* and *E. ovinoidalis*, are known to be highly pathogenic. Clinical signs vary from mild to severe diarrhoea, dullness, abdominal pain, reduced weight gain and weight loss. Because coccidia are usually present in the intestines of sheep of all ages without causing clinical signs, treatment should not be based on oocyst counts alone but particularly on a combination of clinical signs and post-mortem findings, complemented by oocyst counts and preferably typing of *Eimeria* spp. The impression exists that usually no proper diagnosis takes place before treatment, which could lead to an overuse of coccidiostatica. The aim of this paper is to investigate perceptions and interventions of Dutch sheep farmers concerning coccidiosis, with special attention to the use of anticoccidial drugs.

Material and methods
In 2020, after a few online events, sheep farmers were approached to complete a survey. Questions ranged from general questions about the number of sheep, breed, length of the lambing period, housing system, and grazing period to more detailed questions about coccidiosis like clinical symptoms, age categories, diagnosis and treatment.

Results and discussion
In total, 117 surveys were completed. The average flock size of the respondents is 130 with a variation of 3 to 800 animals. Eighty-four per cent of the surveyed sheep farmers consider coccidiosis to be important and almost 43 per cent of the farmers treat their animals with coccidiostatica at least once a year. Sixteen per cent of the farmers treat them twice or even more often. Nine per cent of respondents treat the adult sheep at the same time as the lambs. Preventive treatments of lambs without clear indications of a coccidiosis infection are also performed regularly. Almost half of the sheep farmers dose their animals based on weight estimate of the animals.

Conclusion and implications
Although the number of respondents was lower than expected, the responding farmers give an impression of their perceptions and interventions concerning coccidiosis. They indicate that coccidiosis is an important disease, and they often perform treatments, usually without a proper diagnosis. The possibly resulting overuse of coccidiostatica could result in drug resistance, which has not been found in the Netherlands, but has been described in other countries. It is not clear whether a mentioned apparent treatment failure was related to management practices, incorrect administration of the drug or actually a first indication of drug resistance.

doi: 10.1016/j.anscip.2023.01.234

O-159
Utility of carbohydrate larval antigen salivary testing to lower the risk of gastrointestinal parasitism in Canadian sheep flocks

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Keywords: Parasitism; Immunity; Genetics; Control

Introduction
Gastrointestinal nematodes (GIN) are important contributors to disease in sheep flocks globally. Historically, parasitism in sheep was controlled through anthelmintics; however, the emergence of anthelmintic resistance in GIN worldwide has significantly limited the efficacy of these drugs. As a result, the sheep industry requires novel strategies to control GIN in a sustainable manner. One such method focuses on

identifying and propagating sheep resistant to parasitism. Researchers in New Zealand have developed a commercial test (CARLA® Saliva Test, AgResearch, New Zealand) that identifies animals with increased immunological resistance to GIN. The test measures salivary IgA targeted against carbohydrate larval antigen (CarLA) – a structure found on third-stage GIN larvae. New Zealand data have shown that sheep with high anti-CarLA IgA have 20–30% lower faecal egg counts (FEC) and reduced clinical parasitism, compared to individuals with low anti-CarLA IgA. It remains unclear how CarLA testing performs in Canada, where climate and production practises differ significantly from New Zealand. To date, CarLA testing has been evaluated in one Canadian flock and shows promise, however there is need to demonstrate utility under more diverse conditions.

Material and methods
Eighteen commercial sheep flocks were recruited for the study; farms varied by geography, size, breed, pasture management and parasite control practises. In mid-summer 2022, farms submitted ten faecal samples from lambs for FEC to verify GIN within their flock. In November 2022, thirty replacement ewe-lambs were randomly selected per farm. Each animal was weighed, body condition scored (BCS), CarLA tested, and a FEC was performed. Positive faecal samples on each farm were pooled (10:1) for larval (L_1) culture to facilitate nemabiome sequencing. The study animals, and their future offspring, will be followed for twelve months, and the productivity of individuals with high anti-CarLA IgA will be compared to those with low anti-CarLA IgA.

Results and discussion
The average FEC per farm was 664 eggs per gram (epg), with substantial variation between farms, ranging from 3 – 3152 epg. Similarly, there was considerable variation in FEC between individuals within a farm; the average maximum count was 1977 epg, and the average minimum count was 84 epg. FEC variability within a flock reflects differences in exposure, intermittent egg shedding, and immunity. Data collection is underway for the November 2022 sampling period and results are expected in January 2023.

Conclusion and implications
The FEC data reinforce the importance of sampling multiple animals when monitoring parasitism in sheep flocks. Due to variation in egg shedding between individuals, an average FEC from ten individuals likely provides accurate representation of parasite burdens on farm. Once available, individual CarLA data will be compared with FEC, weight and BCS to determine if sheep with high anti-CarLA IgA outperform their low-CarLA IgA counterparts.

doi: 10.1016/j.anscip.2023.01.235

O-160
Prevalence of the resistance of gastrointestinal nematodes to benzimidazoles assessed by the faecal egg count reduction test in Polish goat herds

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Keywords: Goats; Helminths; Benzimidazoles; Anthelmintic resistance

Introduction
Parasitic infections, especially caused by gastrointestinal nematodes (GIN), are one of the main causes of economic losses in goat farming worldwide. Their control is mainly based on the use of anthelmintics. The widespread use of these products has led to the emergence of drug-resistant parasite strains. One of the most commonly applied tests for the detection of anthelmintic resistance (AR) is the faecal egg count reduction test (FECRT). The aim of this study was to determine the prevalence of resistance to benzimidazoles (BZ) in the Polish goat herds by using an in vivo FECRT, which is useful especially in large-scale epidemiological surveys.

Material and methods
This cross-sectional study was conducted from April 2021 to November 2022 and enrolled 27 dairy goat herds (370 goats) scattered over the entire country. FECRT was performed according to the recent recommendations published by Kaplan (2020). Goats were treated with recommended doses of albendazole. The number of animals enrolled in the treatment group in each herd varied from 10 to 20 animals, depending on the herd size. The faecal egg count reduction (FECR) was assessed between pre- and post-treatment samples from treated animals. Percent egg reduction (%FECR) was calculated according to the formula: $\%FECR = 100 \times (1 - [T1/T0])$ where T0 and T1 were the arithmetic means of faecal egg count (FEC) of the treated group before and after treatment, respectively. The parasite population was considered resistant if %FECR was <95%. Larval cultures were prepared for each group and identified to the species level based morphological features of the third-stage larvae (L3).

Results and discussion
The resistance to BZ was indicated by FECRT in 24 out of 27 goat herds examined in the study (89%; 95% confidence interval: 72% – 96%). The %FECR in the herds with indicated resistance to BZ ranged from 23% to 92%. In only 3 herds the %FECR was >95% (specifically: 96%, 97%, and 100%). The main GIN species detected in 100% post-treatment faecal samples was *Haemonchus contortus*.

Conclusion and implications
Our study shows that resistance to BZ is widespread in goat population in Poland. The prevalence of BZ resistance assessed by the *in vivo* FECRT is in line with results obtained from our previous studies based on *in vitro* AR detection methods, in which the prevalence of resistance to BZ was also 89%.

Acknowledgements and funding
The study was financed by the grant from the National Science Center (UMO-2020/37/B/NZ6/00457).

Reference

Kaplan, R.M., 2020. Biology, epidemiology, diagnosis, and management of anthelmintic resistance in gastrointestinal nematodes of livestock. Vet. Clin. North Am. Food Anim. Pract. 36 (1), 17–30.

doi: 10.1016/j.anscip.2023.01.236

O-161
Nemabiome metabarcoding shows varying levels of genetic diversity in anthelmintic-resistant gastrointestinal nematodes

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Keywords: Nemabiome metabarcoding; FECRT; Anthelmintic resistance; Gastrointestinal nematodes

Introduction
Gastrointestinal nematodes (GINs) are a substantial threat to the livestock industry, hindering the production of milk, meat and wool. Faecal egg count reduction tests (FECRTs) are performed to detect phenotypic resistance of GINs to anthelmintic drugs. These tests give important data regarding the anthelmintic efficacy, but do not provide information about the dynamics and diversity of the resistant GIN species. In the current study, we undertook a molecular analysis of the GIN populations from pre and post-treatment samples collected from sheep farms in southeast England.

Material and methods
On each of the 18 farms, faecal samples were collected from three groups (10 lambs each) at the time of treatment with recommended doses of ivermectin, levamisole, and a combination of both; and at 14 days post-treatment. After the faecal egg counts (FECs), eggs were set up for hatching and DNA extraction from 1st stage larvae. The DNA was used as a template for nemabiome metabarcoding, followed by next-generation Illumina sequencing. The sequencing data were analysed to identify and quantify the GIN species present, and the amplicon sequence variants (ASVs) of each species. The results were confirmed by blasting the ASVs to Genbank sequences, and a maximum likelihood (ML) tree was generated. Finally, principal component analysis (PCA) was performed to show differences between the sampling groups.

Results and discussion
The FECs showed a 30% to 99% reduction in the post-treatment samples, with the combination generally being the most successful treatment. Only a few samples showed more than a 95% reduction, indicating widespread anthelmintic resistance.
We identified nine GIN species in pre-treatment samples, with *Haemonchus contortus*, *Teladorsagia circumcincta,* and *Trichostrongylus vitrinus* being the most common. The post-treatment results showed a dominance of *T. circumcincta*, followed by *Trichostrongylus colubriformis*, while *H. contortus* and *T. vitrinus* were absent or greatly reduced. All three treatment groups showed similar results. The ML tree revealed potentially resistant amplicon sequence variants (ASVs) of each species. The PCA plots demonstrated a significant difference between pre-treatment and post-treatment samples ($P < 0.001$), and between different treatment groups ($P = 0.03$).

Conclusion and implications
The study combines FECRTs with molecular analysis of anthelmintic-resistant species in sheep and provides useful information about the value of anthelmintic drug combinations in the control of anthelmintic-resistant populations. Different GIN species showed different levels of resistance to the tested drugs; hence employing next-generation molecular techniques may help to determine the most suitable drugs or

combinations for individual farms. Importantly, the study provides a strong base and materials for further studies into the diversity present in resistant GIN species and will aid in understanding the genomic basis for anthelmintic resistance.

doi: 10.1016/j.anscip.2023.01.237

O-162
Hydatidosis: A reemerging neglected disease

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Keywords: Hydatidosis; Parasitic diseases; Sheep; Zoonosis

Clinical history
A sheep flock in the south of the Aragon region was suffering a general worsening in the health status of the sheep. The animals of the flock, mainly young ewes, were showing chronic weight loss and weakness. However, no diarrhoea, mortality or other clinical signs were observed in the herd. Initially, ovine anaplasmosis was suspected, although no improvement was observed after oxytetracycline treatment. For this reason, during the spring of 2022, six adult sheep were referred to the Ruminant Clinical Service (SCRUM) of the Veterinary Faculty of Zaragoza for further investigation.

Investigations
A rigorous clinical examination was performed on each animal. Apathy, low body condition, dry mixed dyspnoea, pale mucous membranes and a substantial loss of wool were observed in all ewes.
After that, haematological examination was performed. A non-regenerative, normocytic, normochromic severe anaemia with monocytosis was observed in most of the animals. In addition, anisocytosis and basophilic bodies in erythrocytes were found in blood smears. An RT-PCR test was performed on blood samples, and a positive *Anaplasma ovis* result was obtained.
Ecography was also performed, focusing on the liver and lungs. Some well-defined rounded anechoic vesicles of different sizes were found in the liver and lungs. In addition, a diffuse lung parenchyma consolidation was also observed.
The *post-mortem* study revealed a significant number of multiple cysts both in the liver and lungs. These cysts were compatible with hydatid cysts caused by *Echinococcus granulosus*. Diffuse interstitial pneumonia was also found in most animals, complicated in some cases by catarrhal pneumonia in cranial lung lobes. Molecular tests performed in lung parenchyma showed positive results for Small Ruminant Lentivirosis, *Mycoplasma ovipneumoniae* and *Mannhemia haemolytica.*

Differential diagnosis
Due to the variety of signs the animals showed, the differential diagnosis is quite wide. Most of the animals were visibly weak and apathetic, which could be related to poor nutrition, digestive parasitosis, a chronic respiratory process, pseudotuberculosis, paratuberculosis or anaplasmosis. Additionally, some animals were severely anaemic; this could also be related to anaplasmosis. The poor appearance of the animals (wool loss, extreme thinness) could be related to, again, a chronic process like parasitosis or lentivirosis, or a nutritional deficit.

Discussion
This farm presents a number of problems, and all of them need to be addressed. Even though both anaplasmosis and lentivirosis are diseases that can be seriously detrimental for the animals, the main concern, in this case, is the large number of hydatid cysts present in the liver. Hydatidosis is a very important zoonosis which can produce severe cases in humans. Because of this, in the presence of parasitism this serious, we have to consider establishing adequate control protocols both in sheep and in sheepdogs.

doi: 10.1016/j.anscip.2023.01.238

O-163
The effect of bovine colostrum replacer on body weight and immunoglobulin G absorption in goat kids

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Keywords: Colostrum; Goat kids; Immunity; Weight gain

Clinical history
A dairy goat farm owner in the Netherlands was concerned with the immunity of the goat kids and wanted to evaluate if maternal colostrum could be replaced to achieve a good transfer of passive immunity (**TPI**) and assess if the goat kids that achieved >15 g/L IgG have a better average daily gain (**ADG**).

Material and methods
The experiment was conducted from April to July 2021, on a Saanen farm of 1000 does, 400 female goat kids were born, from which 70 were enrolled in the study. All goats were weighed following birth and fed colostrum replacer (**CR**) from the Saskatoon Colostrum Company Ltd® (14% IgG, 23% fat) within 1 h after birth. All CR was reconstituted as the manufacturer's direction and was tube-fed to all animals enrolled. Blood samples were taken at 30 hr and used to determine % Brix and serum IgG. For the analyses, goats were categorized as LOW (<15 g/L IgG) and HIGH (>15 g/L IgG). Goats assigned to LOW or HIGH were fed 492.5 and 485 mL of CR, respectively ($P = 0.83$). All goat kids had ad-libitum access to milk replacer (CP 26%, Fat 25%) and from the 2nd week of age had ad-libitum access to solid concentrated feed (15% CP, 3.3% Fat), straw hay, and water.
Goats' body weight (**BW**) was measured at birth and at weekly intervals and ADG was calculated from birth to weaning. Data was analyzed using SAS (University Edition; SAS Institute Inc., Cary, NC). All means reported were separated by Tukey's adjustment and are presented as mean ± SEM. The GLIMMIX procedure was used for all variables and to determine the effects of CR on serum IgG concentrations.

Results
The birth BW was 3.3 and 3.2 ± 0.1 kg for LOW and HIGH goat kids, respectively ($P = 0.74$). Total IgG mas fed for LOW and HIGH was also similar between categories: 23.4 and 23.1 ± 0.38 g; respectively ($P = 0.43$). As expected, LOW-classified goats had lower serum IgG values at 30 h in comparison to HIGH goats (10.6 and 21.1 ± 1.01 g/L; $P< 0.01$, respectively). Similarly, Brix values were also lower for LOW goats when compared to the HIGH group (7.9 and 8. 6 ± 0.20 %, $P< 0.01$). The ADG for the total pre-weaning period did not differ for LOW and HIGH-classified kids (0.2 and 0.2 ± 0.00 kg; $P = 0.62$).

Conclusion
Goat kids fed with SCCL® CR performed well during the pre-weaning period. Animals that presented serum IgG >15 g/L did not present greater ADG compared to those <15 g/L of serum IgG. These results indicate that a high-quality commercial colostrum product of bovine colostrum could be a useful alternative when doe's colostrum is unavailable or the quality is low.

doi: 10.1016/j.anscip.2023.01.239

O-164
Live yeast supplementation during last month of gestation improves ewes ruminal microbiota, oxidative status, colostrum quality and offspring immune competence

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Keywords: Rumen microbiota; IgG; Colostrum; Oxidative status

Introduction
Peripartum is a highly challenging period for ruminants as negative energy balance is commonly observed resulting in an increase of lipid mobilization and reactive oxygen species production. Colostrum quality is key for lambs optimal growth and infectious disease prevention. This study investigated the effect of a live yeast supplementation during the end of gestation on ewe ruminal microbiota, oxidative status, colostrum composition and impact on offspring immune status.

Material and methods
Twenty-eight gestating ewes were balanced between control (C) or supplemented (SC) groups, SC ewes received the live yeast *Saccharomyces cerevisiae* CNCM I-1077 (Levucell SC TITAN) in the concentrate at 8×10^9 CFU/h/d during the last month of gestation until parturition. Ruminal and blood samples were collected before supplementation, few days before parturition and 2 weeks post-partum. Volatile Fatty Acids (VFA) were analyzed and ruminal microbiota was studied through DNA sequencing. Glutathione peroxidase (GPx) and Malondialdehyde (MDA) were measured in ewes blood. Neonate lambs received a first colostrum intake and were then separated from their mother and further fed with milk replacer. Colostrum was collected over the first 72 h for analysis. Lambs serum IgG were measured during 55 days. Statistical difference between groups was tested through linear mixed model with repetitions considering values of each parameter before supplementation as the baseline when applicable.

Results and discussion
Parturition was associated with a significant shift in ruminal microbiota composition, as noted on alpha diversity indexes ($p < 0.01$) and on key ruminal functional populations such as Fibrobacteres (bacteria), Neocallimastigomycota (fungi) or among protozoa. Overall, SC supplementation alleviated parturition impact. In C group, a strong decrease of Fibrobacteres abundance was observed (−38 %), while it was more stable in SC group (−8 %). A greater stability of protozoa community was observed in SC group over time ($p < 0.05$). As a result, more stable fermentative activities were measured in SC group ($p < 0.05$).
SC supplementation mitigated ewe oxidative status with lower MDA production ($p < 0.01$) and higher GPx concentration (+29% vs +6%, $p = 0.19$) compared to C group.
A significant increase of bioactive molecules (IgG and oligosaccharides) was measured in the colostrum of SC animals ($p < 0.05$). Immune passive transfer was increased in lambs born from SC ewes with significantly higher serum IgG up to 7d after birth. Lambs from SC ewes were 7.2 % heavier at birth.

Conclusion and implications
Our results show that parturition significantly impacts the female metabolism, digestive microbiota and oxidative status. SC I-1077 supplementation alleviated these negative impacts through stabilization of key microbial populations and mitigation of metabolic and oxidative stress. Better management of energy requirements during peripartum through supplementation positively impacted colostrum bioactive molecules levels which benefited neonate immunity, potentially enhancing early life health.

doi: 10.1016/j.anscip.2023.01.240

O-165
Development of key indicators for kid mortality in dairy goat herds

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Keywords: Goat kids; Mortality; Key indicators; Monitoring

Introduction
Raising goat kids is inextricably linked to dairy goat farming, not only for initiation of lactation, yet equally for herd replacement and improvement of herd genetics. Optimal young stock rearing benefits animal health and welfare and therefore contributes to a more sustainable herd. In order to evaluate the rearing process, producers need insight into the quality of their kid rearing, preferably based on key indicators. Mortality is considered a useful parameter to assess animal health and welfare. We therefore aimed to develop key indicators to monitor kid mortality in dairy goat herds, which can support producers in optimising their rearing system.

Materials and methods
Census data were available from all 395 Dutch dairy goat herds from 2016 until and including 2020. Four mortality indicators were defined: mortality risk of neonatal kids ($\leq$1 week old), mortality ratio of postnatal kids (>1 and $\leq$3 weeks old), preweaning mortality (>3 and $\leq$7 weeks old) and weaned kid mortality (>7 weeks to 6 months old). Mortality rates were calculated for three subgroups of dairy goat herds depending on the quality of available data i.e., accuracy and completeness of data.

Results
Mortality showed a strong declining curve from the first week after birth. The quality of farm data was classified as good in 39%, sufficient in 49%, or poor in 13% of the included herds. For each of the three quality groups, kid mortality was higher for all four mortality indicators in case farm data were indicative for complete registration. Kid mortality was significantly different ($p < 0{,}001$) between all quality groups. Other factors that were associated with kid mortality levels included herd size (the 25% largest herds had lower kid mortality, $p = 0.005$) and age (decreasing trend).

Conclusion
This study showed that it is possible to monitor kid mortality, based on routinely collected data. Nevertheless, data quality should be taken into account when communicating benchmark values and individual results back to farmers. Because of an amendment in identification and registration legislation, from November 2020, all goat kids (born dead or alive) including gender have to be registered individually within 7 days of birth, which is expected to further improve quality of data and figures. It is therefore recommended that benchmark values are calculated on data from herds with the highest data quality.

doi: 10.1016/j.anscip.2023.01.241

O-166
Defining optimal cutpoints for digital Brix refractometry to determine IgG concentration in ewe colostrum and lamb serum from four Scottish lowland sheep flocks

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Keywords: Failure of passive transfer; Sheep; Colostrum; Brix

Introduction
There is opportunity to reduce global lamb mortality rates through more effective colostrum management. The aim of this research was to define Brix cutpoints for ewe colostrum and lamb serum, maximising the utility of this convenient, sheep side test, such that farmers and vets can accurately identify poor colostrum and failure of passive transfer in lambs.

Material and methods
Colostrum samples (n = 112) were collected from ewes from 4 farms prior to lamb(s) suckling and blood samples were colleted from 24–48 hour old lambs (n = 223). Reference immunoglobulin G (IgG) measurements were made using radial immunodiffusion (RID) plates (Triple J Farms, USA). IgG concentrations were indirectly estimated using a digital Brix refractometer (Hanna Instruments, USA).
All statistical analyses were conducted using Stata (StataCorp version 17). Sensitivity (Se) and specificity (Sp) of the Brix refractometer was calculated using receiver operating characteristic (ROC) curves. Optimal cutpoints (for accurately predicting FPT and colostrum quality using Brix) were determined using the Youden index, based on the sum of Se and Sp being maximised giving equal weight to false positive and false negative results.

Results and discussion
Serum results
Serum IgG concentration ranged from 2.6–78.5 g/L (mean = 38.04 g/L, SD = 16.9 g/L). FPT prevalence was 7.3% (95%CI = 4.3–11.4) (using 15 g/L RID), which is lower than international prevalence estimates of around 40% (Alves et al., 2015). There was high correlation between serum RID and Brix (r = 0.69), similar to other work (Kessler et al., 2021). ROC analysis defined a revised Brix cutpoint of 8.6% (Se = 82%, Sp = 94%) for Scottish lambs.
Colostrum results
Colostrum IgG concentration ranged from 36.8-201.5 g/L (mean = 94 g/L, SD = 31.6 g/L). Inadequate colostrum quality prevalence was estimated to be 4.5% (95%CI = 1.5–10.1) (using 50 g/L RID), which lower than previous prevalence estimates of around 20% (Bond, 2020). There was high correlation between colostrum RID and Brix (r = 0.74). ROC analysis defined a revised Brix cutpoint of 22.1% (Se = 90%, Sp = 100%) for Scottish ewe colostrum, lower than previously suggested (26.5%, Kessler et al., 2021).

Conclusion and implications
Improving the accuracy of the Brix refractometer to identify poor colostrum quality and FPT in lambs should improve morbidity and mortality incidences (concurrently reducing antimicrobial use) in neonatal lambs to maximise profitability and sustainability.

Acknowledgements and funding
Funding for this project was provided by the MSD Animal Health Ltd. Small ruminant bursary. Thanks to the farmers and vets who participated in this work for their help.

References
Alves, A.C., Alves, N.G., Ascari, I.J., et al., 2015. Colostrum composition of Santa Inês sheep and passive transfer of immunity to lambs. J. Dairy Sci., 3706–3716
Bond, C., 2020. Evaluation of lamb colostrum supplements. 2020 Vet. Rec., 1–3
Kessler, E.C., Bruckmaier, R.M., Gross, J.J., 2021. Comparative estimation of colostrum quality by Brix refractometry in bovine, caprine, and ovine colostrum. J. Dairy Sci., 2438–2444

doi: 10.1016/j.anscip.2023.01.242

O-167
Triage of sheep injured in wildfires

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Keywords: Prognosis; Triage; Welfare; Wildfires

Introduction
Wildfires have been a common occurrence worldwide and will increase in frequency in the following three decades due to global warming. Farmers are emotionally and financially affected by fires with losses accounting to land, feed, facilities and livestock. Furthermore, future performance of surviving livestock exposed to smoke will also be compromised. Decision-making factors contemplate welfare, clinical prognosis and treatment-related costs as the most important to allocate resources and facilitate rehabilitation after fire disaster. When treatment has been decided as the course of action for an affected animal, a multifaceted approach is granted to cover the complexity of burn injuries. Well-delineated, evidence-based guidelines supported by validated prognostic indicators are needed to facilitate the decision-making process while assisting during this stressful events.

Material and methods
Systematic scoping review to achieve evidence synthesis. Scientific databases (Web of Science, CABI, etc) were searched using the following keywords: livestock, wildfires, burns, prognosis, disaster management, welfare. Selected literature was categorized according to international frameworks for clinical practice guidance to be included on the recommendations regarding triage of burn animals according to strength of evidence.

Results and discussion
Decisions regarding animals affected by wildfires are done mainly based on burn injury presentation and immediate connection to suffering made by the observer. Welfare is an important factor for decision-making while suffering is a limited and subjective parameter. Decisions should be based on animal mobility/awareness, followed by burn severity and systemic compromise as indicators of survivability. Offering prognostic hope for animals benefiting from veterinary intervention can mitigate the sense of loss that communities experience in these situations.

Conclusion and implications
An approach to livestock triage has been defined and a knowledge gap on valid accurate prognostic indicators for ruminants was identified. Henceforth, validation of the scoring for burn triage is underway. There is ample opportunity for the development of low cost technologies that will aid in the application of prognostic indicators in the aftermath of fire disasters involving livestock.

Uncited references
O'Hara et al. (2021), Cowled et al. (2022).

Acknowledgements and funding
Red Meat Research and Development South Africa.

References

O'Hara, K.C. et al., 2021. Impacts from wildfires on livestock health and production: producer perspectives. Animals 11, 3230.
Cowled, B.D. et al., 2022. The Australian 2019/2020 Black Summer Bushfires: analysis of the pathology, treatment strategies and decision making about burnt livestock. Front. Vet. Sci. 9, 790556.

doi: 10.1016/j.anscip.2023.01.243

O-168
Livestock analgesia for improved welfare: An update

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Keywords: Pain; Management; Welfare; Nociception

Introduction
Improved animal welfare is expected by consumers of livestock products in developed nations, yet motivating farmers is challenging, particularly in developing nations where Global & Regional Animal Welfare Strategies (ie RAWS) are yet to achieve progress. It is promulgated that increased regulations are necessary to achieve welfare compliance as aversive husbandry procedures are still routinely conducted in livestock without analgesia, despite recognition they cause pain. Similarly, debilitating transboundary viral infections including foot-and-mouth disease (FMD) occurs in numerous countries, with affected animals suffering debilitating disorders that are often treated with antimicrobial preparations and infrequently with pain relief. Studies addressing this critical issue are reviewed.

Material and methods
A plethora of studies on provision of analgesia were conducted between 2005 and 2022, on both livestock husbandry interventions and more recently, vesicular infectious diseases including foot-and-mouth disease. These studies have examined the use of a commercially available (now registered in 7 countries and increasing), farmer-applied, spray-on topical anaesthetic formulation (TAF), containing two topical anaesthetics, an antiseptic and adrenalin in a gel matrix that provides an effective wound cover and limits bacterial biofilm formation (Tri-Solfen®, Medical Ethics, Australia).

Results and discussion
The TAF causes instant blockage of nociception leading to ablation of hyperalgesia, with readily visible signs of almost instant pain relief when applied to open wounds and lesions incurred during husbandry procedures and FMD infections, respectively. These trials confirm that pain and suffering is markedly reduced, with the use of TAF hastening healing rates, improving demeanour, providing antisepsis and reducing the requirement for antimicrobials to manage risk of secondary bacterial infections, contributes to antimicrobial resistance (AMR) stewardship.

Conclusion and implications
Field evidence indicates livestock producers are motivated by products delivering pain management during husbandry interventions and viral epidermal infectious diseases, including FMD. Additional benefits occur when the TAF is used with a non-steroidal anti-inflammatory drug (NSAID), with parenteral and oral applications increasingly available. This multimodal use of an NSAID for improved pain management is advocated, particularly meloxicam. As pain management improves recovery rates, it enhances productivity and farmer animal health and welfare attitudes yet reduces AMR risk. This potentially increases livestock production efficiency and decreases greenhouse gas emissions from livestock, particularly in developing countries where complex livestock production deficits are common and numerous nutritional and health interventions are required that can substantially improve net meat and milk production per ruminant animal.

Uncited reference
Windsor (2021).

Acknowledgements and funding
Collaborators in several countries including Australia, Cameroon, Indonesia, Kenya, Laos, Portugal and Spain have contributed magnificently to this work. Funding was initially provided from an ARC-LP, MLA, AWI awards with contributions from Medical/Animal Ethics Pty Ltd.

Reference

Windsor, P.A., 2021. Progress with livestock welfare in extensive production systems: lessons from Australia. Front. Vet. Sc. 8, (1). https://doi.org/10.3389/fvets.2021.674482 674482.

doi: 10.1016/j.anscip.2023.01.244

O-169
Health and welfare assessment of ewes in dairy sheep farms

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Keywords: Health; Welfare; Dairy ewes; Productivity

Introduction
Productivity as well as the sustainability of dairy sheep farms largely depend on animal health and welfare status (Sevi et al., 2009). The objective here was to assess the welfare indicators and udder health of milked ewes in dairy sheep farms.

Material and methods
The study involved 25 dairy sheep farms located in Less Favored Areas (LFAs) of north-western Greece. They were raising either Lacaune and Assaf breeds or their crosses with indigenous Greek breeds. In each farm, a random sample of 20% of milked ewes was randomly selected (n = 826). Before milking, the welfare and udder health assessment of ewes was performed in the milking parlour. Specifically, each ewe was examined for head skin lesions, injuries or abscesses, overgrown claws and arthritis. Furthermore, udder asymmetry, skin lesions, abscesses, and fibrosis were recorded by visual observation and palpation of the udder (AWIN, 2015). A thermal camera was used to record udder skin surface temperature followed by a California Mastitis Test (CMT) to detect subclinical mastitis. Data analysis was performed with "R" statistical package "psych". Health and welfare status of studied ewes was considered significantly impaired when the frequency of examined indicators occurred in percentages higher than 20%.

Results and discussion
Results showed that the overall prevalence of overgrown claws, udder asymmetry and subclinical mastitis was 25.0%, 41.9% and 30.1%, respectively. Corresponding frequencies for the rest indicators examined were <20% (0.12%–18.80%). The average of the maximum and mean udder temperature was 36.6 ± 1.57 °C and 35.7 ± 1.73 °C, respectively, within normal references. It is essential that measures such as adoption of appropriate management practices and the use of veterinary assistant should be taken to improve the overall animal health and welfare status in dairy sheep farms.

Conclusion and implications
Limb and udder health problems were the main factors causing the reduction of the welfare status of milked ewes in dairy sheep farms involved in the current study. Such problems can adversely affect the productivity of milked ewes and hence, reduce farm profitability.

Acknowledgements and funding
This research has been co-financed by the European Regional Development Fund of the European Union and Greek National Funds through the Operational Program Western Macedonia 2014-2020 (project code: DMR1-0016238 FarmDain).

References

AWIN, 2015. AWIN welfare assessment protocol for sheep. doi: 10.13130/AWIN_SHEEP_2015.
Sevi, A., Casamassima, D., Pulina, G., Pazzona, A., 2009. Factors of welfare reduction in dairy sheep and goats. Italian J. Animal Sci. 8, 81–101.

doi: 10.1016/j.anscip.2023.01.245

O-170
Effect of a topical anaesthetic gel on pain and healing after disbudding goat kids

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Keywords: Goat kids; Disbudding; Pain; Healing

Cautery disbudding is a routine procedure in intensive dairy goat farms. It is usually carried out within the kids' first two weeks of life and although it causes severe pain, no anaesthesia or analgesia is generally used. The effect of an anaesthetic and antiseptic gel (TriSolfen®, TS) on pain and healing was evaluated.
Sixteen goat kids aged from 3 to 7 days old were randomly allocated to two groups: application of an antibiotic spray on the disbudding wound (n = 8); topical application of the TS gel containing lidocaine, bupivacaine, adrenaline and cetrimide (n = 8). Kids were handled and disbudded as usual and pain signs were observed for three hours after disbudding by two trained observers. Behaviours were registered based on Hempstead et al. (2017) ethogram and were also supported by video recordings. At 15 minutes, 1 hour and 3 hours after the procedure, pain response to pressure on the wound was determined using a algometer. Three days after the procedure, all kids' wounds were evaluated by three independent observers blind to treatment using a healing scale: (1) normal healing with formation of granulation tissue (no thick scab formation or exudate), (2) thick scab present, and (3) exudate or pus present. Differences between groups were calculated using the non-parametric two sample Wilcoxon Rank Sum test.
In the course of the first observations, TS gel was noted to be dripping down to the face of some kids. Behavioural differences were only found in the first half-hour after the procedure. More head shaking was performed by the kids that received the gel but this was considered to be a consequence of the gel dripping down from the disbudding site. In contrast, head scratching had much higher frequencies in the spray group suggesting that TS had some effect in reducing pain. The were no significant differences in the algometry test. Normal healing but also scabs and exudate were present in both groups, suggesting that the gel is as effective as the antibacterial spray in promoting healing. Since no antibiotics are present in its preparation, its application after disbudding may be a good alternative to the spray.
It was concluded that TS gel may reduce pain after disbudding and can replace the use of antibiotic spray with less risk of potentiating antibiotic resistance, a public health concern. We recommend that a more viscous form of the gel should be developed for goat-kids. Further studies should be conducted up to 6 weeks post disbudding and with larger samples.

Funding
Funding by FCT through the projects UIDB/00276/2020 and LA/P/0059/2020 - 442 AL4AnimalS (Lisbon, Portugal).

Reference

Hempstead et al., 2017. Appl. Animal Behav. Sci. 194, 42–47.

doi: 10.1016/j.anscip.2023.01.246

O-171
Evaluation of the effect of a topical wound anaesthesia formulation used for the treatment of contagious ecthyma in lambs infected experimentally

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Keywords: Topical formulation; Treatment; Contagious ecthyma; Lamb

Introduction
Contagious ecthyma (CE) is a zoonotic eruptive skin infection of sheep and goats caused by the *orf* virus (genus *Parapoxvirus*). CE commonly affects the mouth and the lips of young lambs; nevertheless, adult sheep can be affected. The significant impact of CE on the economy of sheep farms, the lack of specific treatment, the use of antibiotics to manage secondary infections together with the increasing worry about antimicrobial resistance, and the nonavailability of a commercial vaccine in most of the sheep rearing countries, make necessary to research on new control strategies. Tri-Solfen® (T-S®, Bayer Animal Health, Gordon, NSW, Australia) is a topical anaesthetic 'spray-on' wound management formulation containing the local anaesthetics lignocaine and bupivacaine, plus cetrimide and adrenalin, in a gel matrix that has been used in the treatment of foot and mouth disease in several countries. The objective of this study was to evaluate the effect of T-S® used for the treatment of CE in lambs infected experimentally.

Material and methods
Fifty 15-day-old Lacaune male lambs that were negative for *orf* virus by PCR and ELISA were divided randomly into 2 groups (n = 25). These lambs were housed independently at the Veterinary Faculty of Zaragoza (Spain) and infected intradermally in the lips and the gums with the *orf* virus obtained by culture in vitro. The animals were weighed weekly and examined daily. Photographs were taken to record and evaluate the lesions' development and severity (that appeared 8 days after the infection). T-S® was administered over the EC lesions in one of the groups (treatment group) 8 and 11 days after the infection, while the other group did not receive any treatment (control group). Blood samples were collected in EDTA tubes for haematological analysis 1 week before the infection, 1 week after (prior to the treatment with T-S®), and 7 and 13 days after the treatment. Swab samples were collected from inoculation areas and CE lesions for *orf*-PCR analysis 1 week before the infection and 7 and 13 days after the treatment. Statistical analyses were performed using IBM SPSS statistics version 26 (2019) software.

Results and discussion
Treatment with T-S® had no effect on the weight gain of the lambs, nor could a delay in onset or a lower severity of the clinical progression of the lesions be demonstrated, and it was not possible to determine whether T-S® had a virucidal effect against orf virus. Haematological parameters showed initial monocytosis in response to lesions in both groups and a significantly higher eosinophil count in the treated batch.

Conclusion and implications
According to these results, treatment of CE lesions with T-S® does not seem to be an advantageous alternative to control the disease in the initial stages.

doi: 10.1016/j.anscip.2023.01.247

O-172
Evaluation of the effect of a topical anaesthetic/antiseptic formulation for the treatment of contagious ecthyma in lambs on the concentration of serum amyloid A

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Keywords: Ecthyma; Lambs; Serum amyloid A; Topical anaesthetic/antiseptic formulation

Introduction
Contagious ecthyma (CE), caused by the orf virus, is a highly contagious eruptive skin infection of sheep and goats, which mainly affects young animals. In Spain, the vaccine for this disease is not available, and treatment involves standard hygiene practices and antibiotics to control secondary infections, which can increase the risk of antimicrobial resistance. There is a need for alternative treatments to improve the welfare of affected animals and control the spread of the disease. This study evaluated the effectiveness of a topical anaesthetic/antiseptic formulation, Tri-Solfen® (T-S, Bayer Animal Health, Gordon, NSW, Australia), containing the local anaesthetics lignocaine and bupivacaine, plus adrenalin and an antiseptic (cetrimide) for the treatment of CE in lambs. The evolution of the concentration of the major acute phase protein serum amyloid A (SAA) was assessed in lambs experimentally infected with the orf virus when animals were, or were not, treated with T-S.

Material and methods
Fifty 15-day-old Lacaune male lambs from a CE free farm in Zaragoza (Spain) were randomly divided into two equal groups, treatment group (T group) and control group (C group), and intradermally inoculated in the lips and gums with the same dose of *orf* virus obtained by culture in vitro. One week later, when the first CE lesions appeared, and 11 days after the infection the lambs in the T group were treated with T-S sprayed on the lesions. Blood samples without anticoagulant were collected from all the lambs prior to the treatment with T-S (T1), at 36 h (T2) and one week (T3) after treatment. The concentration of SAA was assessed in 15 randomly selected animals from each group using a solid phase sandwich ELISA kit (PHASE TM Serum Amyloid A Assay, Tridelta Development Ltd., Maynooth, Ireland). Data were statistically analysed using IBM SPSS statistics version 26.0 software, and for all cases $p < 0.05$ was required to consider statistically significant differences.

Results and discussion
Preliminary statistical analyses using non-parametric tests showed that, in both groups, SAA concentrations increased from T1 to T2, achieving maximum values at T3. In the control group, T3 was significantly higher than T1 ($p = 0.024$) and T2 ($p = 0.020$), whereas, in the T group, a significant increase was not observed from T2 to T3. In addition, SAA concentration at T3 in the group treated with T-S was lower than in the control group, although statistically significant differences were not determined between the groups ($p = 0.115$). This is considered most likely due to the insufficient sample size of each group.

Conclusion and implications
These results appear to indicate that treatment with T-S reduced the elevation of SAA concentration in lambs suffering from CE. The use of a larger sample size is recommended to confirm these findings.

doi: 10.1016/j.anscip.2023.01.248

O-173
Rethinking use of topical anaesthesia for improved livestock welfare

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Keywords: Analgesia; Topical; Anaesthesia; Welfare

Introduction
Improved animal welfare is expected by consumers of livestock products, yet motivating farmers to adopt practice changes is challenging, particularly in developing nations where Global & Regional Animal Welfare Strategies are failing to achieve progress. Increased regulations are promulgated to ensure welfare compliance, particularly where aversive husbandry procedures are routinely conducted without analgesia, despite causing obvious pain. Similarly, debilitating transboundary vesicular viral infections including foot-and-mouth disease (FMD) occurs in numerous countries, with affected animals rarely provided with pain relief and commonly treated with antimicrobial preparations, risking antimicrobial resistance (AMR).

Material and methods
The plethora of recent studies on provision of pain relief conducted on both livestock husbandry interventions and oral and pedal disorders, including cattle lameness and more recently, FMD and Orf infections, were reviewed. The review targeted use of a commercially available, farmer-applied, spray-on topical anaesthetic formulation (TAF), containing two topical anaesthetics, an antiseptic and adrenalin in a gel matrix that provides an effective wound cover and limits bacterial biofilm formation (Tri-Solfen®, Medical Ethics, Australia).

Results and discussion
The studies confirm that TAF causes blockage of nociception leading to ablation of hyperalgesia, with visible signs of almost instant pain relief when applied to open wounds and lesions incurred during husbandry procedures and FMD infections, respectively. Suffering is markedly reduced, with TAF hastening healing rates, improving demeanour, diminishing vial loads in Orf infections, providing antisepsis and reducing the requirement for antimicrobials to manage risk of secondary bacterial infections. As livestock producers in Australia have now treated in excess of 120 million animals with TAF, they appear motivated by access to products that readily deliver visible pain man-

agement. Similarly, smallholder farmers appreciate use of the TAF for both lesions of FMD and the decubitus ulcers occurring from prolonged recumbency. Additional benefits occur when the TAF is used with a non-steroidal anti-inflammatory drug (NSAID), with parenteral and oral applications increasingly available. This multimodal use of an NSAID for improved pain management is advocated, particularly meloxicam.

Conclusion and implications
As pain management improves lesion recovery rates, it enhances productivity and changes farmer animal health and welfare attitudes, contributing to AMR stewardship. This intervention potentially increases livestock production efficiency and may contribute to decreasing greenhouse gas emissions from livestock, particularly in developing countries where livestock productivity deficits are common and strategic nutritional and health interventions can substantially improve net meat and milk production per ruminant animal.

Uncited reference
Windsor (2022).

Reference

Windsor, P.A., 2022. Role of topical anaesthesia in pain management of farm animals, a changing paradigm. Animals 12, 2459. https://doi.org/10.3390/ani12182459.

doi: 10.1016/j.anscip.2023.01.249

O-174
Serogroups of *Dichelobacter nodosus* detected in footrot lesions in sheep using a new multiplex real-time PCR

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Keywords: Lameness; Footrot; Serogroups; PCR

Introduction
Footrot, caused by *Dichelobacter nodosus*, continues to be one of the major health issues for sheep worldwide. To control footrot within a flock, vaccination can be of great value. Currently, the only available vaccines in Europe are multivalent vaccines. Due to antigenic competition, however, these vaccines are not able to induce an effective immune response to all nine serogroups included. In Australia promising results have been observed with farm specific vaccinations based on a maximum of 2 serogroups that are present on the farm. However, the number of different serogroups present on Dutch farms is currently unknown and therefore a field study was set up. At the same time, a new multiplex qPCR was developed which contains serogroups A-M of *D. nodosus* to improve the diagnosis of different serogroups.

Material and methods
Twenty four farms where the farmer suspected footrot to be present on farm were enrolled. In 2021, each farm was visited and footrot scores and swabs from 20 sheep, one foot per sheep, were taken. Ten samples of each farm were selected for further processing based on lesion score. Presence of *D. nodosus* was detected using a *D. nodosus* specific qPCR targeting the *pnpA* gene. Positive samples were subjected to a conventional PCR targeted the *fimA* gene for detection of different serogroups (A-I). On the same samples, a developed multiplex qPCR was applied targeting the same *fimA* gene, and included serogroup M.

Results and discussion
Four farms did not have any *pnpA* positive swabs. Of the remaining 20 farms, the number of positive *pnpA* swabs ranged between one and ten. The conventional PCR detected one or multiple serogroups in 51/157 *pnpA* positive swabs. However, using the multiplex qPCR, a total of 148/157 *pnpA* positive swabs could be assigned one or multiple serogroups.
Serogroup M was not found. As no control strain was available for serogroup M, the effectiveness of the multiplex qPCR for serogroup M has not been studied. Nine swabs tested *pnpA* positive, but could not be assigned to a serogroup. Whether this is due to lack of test sensitivity or an unknown serotype is unclear. Based on the multiplex qPCR, most farms had one ($n = 6$ farms) or two ($n = 7$) different serogroup(s). The remaining farms had samples with 3 ($n = 5$), 5 ($n = 1$) and 6 ($n = 1$) serogroups. Severity of the lesion could not be linked to a specific serogroup.

Conclusion and implications
The newly developed multiplex qPCR for detection of *D. nodosus* serogroups is efficient in detecting serogroups A-I directly from foot swab. As 62% of farms showed only one or two different *D. nodosus* strains, it will be likely that a farm specific vaccine approach will be an effective tool to control footrot on those farms.

doi: 10.1016/j.anscip.2023.01.250

O-175
The role that a photosynthesisation disease plays in lamb production and losses in Scottish hill flocks

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Keywords: Blackloss; Plochteach; Yellowses; Alveld

Introduction
Blackloss is the unexplained loss of lambs on extensive hill grazings in the Highlands and Islands of Scotland. Reported figures for annual blackloss give an average of 18.6% (Tongue et al., 2016), whilst anecdotal evidence suggests that *plochteach* (a hepatogenous photosensitisation disease, also known as yellowses or alveld) may be a contributing factor. The aim of this study was to investigate the role that *plochteach* has in blackloss, as well as its effect on lamb performance, in three hill flocks.

Material and methods
Data were available for 3,074 lambs born between 2014 and 2021 in Scotland's Rural College (SRUC) Auchtertyre (AT, 1,629 lambs), Corrie (AC, 353 lambs), and Twin (TW, 1,092 lambs) flocks. Lamb presence/absence was recorded using EID tags, and count data was used to calculate marking to weaning levels of blackloss. *Plochteach* was diagnosed through clinical signs of photosensitisation on the ears and/or back. The impact of *plochteach* on lamb growth was investigated using GenStat. A General Linear Model was fitted with the liveweight of lambs at recording events (lambing (May), marking (June), shearing (July) and weaning (August)) set as the response variable and Year (8 levels; 2014 to 2021), Sex (2 levels; male & female), Skin Colour (2 levels; black & white), Ewe Crop (5 levels; 1, 2, 3, 4 & 5+), Management Group (3 levels; AT, AC & TW), and *Plochteach* (2 levels; yes or no) set as the fitted terms.

Results and discussion
The eight-year average blackloss observed between marking to weaning was 10.9% in AT, 4.2% in AC and 5.9% in TW lambs. During the eight-year period *plochteach* incidence was 7.4%, 0.6% and 3.2% respectively. Incidence of *plochteach* in the blackloss populations was 13.0% (AT), 0.0% (AC) and 6.3% (TW). There was a statistically significant ($p < 0.001$) weight difference between unaffected and *plochteach* lambs at marking (16.96 ± 0.07 kg, 15.34 ± 0.32 kg), shearing (21.99 ± 0.08 kg, 18.72 ± 0.36 kg) and weaning (26.43 ± 0.10 kg, 22.19 ± 0.44 kg).

Conclusion and implications
The data suggest that *plochteach* is associated with blackloss within these flocks, with over half of the lambs which disappear having previously shown signs of *plochteach* during some years. The results also show that it can have a significant effect on lamb growth rate which will have a negative impact on the performance and financial results from these lambs. Further investigation to improve our understanding of *plochteach*, to reduce the incidence/impact of the disease and identify appropriate treatment options, would be beneficial.

Acknowledgements and funding
This PhD is funded by SRUC and NatureScot and registered at the University of Edinburgh's Royal (Dick) School of Veterinary Studies.

Reference

Tongue, S., Pritchard, I., Watson, D., Hosie, B., 2016. Vet. Rec. 180 (8).

doi: 10.1016/j.anscip.2023.01.251

O-176
Retrospective investigation of ewe body condition score and weight through pregnancy in a single flock with respect to the occurrence of vaginal prolapse

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Keywords: Sheep; Vaginal prolapse; Body condition score; Pregnancy

Introduction
Vaginal prolapse in late pregnancy has been commonly associated with higher body condition score (BCS) or over-feeding through pregnancy with associations with breed, numbers of lambs carried and environmental conditions. This investigation considered a Welsh flock of 280 pedigree Lleyn ewes with a historical prolapse rate of 10%.

Material and methods
Investigations included an audit of protein, energy and trace element supply through pregnancy. Weight and BCS were measured by hand by the farmer on seven occasions between September 2020 and March 2021 and recorded via the on-farm software. The flock lambed from the last week of March and prolapse occurrence was recorded through February and March 2021 with the data collated on an Excel spreadsheet.

Results and discussion
Fifteen ewes (8%) prolapsed before lambing in 2021. The audit indicated that nutrition was adequate and balanced at the level of fermentable energy (FME) and effective ruminal degradable protein (ERDP) and levels of minerals, specifically calcium and magnesium were appropriate. Two practical reasons for high levels of prolapse included the observation that the ewes were kept on steep ground through pregnancy and a number were short tail-docked.
The ewes ranged in age from two years old to six years old and it was predominantly three- and four-year old ewes that prolapsed in 2021. There were 3% prolapse in single-bearing ewes, 5% in twin-bearing ewes and 24% in triplet-bearing ewes.
Throughout pregnancy, the ewes that prolapsed were at a lower BCS (2-2.5 out of 5) than the ewes that did not prolapse (BCS 2.5-3 out of 5). Chi-squared test showed the prolapse ewes to be significantly lower BCS in September 2020 ($p = 0.046$) and in October 2020 ($p = 0.040$) than the ewes that did not prolapse. There was also a significant different in BCS in March 2021 ($p < 0.0001$) though low BCS at this date may have been a consequence of the prolapse.
At no stage of pregnancy was there a difference in ewe weights between ewes that prolapsed compared to those that did not.

Conclusion and implications
Reasons for vaginal prolapses in ewes are varied and complicated. However, it is suggested that, within this pedigree flock, the ewes that are lower in BCS but equivalent weight, may be depositing more body fat within the abdomen rather than subcutaneously and hence predisposing themselves to prolapse due to increased abdominal pressure.

Acknowledgements and funding
This work was funded by Welsh Government Rural Communities through Farming Connect and Menterabusnes.

doi: 10.1016/j.anscip.2023.01.252

O-177
The use of infrared thermography for the clinical assessment of udder health status in goats

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Keywords: Infrared thermography; Udder fibrosis; Udder temperature; Goats

Introduction
Infrared thermography (IRT) is an on-site, rapid, and non-invasive method for measuring body temperature. Despite the various applications of IRT in farm animals, its use in dairy goats for the assessment of their udder health status is not sufficiently documented. The objective of this study was to evaluate infrared thermography (IRT) as a point-of-care technology with the potential to remotely assess the udder health status.

Material and methods
A total of 104 intensively reared purebred Skopelos goats were randomly selected and enrolled in the study. The udder skin surface temperature of animals was measured using an infrared thermal camera (FLIR E8-XT, FLIR Systems Inc.) at the udders' level and at a distance of 70 cm to capture thermal images of the udders. Thermal camera was set at 0.98 emissivity, 320 × 240 resolution, 0.05 °C thermal sensitivity, 2.6 mrad spatial resolution, and ±2 °C accuracy. FLIR professional tool software program was used to estimate the mean and maximum udder halves temperatures. In addition, for each individual goat, udder asymmetry, fibrosis, and the size of the posterior-mammary lymph nodes were clinically assessed. For the statistical analyses, udder halves were used as experimental units ($n = 208$); SPSS v.26 was used, and a nested univariate ANOVA was carried out to compare the mean and maximum temperatures between clinically healthy udder

halves (group A) and (i) fibrotic udder halves (group B), (ii) both fibrotic and asymmetric udder halves (group C), and (iii) udder halves with swollen posterior-mammary lymph nodes (D).

Results and discussion
A total of 88.5% of udder halves (184/208) were clinically healthy, while 11.5% (24/208) were assigned to group B, of which 45,8% were also asymmetric (group C, 11/24). The maximum and mean temperature of group A and group B udder halves were (38.05±0.581 °C and 36.94±0.577 °C) and (37.75±0.588 °C and 36.52±0.707 °C), respectively, with the mean temperature of group B udder halves being significantly lower ($p < 0.05$, $R^2 = 0.951$). When comparing groups A and B with group C udder halves, the mean and maximum temperatures were (38.05±0.581 °C and 36.94±0.577 °C), (37.78±0.521 °C and 36.60±0.628 °C), and (37.73±0.683 °C and 36.42±0.810 °C), respectively, while the mean temperature of group C udder halves was the lowest ($p < 0.05$, $R^2 = 0.954$). Swollen posterior-mammary lymph nodes were observed in 4.8% (10/208) of the udder halves. The mean and maximum temperatures of group D halves were not significantly different compared to halves with normal sized posterior-mammary lymph nodes, despite an observed tendency ($p = 0.120$).

Conclusion and implications
Fibrotic and asymmetric udder halves had lower mean temperature compared to the clinically healthy ones. A future initiative of this study is to estimate the most appropriate udder temperature thresholds and the diagnostic performance of IRT accordingly.

Acknowledgements and funding
The research work was funded by E.U. under the *"Code Re-farm: Consumer-driven demands to reframe farming systems*" (Grant No:101000216).

doi: 10.1016/j.anscip.2023.01.253

O-178
Retrospective survey of goats and sheep treated at the bovine and small ruminant clinic (CBPR) at the University of São Paulo between 2017 and 2022

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Keywords: Small ruminants clinics; Sheep; Goat; Infections diseases

Introduction
The activities performed by the Department of Internal Medicine at the School of Veterinary Medicine and Zootechnics, University of São Paulo (FMVZ/USP) are supported by the fundamental triad of the institution: teaching, research and extension, being essential for the community that uses the services developed by the Clinic of Cattle and Small Ruminants (CBPR/USP), for Resident Veterinarians and students who follow the activities developed in practice. The activities and cases followed in CBPR contribute directly in the training of students and also in the theoretical and practical improvement of professionals who develop activities with ruminants, whether with cattle or small ruminants. Animal health is directly related to the existing diseases in the various animal species, animal welfare, public health and quality of animal products, aiming at food safety. For this, it is necessary to have well-structured, quality veterinary services that are able to detect and adopt early and effective measures for the control, prevention and eradication of diseases.

Material and methods
The aim of this summary is a retrospective survey of goats and sheep seen at the USP Cattle and Small Ruminants Clinic from January 2017 to October 2022, as well as the clinical profile of the animals seen and the main diseases in these animals. For this summary, a survey of the medical records archived at the Veterinary Hospital of the University of São Paulo (USP) was carried out.

Results and discussion
In the period studied between the years 2017 and 2022, 413 small ruminants were attended, being 238 goats (57.62%) and 175 sheep (42.38%). Among this category, 239 females (57.86%) and 174 males (42.14%) were seen. Among the diseases treated, parasitic diseases were the most prevalent, with verminosis being the most diagnosed. A survey was made of the main affected systems among the treated animals. The diseases were separated according to the prevalence of the affected system. Parasitic disorders represent 15.50%, reproductive system disorders 15.01%, other changes / disorders 13.32%, routine evaluations 9.69%, locomotor system 8.72%, gastrointestinal system 6.29%, non-diagnosed conditions 5.57%, urinary system 4.84%, metabolic alterations 3.63%, nervous system 2.91%, dermatological conditions 2.65%, systemic conditions 2.18%, neoplasms 2.18%, return visits 1.94%, vaccinations 0.97%.

Conclusion and implications
It is possible to verify the clear importance of the Veterinary University Hospital of the University of São Paulo for the population and also the importance regarding the practical learning of students and professionals involved in the casuistry of the hospital. This paper sought to demonstrate the importance of the Clinic of Cattle and Small Ruminants at USP in the theoretical and practical development of students and veterinarians, allowing the monitoring of a large number and variety of clinical cases.

doi: 10.1016/j.anscip.2023.01.254

O-179
Small ruminant euthanasia: A how-to guide for captive bolt training for the end-user

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Keywords: Euthanasia; Captive Bolt; Training; On-Farm

Introduction
Investment in veterinary intervention is often very low when the health and welfare of livestock becomes compromised to a point when they require euthanasia. Further, many sheep and goat farmers do not receive sufficient training, or possess equipment, to apply appropriate methods of euthanasia on-farm. The objective of this project was to equip sheep and goat farmers with the knowledge, skills, equipment and confidence to perform timely and effective euthanasia on-farm.

Material and methods
Course participants were solicited through small ruminant commodity organizations. An entry survey was used to gain insight into challenges farmers face with timely and efficacious euthanasia of animals. The course consisted of 3 classroom hours and 2 wet-lab hours. Classroom instruction included, but was not limited to, a definition of euthanasia; euthanasia decision-making tools; acceptable methods of euthanasia; euthanasia equipment and maintenance; and captive bolt landmarks and acceptable secondary kill steps. The wet-lab consisted of a safety demonstration; hands-on captive bolt gun live fire exercise using cadaver sheep and goat heads; and review of correct and incorrect captive bolt landmarks using real time mid-saggital sectioning of cadaver heads. Participants were required to live-fire the captive bolt gun on a cadaver sheep or goat head. All participants developed an on-farm euthanasia protocol, completed a written test, and completed a post-training survey prior to concluding the course. Upon completion of the course each participant received a Blitz captive bolt gun and cartridges to take home to be used on their farm.

Results and discussion
There was a high demand for this hands-on captive bolt euthanasia training course for sheep and goat farmers. A total of 122 farmers (88 sheep; 31 goat; 3 both), split evenly over 6 course offerings, participated in hands-on euthanasia training. All but one course participant completed both the classroom and wet-lab portion of the course, and went home with a captive bolt gun. Course participants reported on average improving their confidence in on-farm euthanasia by 1.5 points on a 1-5 scale. Course participants consistently ranked the course content, take-home materials, and hands-on instruction very high.

Conclusion and implications
Sheep and goat farmers are caring, conscientious, and determined. This project demonstrated a strong demand for euthanasia training among these commodity groups. The hands-on classroom and wet-lab training methodologies used in this project were successful in improving the competence and confidence of farmers who participated in the course. This course could be used as a model for meeting the demand for euthanasia training in the sheep and goat industries, as well as in other livestock species.

Acknowledgements and funding
The authors acknowledge the Ontario Sheep Farmers and the University of Guelph Animal Health Laboratory.

doi: 10.1016/j.anscip.2023.01.255

O-180
Sheep habit during hand milking, and relations between the incorrect hand milking procedure and mammary health

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Keywords: Ewe habit; Hand milking; Mammary health; Statistical analysis

Table 1
Bacteriology, clinical findings, and milk SCC for each workstation.

	S. aureus positive	CoNS positive	Negative	Presence of lesions	Absence of lesions	SCC (LOG 10/ml) (RMSE = 0.701)
W1	(32%)	(36%)	(21%)	(41%)	(16%)	5,80 Aa*
W2	(16%)	(18%)	(27%)	(13%)	(26%)	5,37 Bb*
W3	(32%)	(26%)	(30%)	(24%)	(30%)	5,52 Bc*

*Capital letters indicate differences for $P \leq 0.01$; lowercase for $P \leq 0.05$.

Introduction
This study aimed: (1) to evaluate the relation between the incorrect hand milking and mammary health; (2) to test the hypothesis of the ewe habit in the workstation, of their choice, during the milking.

Material and methods
The investigation was carried out in a semi-extensive dairy hand milking farm in Sicily (Italy) rearing 470 ewes (lactating "L" = 420; dry "D" = 50). The animals were at the second half of lactation and were milked twice a day by 3 employees (E) sitting in 3 different workstations (W); each milker always used the same workstation. E1 always humidified the teats with milk foam collected from his milk tank (~18lt), whilst E2 and E3 did not. Milk sampling for bacteriology parameters and somatic cell count (SCC) determination from each half udder were collected. To evaluate the sheep habit in the workstation of their choice during milking, for 8 non-consecutive days, within a period of 25 days, each ewe was monitored using 3 microchip scanners. Statistical analysis was carried out with a two-factors Anova model, where the somatic cell count (Log10) was the dependent variable, while the workstation chosen by each ewe, and the age class (2, 3, 4 and ≥5 years) were the fixed factors. The statistical analysis included only the ewes they chose the same workstation at least 6 out of the 8 recording assessments (≥75%).

Results and discussion
The SCC values (LOG 10/ml) were higher in the half udders with lesions (6.28) and excreting *S. aureus*, Coagulase-negative staphylococci (CoNS) or with negative culture (6.70 *vs* 6.35 *vs* 6.20), compared to those without lesions (5.59) and excreting *S. aureus*, CoNS or with negative culture (6.04 *vs* 5.79 *vs* 5.50).
At least on 75% of the time, 118 (L = 108; D = 10), 113 (L = 102; D = 11), and 136 (L = 122; D = 14) ewes always chose the same workstation 1, 2 and 3, respectively.
As regard the effect of workstation on milk SCC (Table 1), in W1 SCC mean value was statistically higher than W2 and W3. W1 showed higher number of half udders with *S. aureus,* CoNS infection and clinical lesions.

Conclusion and implications
Teat moisturization with foam milk collected from the milk tank represents a high-risk factor because potentially contain mastitis-causing bacteria previously released from affected ewes. Moreover, it was found that sheep are routinary animals by habit during hand milking.

doi: 10.1016/j.anscip.2023.01.256

SEOC (Sociedad Española de Ovinotecnia y Caprinotecnia)

O-181
Sheep flock proliphicacy in Chile, associated to gene polomosphisms

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Keywords: Local breeds; Genetic markers; Prolificacy; SNP

Introduction
The identification of genetic markers in the form of SNP allows to associate their presence with productive characteristics and later to be used as a tool for genetic selection. Litter size has been associated with the presence of genetic polymorphisms in sheep breeds. The objective of this work was to identify by means of PCR-RFLP and automatic sequencing the main polymorphisms associated with prolificacy located in the BMPR1-B, BMP-15 and GDF-9 genes in the Araucana, Chilota, Corridale and Austral breeds (Paz et al., 2015).

Material and methods
Blood samples (n = 520) were obtained from 22 herds of the four different breeds. Genomic DNA was extracted and primer sets were used to amplify the different regions of the BMPR1-B, BMP-15 and GDF-9 genes. PCR was performed and the products were separated by electrophoresis. PCR products were digested and separated by agarose gel electrophoresis. The PCR products were sequenced and subsequently aligned using the programs available online; BLAST, MAFFT and CLUSTW. Genepop version 3.4 software was used to calculate allele and genotypic frequencies to determine Hardy-Weinberg equilibrium in populations (Bravo et al., 2016).

Results and discussion
For the BMPR1B gene, the FecB polymorphism was analyzed; Six polymorphisms were analyzed in the BMP15 gene: FecX1, FecXB, FecXC, FecXG, FecXH, and FecXR. In the GDF9 gene, 13 polymorphisms were analyzed: 152A>G, G1, G2, G3, 692T>C, G4, 729G>T, FecGA, G5, G6, FecG5, G7 and G8.
No polymorphisms associated with the BMPR1-B and BMP-15 genes were detected in the analyzed breeds.
In the Araucana breed, 8 SNPs were identified in the GDF9 gene (G1, G2, G3, 692T>C, G4, G5, G6 and the FecGA SNP was detected for the first time in a sheep breed. In the Austral, Corridale and Merino breeds Only the G1 polymorphism was identified.In the Chilota Creole breed, the G1, G5, and G6 polymorphisms were identified.

Conclusion and implications
When associating the presence of SNPs with prolificacy, a significant association was found for SNPs G5 and G6 in Araucanian sheep and SNP G1 in Chilota sheep.

Acknowledgements and funding
Acknowledgements: The authors thank FONDECYT 1120474 and Dirección de Investigación de la Universidad de La Frontera projects supported this work. The authors are members of the HealthyMeat network, funded by CYTED (ref. 119RT0568).

References

Bravo, S., Larama, G., Paz, E., Inostroza, K., Montaldo, H., Sepúlveda, N., 2016. Polymorphism of the GDF9 gene associated with litter size in Araucana creole sheep. Anim. Genet. 47, 286–391. https://doi.org/10.1111/age.12404.
Paz, E., Quiñonez, J., Bravo, S., Montaldo, H.H., Sepúlveda, N., 2015. Genotyping of BMPR1B, BMP15 and GDF9 genes in Chilean sheep breeds and association with prolificacy. Anim. Genet. 46, 98–99.

doi: 10.1016/j.anscip.2023.01.257

O-182
Lambing-mating interval as a crucial factor to improve the fertility of meat sheep

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Keywords: Reproductive success; Ewe; Fecundity; STAR system

Introduction
Minimizing non-productive days is one of the main reproductive goals in meat sheep production. The lambing-mating (L-M) interval in a STAR system (5 lambings per ewe/3 years) is crucial in ovine species, and the lowest number of days required to obtain the highest fertility is not defined. For this reason, this survey aims to establish the cut-off point at which the best results in terms of reproductive parameters (fertility, fecundity and prolificacy) are obtained.

Material and methods
To achieve this aim, 567 adult Castellana ewes (2 to 8 years old) were used during the non-breeding seasons of 2020 and 2021. Previous lambing dates were recorded and the L-M interval was set from 59 to 76 days. The L-M interval was divided into 3 periods of 6 days each one: P1: 59–64D, n = 188; P2: 65-70D, n = 231; P3: 71–76D, n = 148. All ewes were subjected to a treatment for estrus induction and synchronization using intravaginal sponges with 20 mg fluorogestone acetate (Chronogest®, MSD) over 7 days. On day 0 of synchronization treatment, 2 mL of prostaglandin F2α (Prosyl®, CEVA) was administrated intramuscularly (IM). The sponges were removed on day 7 and 480 UI of eCG (Folligon®, MSD) were injected IM. After 24 hours, the rams (a ratio of 1 male per 3 females) were introduced with the synchronized ewes and separated after 3 days. Fertility [(lambed/mated ewes) $\times$ 100] was calculated according to the births registered at 137–154 days post-mating considering mating 48 hours after sponges withdrawal. Fecundity (lambs/mated ewes) and prolificacy (lambs/lambed ewes) were also calculated. Data were analyzed with SAS/STAT® version 9.1 statistical package (SAS Institute, Cary, NC, USA). Fertility data were compared using a Chi-square test considering a binary response model. Fecundity and prolificacy data were analyzed using a MIXED procedure. Differences were statistically significant at $p < 0.05$.

Results and discussion
Fertility in the different established periods was as follows: 60.6% P1, 72.2% P2, 70.3% P3. Fertility was significantly higher ($p < 0.05$) in P2 period compared to P1. Moreover, the fecundity showed an increase between P1 and P2 (1.1 and 1.3, respectively) ($p < 0.05$). However, the prolificacy was similar in the three periods of interest: 1.8, 1.8 and 1.7, respectively.

Conclusion and implications
In conclusion, 65 days post-partum is the best time to re-mating ewes and obtain the highest fertility rate and the best fecundity in meat sheep in a STAR system.

Acknowledgements and funding
Supported in part by MICINN -PID2021-122470OB-I00-, JCyL through the Consejería de Educación and FSE PO 1420 - CyL -fellowship EDU/556/2019-, University of León and Ganadería AR.

doi: 10.1016/j.anscip.2023.01.258

O-183
Factors involved in pregnancy percentage of ewes from the Mexican Central Highlands

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Keywords: Mating season; Body condition score; Pregnancy diagnosis; Ultrasound

The reproductive activity of ewes is mediated by different factors such as the nutrition, photoperiod, breed, age, body condition score (Kenyon et al., 2014). The variation of these factors will be reflected in conception success. Many reviews had reported individual effects and interactions between them, the most studied are the interactions between weight, nutritional level and body condition score on fertility; however, there are few studies that report the interaction between ewe body condition score and mating season on pregnancy rate. Thus, the objective was to evaluate the pregnancy percentage of ewes when mating was carried out in different seasons and body condition scores. Material and Methods A total of 775 pregnancy diagnoses were performed on ewes of Katahdin breed 35 days after mating by ultrasound equipment. The data were recorded in spring, summer, fall and winter during two consecutive years. Also, the ewes were classified according to their body condition score at mating in 4 categories (1, very low; 2, low; 3, good and 4, fat). The pregnancy percentage was recorded as 1 for positive and 0 for negative ewes. For data analysis, a logistic regression model was fitted considering the interaction effect of body condition and season using PROC LOGISTIC of SAS. Significance was declared at $P < 0.05$, otherwise indicated. Results and Discussion The analysis revealed a significant interaction between season and body condition score at mating on pregnancy percentage, which was reported by Semakula et al. (2020). The conception rates according to mating season were: 67.2%, spring; 91.9%, summer; 97.5%; fall and winter, 92.5%. The higher conception rates (97.6%) were detected in the fall season with a good body condition score of 3 units ($P < 0.001$). On the contrary, the lower values (33%) were found in the spring season and the lowest body condition score. The presented results clearly indicated the influence of body reserves coupled with mating season on reproductive performance. In conclusion, the higher pregnancy percentages of ewes were detected during fall and with body reserves of 3 at mating. The results support the importance of monitoring body reserves and choosing the most favorable season for improving conception rate and subsequent fertility as it has been widely studied.

Acknowledgments
Proyecto CI2251. Evaluación de los efectos del genotipo y ambientales sobre la eficiencia reproductiva y productiva en ovejas. 2022.

References

Kenyon, P.R., Maloney, S.K., Blache, D., 2014. Review of sheep body condition score in relation to production characteristics. New Zealand J. Agric. Res. 57, 38–64.
Semakula, J., Corner-Thomas, R.A., Morris, S.T., Blair, H.T., Kenyon, P.R., 2020. The effect of age, stage of the annual production cycle and pregnancy-rank on the relationship between liveweight and body condition score in extensively managed Romney ewes. Animals 10, 784.

doi: 10.1016/j.anscip.2023.01.259

O-184
Scrotal circumference as a trait for reproductive selection in white merino breed

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Keywords: Ram; Merino; Scrotal circunference; Reproduction

Introduction
Scrotal circumference (SC) is one of the parameters that can be measured in males. It is perfectly stablished the relationship between SC and many reproductive characters. In sheep there are recommendations of not using lamb or adult rams with SC less than 30 cm and 32 cm respectively and indicating satisfactory potential breeders, when rams between 6–13 months have SC of 30–35 cm and males >14 months have a SC of 33–39 cm.
The use of primary traits, as general appearance, lamb growth rates and efficient gain as criteria for selection, disregarding reproductive traits as SC, can be responsible, in time, for decreasing the SC mean in the breed. It is important to understand the present status of Portuguese merino breed, advising farmers for the importance of this parameter as selection criteria.

Material and methods
SC was measured in white (n = 436, 352 animals) merino rams, included in the Portuguese flockbook, from 5–177 months (0–14 years). Animals were randomly measured along the year in 19 farms using a flexible measuring tape in the widest part of the scrotum, holding testis in a distal position. Five age categories were used for classification of the males and environmental traits such as season, body score and farm were analysed because of expected influence in SC.
Statistical analysis was performed using SAS® 9.4 software, through MEANS and GLM procedures.

Results and discussion
The means of the SC of animals of different age groups (6–12; 12–18; 18–24; 24–36 and >36 months) were estimated, respectively 25.7, 29.4, 31.1, 34.8 e 34.9 cm, and a greater variability was observed in the younger age groups (VC's of 12.5 and 19.6%), partly because animals were in the growth phase and with individual differences in the onset of puberty, that is variable and usually occurs between 5–7 months of age, when 65% of body weight is achieved.

Conclusion and implications
Although the mean values of SC observed in animals >24 months are close to the values indicated by the American Sheep Industry Association (33 cm and 35 cm), of the 245 available records, only 175 (71%) are within these values. There were also significant differences (P < 0.05) in the SC of animals from different farms, maybe due to different environmental farm conditions, such as genetic differences, eventually because some breeders are more prone to the use this parameter in selection.
This is the first study on the SC of this breed in Portugal and results can be an important standard indication, as well as a tool when selecting males.

Acknowledgements and funding
This presentation is funded by MED (Instituto Mediterrâneo para a Agricultura, Ambiente e Desenvolvimento). We thank the collaboration of the ACORME's farmers in collecting this data on the farms.

doi: 10.1016/j.anscip.2023.01.260

O-185
Parameterisation of winter lamb production in the extensive sheep production system with rotational and holistic grazing

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Keywords: Lamb; Winter fattening; Rotational; Holistic

Introduction
The objective was to evaluate technical-economic parameters of the production of lambs reared in winter on concentrate feed or pasture, in the extensive sheep system with rotational or holistic grazing.

Material and methods
Merino lambs, born in September in two flocks of the experimental farm Valdesequera (Cicytex) managed in two grazing systems: rotational (C) and holistic (H), are studied in fattening with concentrate and weaned (C: natural lactation in grazing until weaning at 44 days, with availability of starter feed from day 24, and fattened with feed and straw ad libitum until slaughter; 74 lambs) and in fattening with grass and suckling (H: natural lactation without weaning and grazing until slaughter; 74 lambs). Lambs were marketed at 88 days of age (26.9 ± 0.6 and 24.6 ± 0.4 kg, respectively), however, H lambs needed to be weaned and fattened on fattening feed and straw to reach mar-

ketable weight (26.7 kg). Feed consumption was monitored by batch, and individual weight was recorded on a digital scale (Alflex FX1). Statistical treatment of individual data was carried out with the Statgraphics Centurion XVI p GLM simple program to establish the effect of the production system. The significant effect is established by comparison of means by Tukey's test ($P < 0.05$).

Results and discussion
C lambs showed significant growth improvements of 11% up to 24 days ($p = 0.03$), 13% up to weaning at 46 days ($p = 0.03$) and 10% up to marketing at 88 days ($p = 0.001$). These differences can be related to the feeding level with respect to the nutritional requirements of the respective growth phases. The values observed for consumption of starter (232 g/d) and fattening (1,066 g/d) concentrate are within the normal range for this type of production (C). The marketing weight of H lambs was 8 % significantly lower ($p = 0.003$), so they needed a weaning and finishing period of 10 days in the feedlot to be marketed, thus requiring 23 kg/lamb, compared to the C lambs (5 and 44 kg/lamb of starter and fattening concentrate, respectively). The gross margin per lamb, that is to say, the difference between the commercial value of the lamb (applied price: 81 and 56 €/88-day C and H lamb, respectively, or 60 €/98-day H lamb) and the feed cost (applied price: 25 €/88-day lamb, 12 €/98-day lamb), was equal for both production systems at 88 days. However, when the 10 days weaning and finishing period needed for H lambs is considered, their gross margin decreased by 13%.

Conclusion and implications
The holistic system decreases the marketable weight of 88-day lambs by 10%, requiring weaning and 10 more days of finishing with fattening feed. The estimated gross margin is 13% lower in the holistic system.

doi: 10.1016/j.anscip.2023.01.261

O-186
Udder ecogenicity as indicator of mamary health in sheep

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Keywords: Ultrasonography; Lamb; Growth; Images

Introduction
The use of ultrasound techniques as tools for monitoring and follow-up of mammary health in livestock farms has not been magnified due to the lack of practical information for its implementation. In this sense, the objective of the present study was to evaluate the echogenicity of the udder of hair sheep in different tissues, consistency and presence of abscesses in the mammary tissue in order to generate information that can be used as a health monitoring criterion. mammary in sheep.

Material and methods
The study was carried out in a commercial flock ($n = 500$) of hair sheep intended for the production of lambs for slaughter. Twenty-two adult multiracial female sheep (<1 parity) were randomly selected and 1070 data from 8 ultrasound udder slices with 5 replicates per slice were recorded. The ultrasound slices (CE) were made with the Mindray® equipment, model dp-10 (5 MHz transabdominal convex probe). The images were analyzed using the Image J® 1480 free software program. Digital images of each field (8 bits) were obtained. The recorded slices were right caudal longitudinal (LCaD); right caudal transverse (RCT); median caudal longitudinal of the udder (LCMM); left caudal longitudinal (LCaI); left caudal transverse (TCI); left nipple (PI); left cranial longitudinal (LCrI); right cranial longitudinal (LCrD), in each section the type of tissue (parenchyma or cistern), consistency of the udder (hard, firm and soft) and presence of abscesses were recorded. Statistical analysis was performed using the statistical package SAS v.9.4. A fixed effects model was used, with a completely randomized design, with the GLM procedure.

Results and discussion
An effect was found due to the type of cut and where LCaD, TCD, LCaI, TCI, PI, LCRD and LCrI had higher values ($p < 0.05$) than LCMM, which was the cut with the least amount of pixels. It was found that the highest number ($p < 0.05$) of pixels were observed in the parenchyma sections, while the sections made in abscesses and cistern tissue had the least number of pixels per section ($p > 0.05$). Regarding udder consistency, a greater amount ($p < 0.05$) of pixels was found in cuts made on soft tissue, while the cuts on firm and hard tissue presented the lowest values ($p > 0.05$).

Conclusion and implications
It is concluded that the type of cut, as well as the type of tissue, consistency and presence of abscesses influence echogenicity and therefore can be used as indicators of mammary health to detect early pathologies that could affect the productivity of the herd.

Acknowledgements and funding
Programa de Apoyo para Proyectos de Inovación y Mejoramiento de la enseñanza (PE-212719).

doi: 10.1016/j.anscip.2023.01.262

O-187
Isolation of possible lactic acid bacteria in ovine and caprine raw milk in Spain: Preliminary selection for future antimicrobial evaluation studies against *Mycoplasma* spp.

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Keywords: Lactic acid bacteria; Mycoplasma; Milk; Small ruminants

Introduction
Contagious agalactia (CA) is a problem of high economic importance for the small ruminants' sector as it produces a triad of symptoms including mastitis, arthritis and keratoconjunctivitis. The abusive use of antimicrobial agents to control mastitis is a concern for public health as it generates antibiotic resistance. Although probiotics are widely developed, there is no specific strain commercialized for the prevention of mastitis. Lactic acid bacteria (LAB), which are the most common probiotics, tend to be host specific and it would be reasonable to conjecture that probiotics manufactured with LAB isolated from and for the target specie, would be more effective. Therefore, the aim of this study was to isolate possible LAB in small ruminants' raw milk and evaluate their capacity to grow in a *Mycoplasma* spp. specific medium for further *in vitro* experiments to assess capacity to inhibit this important causative pathogen of CA.

Material and methods
Milk samples were collected in sterile conditions from 72 healthy animals, from three caprine and six ovine farms (eight animals per herd) located in Spain. The possible LAB were isolated on Man, Rogosa and Sharpe (MRS) agar for the isolation of *Lactobacillaceae* and on MRS agar enriched with cysteine for *Bifidobacterium* spp. The isolated strains were subsequently tested for their ability to grow in a mycoplasma specific medium by measuring the optic density (OD) and the concentration after 18 hours of incubation.

Results and discussion
Lactic acid bacteria were isolated in eight out of nine farms and from one to six animals per herd. The concentration of LAB per animal ranged from one Colony Forming Unit (CFU) per mL to 7000 CFU/mL. Overall, the mean bacterial count for possible lactobacilli was 60 CFU/mL and for bifidobacteria 10^2 CFU/mL. Bifidobacteria were more frequently isolated in goats ($P < 0.05$). Seventeen strains, from a total of 63 isolated strains (26,9%), were able to grow well in the mycoplasma medium with an OD ≥ 0.100 and a concentration $\geq 10^7$ CFU/mL.

Conclusion and implications
The important fluctuation of the isolation and concentration rates of possible LAB, including within the same herd, highlight the impact of both external and internal factors on the animals' microbiota. The low amount of LAB able to grow in a mycoplasma specific medium confirms the importance of screening to select the best technological strains. Future studies should evaluate the ability of these LAB strains to inhibit *Mycoplasma* spp. in order to be used as a possible probiotic.

Acknowledgements and funding
Marion Toquet is the recipient of a FPI contract by the CEU-UCH. Raquel Toledo is the recipient of a grant by the Generalitat Valenciana (CIACIF/2021/245).This work was funded by the project PID2020-119462RA-I00/AEI/10.13039/501100011033.

doi: 10.1016/j.anscip.2023.01.263

O-188
Evaluating haematological changes in Latxa sheep associated with *Anaplasma* infection in semi-extensive grazing system

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Keywords: Tick-borne disease; Hematology; Anaplasmosis; Tick-borne fever

Introduction
Tick-borne diseases affecting livestock have been reported throughout the world. One of these diseases is caused by obligate intracellular bacteria of the family *Anaplasmataceae*. The impact of anaplasmosis is higher on management systems where animals spend long periods grazing in mountain pastures exposed to tick bites. Nonimmune animals might suffer the disease when firstly contact with infected ticks and after, infected animals remain as carriers which can act as source of infection for vector ticks originating an endemic status in areas where hosts, ticks and pathogens coexist. This study aimed to evaluate changes in haematological parameters along the grazing season in relation to *Anaplasma* spp. infection.

Materials and methods
Three sheep flocks that grazed in a mountainous area in Alava (Basque Country, Northern Spain) in communal mountain pastures (700–1,200 m above sea level) were selected. Animals were sampled at three different times of the year, once before going to communal pastures (spring) and twice while grazing in communal mountain pastures (summer and autumn). Blood samples were randomly collected from 25 sheep per flock and sampling, divided into three age categories: lambs <1 year; yearlings 1–2 years; ewes >2 years. Haematological analyses were performed with an electronic cell counter in blood samples collected in EDTA-containing tubes. Presence of *Anaplasma* spp. was firstly determined using a real-time PCR (targeting the 16S rRNA gene). All samples positive to *Anaplasma* spp. were analysed with a multiplex PCR assay that specifically amplifies the *msp*2 gene of *A. phagocytophilum (*Ap*)*, and the *msp*4 gene of *A. ovis (*Ao*)*. Association between haematological parameters and season, age and *Anaplasma* infection was evaluated using no-parametric statistical tests.

Results and discussion
As expected, most of the haematological parameters changed between season and age. Moreover, while Ap prevalence was clearly associated with season (highest prevalence in autumn), Ao prevalence was associated with age (highest prevalence in ewes). Overall, lower red cell count values were associated with Ao infections. No significant association was found between leucocyte, neutrophil or lymphocyte values and infection status. However, Ao infection was associated with monocytosis. The stratified analysis showed a non-generalizable relationship between haematological parameters and infection status that varied depending on age and season. Animals with mixed infections showed different patterns of haematological alterations.

Conclusion and implications
Infected animals could be apparently "healthy" but can show changes in haematological parameters. Seasonality and age are important factors to take into account when evaluating haematimetric values in sheep in semi-extensive grazing systems. Haematological alterations can be unpredictable when mixed infections by *Anaplasma* occur, or even in case of co-infections with other pathogens such as piroplasms not evaluated in the present study.

doi: 10.1016/j.anscip.2023.01.264

O-189
Effect of subclinical experimental infection with *Taenia hydatigena* on different productive parameters in lambs

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Keywords: *Taenia hydatigena*; Lambs; Subclinical parasitosis; Productive losses

Introduction
In the specialized development of sheep production, subclinical diseases have been identified that produce a negative impact on production. In metacestodosis caused by *Taenia hydatigena* larvae, it is very difficult to calculate economic losses because in most cases, it does not produce obvious clinical signs and most farmers think that it does not have any repercussions on the health of sheep. The objective of this study was to evaluate the effect of the experimental infection of *T. hydatigena* on different productive parameters in sheep.

Material and methods
Seventeen male Columbia lambs distributed in three groups were used. The lambs of the first group ($n = 5$) were orally inoculated with 1000 T. hydatigena eggs (low dose). The lambs of the second group ($n = 5$) were inoculated orally with all the eggs of the last proglottid of an adult cestode (high dose). The lambs of the third group ($n = 7$) only received a placebo and were used as a control group. All lambs were humanely euthanized at week 13 postinfection, and carcass yield and conformation were evaluated. The area under the curve (AUC), the multivariate study (MANOVA) and simple Pearson correlation were performed to analyze the variables studied.

Results and discussion
The infection rates of the lambs from the high-dose infected group and the low-dose infected group were 100% and 40%, respectively, with a mean of 2.4 ± 0.6 and 1 ± 0.7 metacestodes in the abdominal cavity, respectively. The AUC of body condition score ($p < 0.001$), weight gain ($p < 0.1$), and carcass yield ($p < 0.1$) were lower in lambs from the high-dose infected group than in lambs from the control group. The feed intake ($p < 0.1$), final feed conversion ($p < 0.1$), AUC of eosinophil count ($p < 0.001$), and serum alkaline phosphatase (ALP) levels ($p < 0.001$) were higher in lambs from the high-dose infected group than in lambs from the control group. The MANOVA considering the productive variables showed a highly significant effect of the infection ($p < 0.0001$). The increase in serum ALP is a consequence of liver damage that had a strong negative correlation ($r = -0.63$, $p < 0.007$) with the body condition of the lambs. Despite these findings, we did not observe obvious clinical manifestations in any of the infected lambs. No differences ($p > 0.1$) were observed between the lambs of the control group and the lambs of the low-dose infected group in the parameters evaluated.

Conclusion and implications
The infection of *T. hydatigena* metacestodes subclinically produces a decrease in productive efficiency, alterations of some hematological and biochemical values, and a slight deterioration in the general appearance of the infected lambs. The above aspects are rarely detected by most farmers, but they have a negative impact on the productivity of infected lambs.

Funding
This study was funded by a grant from PAPIIT/UNAM, Mexico (No. IN210322 and IN211222).

doi: 10.1016/j.anscip.2023.01.265

O-190
Coxiella burnetii excretion in goats after a Q fever outbreak: A preliminary study of the vaccination as a control measure

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Keywords: Q fever; *Coxiella burnetii*; Goat; Vaccination

Introduction
Q fever is a worldwide zoonosis caused by the bacteria *Coxiella burnetii* (Cb). The most frequent clinical sign of the disease in small ruminant herds is abortion at the last term of gestation, which can be as high as 90% in goats. Higher abortion rates and vaginal and fecal bacterial excretion have been observed in goats compared to sheep. Even though vaccination is one of the most effective prevention measures to reduce bacterial spreading, limited information is known about the dynamics of Cb excretion after vaccination in Q fever outbreaks in goats. It is unknown whether the nasal route could be an excretion route in this specie. The objective of this study was to evaluate the dynamics of nasal, vaginal, fecal and milk excretion of Cb before and after vaccination in an outbreak of Q fever in goats.

Material and methods
The study population was from a mixed-breed goat herd in south Spain. The experimental group was composed of six multiparous goats aborted during the last kidding. Sampling was performed at two times: Time 0 (T0), during the first-week post-abortion before vaccination; and Time 1 (T1), two months after revaccination. The entire herd was vaccinated following the manufacturer's (Coxevac®) guidelines for goats. A total of 48 samples were taken for the detection of Cb by q-PCR for all the animals at both times: vaginal swabs, nasal swabs, milk and feces.

Results and discussion
At T0, the samples where Cb was most frequently detected were nasal swabs and fecal samples (6/6 positive samples; 100%), followed by the vaginal samples (4/6 positive samples; 67%) and the milk samples (1/6 positive samples; 17%). After the vaccination (T1), it was observed that 33% (2/6) of the animals continued having q-PCR-positive results. Specifically, two goats maintained positive nasal samples after vaccination. The positive effect of the vaccination as a control measure was observed with a 67% reduction in animal shedders 2 months after revaccination. For the moment, there is no information about nasal Cb excretion in goats. It has been considered as an environmental contamination indicator.

Conclusion and implications
This preliminary study detected the presence and persistence of Cb in the nasal cavity. Further studies are necessary to determine nasal samples as a route of excretion and diagnostic method of Q fever in clinical outbreaks in goats.

Acknowledgements and funding
This study was supported by the project from Spanish Ministry of Science and Innovation of UCH-CEU (PID2020-119462RA-I00/AEI/10.13039/501100011033), IP: Á. Gómez-Martín. Á. Gómez-Martín and J.J. Quereda are supported by a "Ramón y Cajal" contract of the Span-

ish Ministry of Science, Innovation and Universities (RYC2021-032245-I; RYC-2018-024985-I). A research grant from the CEU-UCH supports M. Toquet. A research grant from the Generalitat Valenciana supports R. Toledo.

doi: 10.1016/j.anscip.2023.01.266

O-191
Exploring the global prevalence of coccidia in sheep: A meta-analytical review

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Keywords: Eimeria; Sheep; Parasitism; Prevalence

Introduction
Coccidiosis affects many mammals including ruminants. Specifically in sheep, lambs lack an effective immunity against primary infections showing most pronounced clinical signs with delays of growth and development. In contrast, older lambs show partial immunity against reinfection (Chartier and Paraud, 2012). The aim of this work was to carry out a systematic review and meta-analysis to determine the global prevalence of coccidiosis in sheep and to explore the sources of heterogeneity of reported prevalence.

Material and methods
A compressive and structured search of articles was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA). The search was carried out by three field experts to avoid reviewer-bias using the follow keywords: ‘‘prevalence”, ‘‘coccidia”, ‘‘lamb”, ‘‘sheep” and ‘‘*Eimeria* spp”. Polled prevalence was estimated using a logistic regression model in the ‘‘Meta” package of the R environment for statistical computing. Heterogeneity was explored by the percentage of variability explained by heterogeneity rather than simple variance (I^2 index). The sources of heterogeneity were assessed through a subgroup analysis using as moderator outcomes: sheep' age, *Eimeria*'s specie, agro-ecological region (arid, semi-arid, humid, sub-humid and temperate), continent, season (rainy and dry) and system (grazing and indoor).

Results and discussion
A total of 42,485 samples from 85 articles were analyzed in the current study. The global prevalence of coccidia in sheep was of 0.17 (95% CI:0.15–0.18) showed a significant heterogeneity (I^2 = 97.4; $p < 0.001$). The heterogeneity of prevalence among studies was significantly explained by the Eimeria's specie ($p = 0.001$), region ($p = 0.02$), season ($p = 0.0014$), continent ($p = 0.0012$) and production system ($p = 0.001$). The subgroup analysis did not show a difference of coccidia prevalence associated with the age ($p = 0.19$). In relation with the *Eimeria* specie, the highest prevalence was showed by *arloingi* (0.48; 95% CI:0.15–0.81), *caprovina* (0.26; 95% CI:0.19–0.34) and *crandallis* (0.22; 95% CI:0.16–0.29) species. The highest prevalence was identified in Oceania (0.27; 95% CI:0.18–0.36) followed by Africa (0.20; 95% CI:0.16–0.24) and Europe (0.18; 95% CI:0.15–0.21). The temperate region depicted the largest prevalence (0.28; 95% CI:0.14–0.48) followed by sub-humid region (0.15; 95% CI:0.11–0.18). Finally, prevalence of coccidia in sheep was largest in the rainy season (0.10; 95% CI:0.05–0.15) and in semi-intensive systems (0.34; 95% CI:0.27–0.41).

Conclusion and implications
The prevalence of coccidia in sheep showed a high variability which can be explained by the agroecological region, season, continent and system. Also, significant differences were found in relation with the species of *Eimeria* that affect the sheep. These findings can be useful in the development of programs to monitor and control of coccidia in sheep.

Reference

Chartier, C., Paraud, C., 2012. Coccidiosis due to Eimeria in sheep and goats, a review. Small Ruminant Res. 103 (1), 84–92.

doi: 10.1016/j.anscip.2023.01.267

O-192
Superoxide dismutase-rich melon extract supplementation helps improve heat stress adaptation and milk quality of dairy goats

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Keywords: Antioxidant; Goats; Heat; Milk

Introduction
Heat stress is known to be one factor that can trigger oxidative stress. For dairy goats, during hot periods (Temperature Humidity Index (THI) higher than 70), milk yield and quality of milk are reduced up to 10% (Salama et al., 2014). The objective of this study was to evaluate the effect of an antioxidant supplementation (Melofeed) to alleviate the negative impacts of heat stress.

Material and methods
48 Murciano-Granadina goats were allocated in two groups and fed an alfalfa hay and pelleted concentrate (30.7% NDF, 16.8% CP and 25% Starch and sugars) diet. 24 goats were supplemented with a superoxide-dismutase-rich melon extract included at 25 mg/hd/d (Melofeed) and the other 24 goats received a diet without any other antioxidant solution (Control). Two periods were set for heat stress severity: P1, first 42 days (8 hours/d with THI $\geq$ 80) and P2, next 49 days (11 hours/d with THI $\geq$ 80). Temperature and Humidity inside the barn was monitored hourly, individual milk production and rectal temperature twice a week and milk composition and somatic cells count (SCC) once a week. Blood samples were taken individually once a month to measure Total Oxidant Status (TOS) and a hemolysis score. Milk yield, LogSCC, Rectal temperature and LogTOS were analyzed with a mixed model, using Days on treatment as repeated measures and Animal as random subject. Milk loss was calculated as the difference between final and initial individual production. For LogSCC, the slope of individual trajectory was compared using T-Test. A binary logistic regression with repeated measures (Days) was run to evaluate the probability of having animals above 1.5 M cells/mL. Chi-2 test was used to analyse Hemolysis score.

Results and discussion
Overall, Melofeed supplemented goats showed a lower SCC under heat stress compared with control: 280 000 vs 340 000 cells/ml, especially during P2 ($P < 0.1$). In Control group, the slope of the SCC curve showed significant increase versus a decrease in Melofeed group, especially during P2 ($P < 0.01$). Besides, Melofeed supplementation helped reduce by 60% the percentage of goats with SCC $\geq$ 1.500.000 cells/mL between P1 and P2 ($P < 0.05$). In Melofeed group, there was a T $\times$ D interaction for milk yield, with greater production towards the end. Milk losses also tended to be reduced during heat stress: −0.8kg/goat/d in Control group vs. −0.4 kg/goat/day in Melofeed ($P < 0.1$). Rectal temperature was significantly lowered in Melofeed group ($P < 0.01$), suggesting a reduced systemic inflammation. Overall, TOS was lower in Melofeed group ($P < 0.01$) and the number of samples in medium to severe hemolysis was reduced ($P < 0.10$).

Conclusion and implications
Supporting dairy goats during heat stress with antioxidant solutions such as Melofeed can help alleviate negative effects that are commonly observed and confirmed in our Control group: SCC increase, milk losses, increased body temperature and global inflammation.

doi: 10.1016/j.anscip.2023.01.268

O-193
Attitude of cheese consumers towards the sustainability of dairy sheep production systems

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Keywords: Cheese; Consumer perception; Sustainability; Sheep

Introduction
Society's concern for the consumption of dairy products that have been sustainably produced and processed is growing. This trend could affect the purchasing decisions of sheep cheese consumers. The objective of this work is to know which attitudes towards the sustainability of milk and sheep cheese production prioritize consumers from the social, environmental and economic perspectives.

Material and methods
A survey was conducted in Palencia (Castilla y León, Spain) from May to June 2022. A total of 190 consumers over 18 years of age who declared consuming sheep cheese were included. The questionnaire was divided in the following sections: sociodemographic information (age, sex, education, employment status, knowledge of livestock farming); frequency of sheep cheese consumption; perception of sheep cheese sustainability from the social, environmental and economic perspective in a scale from 1 to 7 points (animal welfare, environmental

friendly production, local resources of animal feeding, settling population in rural areas, fair price for the farmer, local production, circular economy). Data were analysed as frequencies and percentages.

Results and discussion
Respondents between 18 and 29 years, 30 and 59 years and > of 60 years were 78 (41%), 62 (33%) y 50 (26%), respectively. The 54% were male and the 46% female. The 56% of respondents declared that they consume sheep cheese at least once per week and 44% at least one per month or per year. With reference to sustainability scores by those who consume cheese weekly, local resources of animal feeding, fair price for the farmer, settling of population in rural areas and local production were the most valued items (5.97, 6.32, 6.07 and 5.88 points respectively) and the lowest scores were for animal welfare, environmental friendly production and circular economy (5.79, 5.76 and 5.79 respectively). This data could be according to a greater preference of consumers towards artisanal production and local sheep cheeses.

Conclusion and implications
This study provides a preliminary context of sheep's milk cheese consumers' attitudes towards sustainability of dairy sheep production systems. The most valued sustainability is related to the settling of rural population and the fair price for the farmer. These results/findings could be taken into account to set the price of the milk and in marketing strategies, improving the sustainability of dairy sheep production systems. In any case, more studies are necessary to verify if consumers are willing to pay more for them.

Acknowledgements and funding
This study is part of the projects PID2020-113395RB-C21 y PID2020-113395RB-C22 funded by MCIN/AEI/10.13039/501100011033.

doi: 10.1016/j.anscip.2023.01.269

O-194
Plasma lipid peroxidation of dairy ewes fed with rose wine by-products

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Keywords: Winery by-products; Chemical composition; Plasma lipid peroxidation; Dairy ewes

Introduction
Residues from the wine industry are rich in phenolic compounds and its concentration depends on the winemaking process. In rose wine industry, grape pomace is removed before alcoholic fermentation and high proportion of polyphenols remains in this wine by-product. The use of rose grape pomace could be a natural and alternative source of antioxidants in ruminant feeding and help to waste management. The **aim** of this study was to evaluate the chemical composition, including phenolic compounds, of grape pomace from rose wine and its effect on plasma lipid peroxidation of dairy sheep.

Material and methods
Chemical composition and phenolic compounds of rose grape pomace from three wineries of Castilla y León were analysed by standards methods. Twenty six lactating Churra ewes were divided into two dietary treatments (n = 13): control treatment (CTL, without rose grape pomace) and GP treatment (GP, with 7.5% of grape pomace from rose wine). Ewes were fed *ad libitum* with a 50:50 forage:concentrate TMR and the diets were offered at 9:00 h and 17:00 h. On days 40 and 47 of experimental period, ewes were blood sampled 0, 4, and 8 h after feeding in the morning. Lipid peroxidation was analysed in the plasma samples using the thiobarbituric acid-reactive substance (TBARS). Plasma TBARS were analysed by repeated measurement analyses using the MIXED procedure of SAS.

Results and discussion
Dry matter content of rose grape pomace was 461 g kg^{-1} and NDF, ADF and lignin content was 240, 205 and 122 g kg^{-1} DM respectively. The CP content was 90.7 g kg^{-1} DM with a 27% of CP bound to fibre. The EE was 13.9 g kg^{-1} DM with 61% of polyunsaturated FA. The extractable polyphenols, hydrolysable polyphenols, condensate tannins and total anthocyanin content of rose grape pomace (g kg^{-1} DM) was 68.8, 10.9, 94.3 and 13.9 respectively. Plasma lipid oxidation (TBARS) was not affected (P > 0.05) by the treatments but numerically was lower in GP than CTL treatment at 0 h, 4 h and 8 h after feeding. There was no significant interaction (P > 0.05) between treatment and time after feeding.

Conclusion and implications
The nutritive value of grape pomace is limited because of their lignocellulosic nature. Grape pomace could be a source of unsaturated FA and natural antioxidants for dairy sheep nutrition. Further experiments are necessary to verify the effects of rose grape pomace on preserving animal health and product quality.

Acknowledgements and funding
This research has been financed by a collaboration agreement between the Agricultural Technological Institute of Castilla and León (ITACYL), the University of Valladolid (UVa) and the Scientific Park Foundation of the UVa and the project AGL2016-75159-C2-1-R funded by the Spanish State Research Agency (AEI) and the European Regional Development Fund.

doi: 10.1016/j.anscip.2023.01.270

O-195
Strategic analysis of the dairy sheep production systems in Brazil – An approach by SWOT methodology

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Keywords: Inputs; Organization; Production; Processing

Introduction
Dairy sheep are concentrated around the Mediterranean and Black Sea regions worldwide, where their dairy products are typical ingredients of the human diet. The Brazilian dairy sheep production systems and industry are still very small and present great variation regarding the structure of the farms, animal productivity, costs, processing, and destination of product. The main product of the business is cheese and other derivatives. The objective of this work was to describe the components of the sheep milk production systems in Brazil, identifying weaknesses and strengths, opportunities, and threats, using the SWOT methodology.

Material and methods
The present study was developed through face-to-face interviews with agents linked to the fifteen sheep milk farming systems in Brazil, in the year 2017. The agents pointed out and described the strengths, weaknesses, opportunities, and threats of each of the four segments of the sheep milk production chain (inputs, production, processing, and marketing) which were organized in a SWOT matrix.

Results and discussion
In general, the lack of adoption of adequate technology and the lack of data and costs control on the farms are considered weaknesses in sheep milk production systems. Regarding to processing industry, the low volume of milk production due to the small size and the low efficiency of Brazilian dairy herds, and the difficulties related to legislation were pointed as the main weaknesses. The lack of consumer culture and knowledge of products derived from sheep's milk are important critical points that reflect on the sector. On the other hand, the physicochemical, nutritional, and antiallergenic properties, as a beneficial alternative milk product, and the possibility of marketing of artisanal products are considered strengths.Other opportunities are the possibility of production in smaller farming, added value of sheep milk products, and growing consumption of sheep food products. Linked to these aspects, the development of sheep's milk production and artisanal cheese processing, together with the tourism sector in several Brazilian states, has been another value-adding aspect. Farther, the production of lambs for meat in the same sheep milk farming systems, as an important revenue-generating product, was mentioned as strength in Brazilian sheep business model.

Conclusion and implications
Milk sheep production and processing techniques should be implemented as well as data and cost control. The intensive production with added value and the growing consumer market favors the growth of the sector, and campaigns to promote milk sheep and its derivatives must be carried out. The production of sheep's milk in Brazil is a small production chain that is still being organized; although the productive components of the systems are heterogeneous, they present positive economic indicators, showing that it is a potential agricultural activity.

Acknowledgements and funding
Brazilian Association of Dairy Sheep Breeders (ABCOL).

doi: 10.1016/j.anscip.2023.01.271

O-196
Animal growth, tissular composition, and carcass conformation of light Merino lambs

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Keywords: Light lamb; Carcass; Growth; Merino breed

Introduction
In Spain, light lamb is the most consumed sheep commercial type. These animals are around 3 months old and have between 18 and 24 kg of live weight. Merino breed has the largest census in Spain. Originally, wool was the main production of this sheep breed. However, when synthetic fabrics downplayed its importance, the breed was subjected to genetic selection improving its meat characteristics It is important to check if there has been an evolution regarding the meat characteristics over time. Therefore, the objective of this study was to evaluate lamb (males and females) growth during the fattening process, conformation measurements and tissue composition on their carcasses.

Material and methods
A total of 73 lambs were controlled (37 males and 36 females) from 13 different farms. Growing rate data from 75 to 115 days old were taken at Feedlot. After carcasses cooling (24 h/4 °C), carcass performance (EUROP Classification (15 levels) assessed by a technical expert) and carcass measurements (carcass length (K), rump width (G), thorax depth (Th) and leg length (F)) were evaluated. After cutting the carcass of the animal, the shoulders were dissected and the tissue composition (muscle, fat, bone and others) was obtained. An ANOVA with the sex of the animal (male and female) as a fixed effect was performed.

Results and discussion
Neither the age (average 74.3 ± 2.9 days) nor the arrival weight of males and females (average 15.38 ± 0.25 kg) at the fattening farm, after the lactation period, were statistically significant. At the end of the fattening period, statistically significant differences were found for the weights and growth of the two sexes (25.91 ± 0.59 kg vs. 22.52 ± 0.52 kg (*p-value*: 0.000), and 242.15 ± 10.15 g/day vs. 178.51 ± 9.86 g/day (*p-value*: 0.006) in males and females respectively). Regarding carcass conformation measurements, the differences between sexes were statistically significant for: K, G and Th, but not F. In the carcass performance, there were significant differences between males (7.5 ± 0.3) vs. females (6.7 ± 0.2) (*p-value*: 0.023), which means that the males had a rating of R- and the females O+. Regarding tissue composition, only the percentage of muscle was significantly higher in males (58.50 ± 0.88) than in females (52.94 ± 0.76), (*p-value*: 0.011). After the logical differences between males and females, the study showed that both sexes had a higher growth potential than the final weights at which the study was carried out, since they did not show a high fattening (22.76 ± 0.86 percentage). Our results were in accordance with other authors.

Conclusion and implications
The genetic selection that has been carried out on this breed showed good growth parameters and quality of the carcass that are maintained over time.

Acknowledgements and funding
Asociación de Criadores de Ganado Merino and Matadero frigorífico Agudo.

doi: 10.1016/j.anscip.2023.01.272

O-197
Effect of Castellana lambs rearing system on meat texture, colour and oxidative stability

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Keywords: Lamb; Organic; Pasture; Indoors

Introduction
The objective of this study was to assess the effect of rearing system on meat quality (texture, colour and oxidative stability) of Castellana breed lambs reared under different management systems.

Material and methods
Twenty-eight lambs from the same farm and lambing season were reared with their dams until they were 6 weeks old, when they were weaned. After weaning, lambs were assigned to two different rearing systems. Thus, 14 lambs were reared indoors with free access to commercial concentrate and barley straw (group indoor) whereas another 14 lambs were reared outdoors on spring rye and barley grass with no concentrate supplementation (group outdoor). Outdoor lambs were managed under a system qualified as "organic". Slaughtering took place when animals reached 4.5 months old on four different days, between 3 and 4 animals from each group being slaughtered on each day. Carcasses were chilled at 4 °C for 24 h and afterwards transported to the ITACyL facilities in an isolated van. The muscle longissimus

thoracis et lumborum (LTL) was removed from the carcass, vacuum packed and stored under darkness at 4 °C for 15 days. Colour and pH were measured on days 1, 3, 9 and 15 post-slaughter, whereas water holding capacity (WHC), texture profile (TP) and oxidative stability (TBARS) were determined on days 3, 9 and 15 post-slaughter.

Results and discussion
Some of the parameters resulted affected by time regardless the rearing system. Thus, pH decreased from day 1 to day 9 and then raised again on day 15 ($P < 0.05$); values of yellow index (b*) increased with storage time (day 9 and 15 compared to day 1 and 3), this fact led to an increase in tone (hue) and saturation (chroma) values ($P < 0.001$); TBARS also increased in response to storage time, particularly from day 3 to 9 ($P < 0.05$). Rearing system also affected some parameters: yellow index (b*) was lower ($P < 0.05$) and colour tone (hue) tended to be lower ($P < 0.10$) in outdoor compared to indoor lambs. Likewise, TBARS values were significantly lower in outdoor lambs as time goes by ($P < 0.01$). As for texture, outdoor meat samples showed significantly higher shear force values ($P < 0.001$) than indoor lambs regardless time. There was no effect of time or rearing system on WHC.

Conclusion and implications
Rearing lambs outdoors is an alternative to produce organic or pasture based meat that entail improvements in meat oxidative stability. However, this benefit may be accompanied by increases in meat hardness and changes in meat colour.

Acknowledgements and funding
Project EcoLamb (Holistic production to reduce the ecological footprint of meat), funded by ERA-Net SusAn (project ID 48) through the Spanish Agencia Estatal de Investigación (PCIN-2017-074).

doi: 10.1016/j.anscip.2023.01.273

O-198
Meat colour and oxidative stability of lambs reared under conventional and holistic management systems

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Keywords: Holistic; Lamb; Meat; Stability

Introduction
The objective of this study was to asses meat colour and oxidative stability of Merino breed lambs reared under different management systems: conventional and holistic.

Material and methods
Sixteen Merino male lambs from two experimental flocks were reared under different production systems: conventional (C: lambs were milk-fed from birth -day 0- till weaning -day 44-, with free access to a starter concentrate from day 22, and finished on a concentrate+straw diet) and holistic (H: lambs reared with their dams under grazing system from birth to slaughter). Slaughtering took place at 88 days of age. Carcasses were chilled at 4 °C for 24 h and afterwards transported to the ITACyL facilities in an isolated van. The muscle longissimus thoracis et lumborum was removed from the carcass, vacuum packed and stored under darkness at 4 °C for 15 days. Colour and pH were measured on days 1, 3, 9 and 15 post-slaughter, whereas oxidative stability (TBARS) were determined on days 3, 9 and 15 post-slaughter.

Results and discussion
There was a clear effect of time on some parameters regardless the rearing system. Thus, meat pH evolved parallelly in meat from both experimental groups with a trend to decrease from day 1 to 3, values recovering form day 3 to 15 ($P < 0.10$). Likewise, there was a significant increase in TBARS from day 3 to 9 and from 9 to 15 ($P < 0.05$) without differences between production systems. There was an evolution of meat colour over time in both experimental groups. Thus, lightness (L*) decreased at day 3, the values recovered afterwards ($P < 0.001$); likewise, values of yellow index (b*) decreased with storage time (day 9 and 15 compared to day 1 and 3), this fact led to a decrease in tone (hue) and saturation (chroma) values ($P < 0.001$). In addition, differences between groups were observed in lightness (L*), with lower values in the H group. Red index (a*) values tended to be higher and hue (H*) lower in the H group.

Conclusion and implications
Under the conditions of the present study, meat oxidative stability from lambs under holistic system (reared with their dams on pasture), was similar to that from animals reared indoors. However, it is clear that rearing system may affect other parameters, such as meat colour; thus, meat from lambs reared under the holistic system was paler and redder than that from conventionally reared lambs.

Acknowledgements and funding
Project EcoLamb (Holistic production to reduce the ecological footprint of meat), funded by ERA-Net SusAn (project ID 48) through the Spanish Agencia Estatal de Investigación (PCIN-2017-074). Project GoDEHESA (Gobernanza de dehesas para un desarrollo humano, económico con sostenibilidad ambiental) funded by Junta de Extremadura (PGO/32/2017) and by technical assistance contract Cicytex/Tagus (Decr. 94/2016).

doi: 10.1016/j.anscip.2023.01.274

O-199
Meat quality and shelf life of suckling lamb from ewes' fed with by-product from rose wine winery process, packaged under modified atmosphere

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Keywords: Winery by-products; Suckling lamb composition; Lipid oxidation; Shelf life

Introduction
Meat purchasing is related to extrinsic cues in quality perception, such nutrition, health, and convenience. Shelf life is influenced by microbial growth and oxidative processes, which are affected by temperature, oxygen and light. Retail conditions enhance deteriorate in meat with high contents of unsaturated fatty acids. In order to increase antioxidant capacity of lamb meat, the use of by-products rich in phenolic compounds, such as those from rose wine industry in ewes' diet, could be profitable from an economic and environmental point of view.
The objective was to evaluate the effect of supplementing ewes' diet with grape pomace from rose wine in meat quality of their suckling lambs throughout its exposure in retail conditions.

Material and methods
Twenty-eight pregnant Churra ewes were assigned to one of two treatments. Control group received a basal diet and other group was supplemented with 7.5% of grape pomace from rose wine. Suckling lambs were slaughtered at 11 kg of live weigh. Proximal composition and fatty acid profile of Longissimus thoracis muscle was analysed. The shelf life was evaluated in meat packaged under high oxygen modified atmosphere and stored in cabinet with white fluorescent light at 4 ± 1 °C. Sampling points were 0, 4, 9, 13 and 16 days after packaging, when lipid oxidation (thiobarbituric acid-reactive substance-TBARS) and microbial charge (psychrotrophic bacteria, enterobacteria, Pseudomonads spp, and lactic acid bacteria) were analysed. Data were statistically analysed using GLM procedure (Statgraphics-18).

Results and discussion
The inclusion of grape pomace in ewes' diet did not affect meat lamb composition. Only slight differences between treatments were found regarding individual fatty acids composition ($P < 0.05$). However, meat from ewés supplemented with grape pomace had higher levels of PUFA n-3.
All microbial populations increased significantly during storage ($P < 0.05$). The inclusion of grape pomace seems to have an antimicrobial effect since this group registered lower enterobacteria counts ($P < 0.05$). Also, values of TBARS increase with time of storage ($P < 0.05$) and pomace grape supplementation resulted in lower lipid oxidation at the end of storage.

Conclusion and implications
The inclusion of grape pomace from rose wine process in ewes' diet could be a profitable alternative since it resulted in a delay of deterioration of suckling lamb meat throughout storage.

Acknowledgements and funding
This research has been financed by a collaboration agreement between the Agricultural Technological Institute of Castile and Leon (ITACYL), the University of Valladolid and the Scientific Park Foundation of the University of Valladolid and the project AGL2016-75159-C2-1-R funded by the Spanish State Research Agency (AEI) and the European Regional Development Fund. The field work was carried out within the framework of a collaboration agreement between the CIF Viñalta (Palencia) and the Universidad de Valladolid.

doi: 10.1016/j.anscip.2023.01.275

O-200
Proximal composition, mineral content, and texture of meat from light lambs and non-pregnant ewes

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Keywords: Age; Sex; Nutritional value; Quality

Introduction
Spain is one of the largest producers of sheep meat in the EU-27, with suckling lamb or light lamb being the typical product. Since lamb consumption has decreased in recent years, it is essential to look for strategies to increase the income of farmers, including the use of other types of animals. Near the 2% of the herd are non-pregnant ewes, which represent great losses for the farmer. To value non-pregnant ewes' meat would be a viable market strategy but the age and sex of the animal influence the quality of its meat, including nutritional characteristics, which can determine the purchasing decision of consumers aware by health. The objective of this study was to evaluate the nutritional quality of the meat of non-pregnant ewes and light lambs (males and females) of the Merino breed.

Material and methods
We used 10 ewes (in average, 26.7 Kg of Hot Carcass Weight), and 20 lambs (half females, half, males; 10.9 Kg Hot Carcass Weight, 3 months-old). After carcasses cooling (24 h/4 °C), the muscle Longissimus thoracis et lumborum was extracted and sampled for determination of the proximal composition (NIRS Foss), mineral content (atomic emission spectrometry in plasma ICP) and texture (TPA, Instron 5543). An ANOVA with the type of animal as fixed effect and a Tukey test for differences between means ($p < 0.05$) were performed.

Results and discussion
The ewe's meat presented a lower percentage of moisture (72% vs. 75%), but higher content of fat (7% vs. 3.5%), saturated fats (2.3% vs. 1%), collagen (2.2% vs. 0.9%) and ashes (3.4% vs. 2%) than that of lambs, in which no influence of sex was found, accordingly with other authors (Martinez-Cerezo et al., 2005). The ewe's meat had higher amounts of calcium (11.5 mg/100 g vs 6.2 mg/100 g) and iron (3.3 mg/100 g vs 1.9 mg/100 g) and lower amounts of the other minerals than the lambs' meat, without differences between sexes. The ewe's meat had 350 mg/100 g of K, 25.3 mg/100 g of Mg, 46.9 mg/100 g of Na and 197.0 mg/100 g of P, while the data for lambs were 408 mg/100 g of K, 28.3 mg/100 g of Mg, 61.3 mg/100 g of Na and 235.5 mg/100 g of P. No differences were found between batches for Zn content (2.7 mg/100 g; $p = 0.216$) nor for hardness (54.0; $p = 0.321$) or adhesiveness (0.2; $p = 0.937$), indicating that the texture of the ewe's meat is like that of lambs.

Conclusion and implications
The meat quality of the non-pregnant ewes is like that of typical light lambs and a viable market strategy.

Acknowledgements and funding
to the Analytical Services of UZ.

Reference

Martinez-Cerezo, S. et al., 2005. Breed, slaughter weight and ageing time effects on physico-chemical characteristics of lamb meat. Meat Sci. 69, 325–333. https://doi.org/10.1016/j.meatsci.2004.08.002.

doi: 10.1016/j.anscip.2023.01.276

Miscellaneous

O-201
The status of sheep production in Malawi. The opportunities and the challenges

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Introduction

Malawi is an agriculture based economy mostly striving on cash crops such as tobacco, tea and of late some soybean production. Livestock Production also contributes considerably towards the agricultural GDP. Agriculture contributes around 23% of the country's GDP with livestock contributing around 30% of the agriculture GDP. Much of the country's livestock population is dominated by poultry with an annual through-put of over 200million. The ruminant population is mostly dominated by Goats (over 10million), Cattle (2million) and the least is Sheep at around 400,000 heads mostly fragmented and owned by smallholder farmers with 2–5 heads of sheep on average.

Tobacco, which has over the years remained the main stay of the country's economy is currently facing both production and marketing challenges. Climate change has led to the unpredictability of the country's rainfall with the country mostly receiving below normal rainfalls resulting into low tobacco production thus less revenue for the economy. The anti-smoking lobby has also led to low tobacco prices on the global market again resulting into low revenue inflows for the country.

The challenges facing tobacco production and marketing have led Malawi into diversifying the economy through other alternative enterprises. To this effect, the country has developed an Agricultural Diversification Strategy trying to explore alternatives for the sustainability of our agricultural economy and livestock production is now getting considerable attention from both government and other stakeholders.

The Ministry of Agriculture through the Department of Animal Health and Livestock Development operates at least 2 sheep breeding farms as a source of quality breeding stock for smallholder farmers in the country. From these government farms, the department has also trained and equipped stud breeders who are progressive farmers that have been supplied with pure Dorper sheep for breeding so that they supply breeding stock to farmers in their locations.

Opportunities in the sheep industry

Malawi as a country has enormous opportunities in the sheep industry. For example, before the COVID-19 pandemic, the country was exporting goat meat to the middle east. Malawi small ruminants are much sought after because the production system is mostly extensive thus closer to organic production.

Climate change with its impact on feed and water availability has enabled small ruminants to thrive much better than large ruminants because the nutritional requirements for small ruminants are relatively lower.

Another opportunity is the political-will that has prioritized livestock production amongst the key sectors. To this effect government has included small ruminants in its Affordable Input Programme where other than just the usual seed and fertilizers, farmers now have an option to buy breedable goats at subsidized prices. Concerned with the lack of private sector investment in the sheep value chain, Government has taken it upon herself to invest into livestock mega farms which are large scale farms for livestock production with a commercial trajectory.

Another opportunity is that the National Livestock Development Policy (2021–2026) has prioritized commercialization of the livestock sector as its Key Priority Area number 1 having seen that the sector has very little private sector investment.

Although domestic mutton consumption is low, Malawi is a touristic destination as such the hospitality industry offers a lucrative market for mutton.

Threats/Constraints in the sheep industry

Despite sheep as small ruminants having similar attributes to goats have faced social constraints that have over the years led to the stagnation of the sheep population in Malawi. Among the social threats are;

The strong association of sheep to religious beliefs that sheep is a holy animal as such sheep slaughters and consumption is limited obviously leading to low investment in the sheep industry since market is a challenge due to low consumption.

Some emerging and re-emerging disease outbreaks: frequent disease outbreaks amidst shortage of qualified veterinary staff leading to wanton use of antimicrobials which has led to anti-microbial resistance.

Climate change has also led to feed scarcity and thus posing nutritional challenges to sheep production.

Production system is mostly extensive as such growth rates are relatively low.

Sustainability

Among the sheep production sustainability measures that government of Malawi has put in place include;

Capacity building for staff and farmers in good husbandry practices.

Organisation of farmers into Cooperatives so that they have more bargaining power on prices for their animals and animal products.

Promotion of integrated farming to facilitate recycling of residues and wastes across enterprises.

Breeding programmes that promote more adaptable breeds like the indigenous unlike the exotic breeds.

Promotion of adaptable, fast growing and highly productive fodder species.

doi: 10.1016/j.anscip.2023.01.277

Animal - Science Proceedings 14 (2023) 208–281

Contents lists available at ScienceDirect

Animal - Science Proceedings

journal homepage: www.elsevier.com/locate/anscip

10th International Sheep Veterinary Congress (ISVC 2023) – Posters

ISVA: Sustainability

P-001
Tumors in small ruminants: A retrospective study

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Keywords: Sheep; Goats; Tumors; Diagnostic

Introduction
The aim of this study was to describe investigations and outcome of small ruminants admitted to the clinic with a tumor disease.

Material and methods
Selected dates according medical history, physical examination and results of further examinations such as imaging techniques, histological examination of tissue samples and post mortem investigations (e.g. histopathological results of the grade and histogenetical of the tumor) from patient records of sheep and goats suffering from a tumor disease were collected and evaluated from the "Animal Hospital Information System Vienna" between 2010 and 2021. Statistical analysis included cross table, qui quadrat test, analysis of variance, mann - whitney tests and correlation analysis.

Results
Eighteen goats with an average age of 10.6 years and 9 sheep with an average age of 10.1 years were diagnosed with tumors. The tumor was graded into 20 malignant (12 goats/8 sheep) and two benign (2 goats), whereas the type of the tumor of 5 animals were not determined. On average the goats with malignant tumors were reported ill for 16.4 days, sheep for 38 days respectively before they arrived at the clinic. A statistical association between the nutritional status and the malignancy of the tumor was not found ($p = 0.311$). Clinical examination at admission revealed a suspected diagnosis of tumor in 8 animals, four animals died immediately after admission. Ultrasonography and or X-ray was performed in 23 cases (17 goat/6 sheep), ultrasonography and computed tomography in one goat and in one sheep all three imaging diagnostic techniques had been used. Imagine diagnosis lead to the diagnose neoplasia in 11 goats and in 5 sheep. Moreover in goats 4 tissue samples and1 fine needle aspiration sample for histological examination were obtained. The results of the tissue samples in goats were three giant cell sarcoma (testes/oral cavity/abdominal cavity) a comedocarcinoma (udder) and a spindle cell carcinoma in the lower jaw. Eleven goats and 8 sheep died or were euthanized. Postmortal histopathology examination of the tumors revealed 4 squamous cell carcinoma (2 goats/2 sheep), 4 adenocarcinoma (3 goats/1 sheep), 2 lymphatic leucosis (1 goat/ 1 sheep diagnosed using blood samples), in goats 1 fibrosarcoma , 1 comedocarcinoma, 1 leiomyoma and 1 osteosarcoma and in sheep 1 neuroblastoma, 1 spindle cell sarcoma, 1 chondrosarcoma, 1 pheochromocytoma and 1 sarcoma. In goats histogenetically 57.1% of the tumors were of epithelial and 42.9% of mesenchymal origin and in sheep 33.3% of the tumours were of epithelial, 22.2% of neuroectodermal and 44.5% of mesenchymal origin.

Conclusion
Studies according tumors are rarely reported in the literature. Generally this study should be of scientific interest and also useful for veterinarians in terms especially of diagnosis and prognosis.

doi: 10.1016/j.anscip.2023.01.279

P-002
Annual evolution of NH_3, CO_2, temperature and relative humidity in a concentrated lamb feeding operation, and their relationships with density and mortality rate

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Keywords: Lambs; Feed-lot; NH_3; CO_2

Introduction
The emission of NH_3 and CO_2 in concentrated animal-feeding operations affect animal health and welfare. High levels of NH_3 cause an increase in pulmonary macrophage activity and reduce feed intake, resulting in reduced BW gain. CO_2 is the product of the respiration of the animals, and the microbial degradation of organic materials under aerobic and anaerobic conditions. Increased concentrations of CO_2 and NH_3 and relatively high room temperatures increase the risk of respiratory problems. The aim of ths work was to monitor NH_3, CO_2, temperature (T), and relative humidity (RH) in a concentrated lamb-feeding operation throughout a year, and their correlations with animal density and percentage of mortality.

Material and methods
This work was performed in a concentrated lamb-feeding operation (Franco y Navarro S.A.) in La Joyosa, Zaragoza, Spain (41°45′N,1°5′W). The farm consists of three sheds (70 × 15 m), to house 1750 lambs each. The central shed contains the space for receiving and classifying the lambs according to age, body condition, and weight. Lambs are redistributed and remain stabled in 10 pens (9.5 × 10 m; 200 lambs), until slaughter (25 kg). NH_3, CO_2, T and RH were monitored by two probes, and weekly data were downloaded using an online platform. Pearson's correlation among animal density and percentage of mortality with the studied variables were calculated. Data were codified by season and time of the day, and compared by ANOVA; a post hoc Fisher's least significant difference (LSD) test was performed.

Results and discussion
The highest values ($P < 0.001$) for NH_3 and T were detected in summer, and CO_2 and RH in winter. High correlations ($P < 0.001$) were observed between NH_3 and T (0.991), RH (−0.974) and CO_2 (−0.684), and between CO_2 and T (−0.754) and RH (0.784). Both gases were closely and negatively correlated (−0.684, $P < 0.001$). Mean NH_3 presented a peak in the evening (0.323 ppm at 18:00–19:00 pm); CO_2 presented a morning (718 ppm, 8:00 am) and an evening peak (690 ppm, 22:00). The highest and lowest T were recorded at 18:00 and 7:00, and for the RH, at 17:00 and 8:00, respectively. Maximum mortality was during summer (2.62%). Mean density was not correlated with any of the environmental variables, but mortality rate was correlated ($P < 0.001$) with NH_3 (0.677) and RH (−0.628).

Conclusion and implications
Continuous monitoring of NH_3 and CO_2 levels in this farms constitutes a useful tool to prevent disease caused by deleterious environmental conditions.

Acknowledgements and funding
Proyecto AWR-Aragón (Animal Welfare in Ruminants), PDRAragón 2014-2020. FC was funded by ANID/Doctorado-Becas Chile/2020-72210031.

doi: 10.1016/j.anscip.2023.01.280

P-003
Effect of moderate altitude hypoxia on NRBC numbers and PLT/MPV ratio in pregnant ewes having low or high hematocrit values

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Keywords: Nucleated red blood cells; Platelet- to- mean platelet volume; Hypoxia; Ewes

Introduction
The object of the present study was to investigate changes in nucleated red blood cells (NRBC) numbers and PLT/MPV ratio due to mild hypoxia in pregnant Ile De France ewes with different hematocrit values.

Material and methods
Thirty Ile De France ewes were selected from an experimental herd (n = 110) according to their hematocrit level and were allocated into 3 groups as follows: low hematocrit (LHct) group (hematocrit range −19.7 to 27.9%), high hematocrit (HHct) group (hematocrit range −32.0 to 36.9%) and mean hematocrit (MHct) group (hematocrit range −28.3 to 29.8%). At the end of breeding campaign and immediately after shearing, ewes were transported from the Institute farm (altitude 500 m) to a mountain pasture (altitude 1440 m). Blood samples were taken by jugular venepuncture at the following time points: before transportation (baseline level), on day 7, 20 and 42 after the transport. Nucleated red blood cell numbers (NRBC, %), platelet count (PLT) and mean platelet volume (MPV) were measured via 5 diff VET hematology analyzer.

Results and discussion
Baseline NRBC numbers in LHct ewes were significantly higher as compared to HHct ewes (P < 0.05). NRBC numbers were significantly higher in MHct compared to HHct ewes at d 20 (P < 0.05). Mean platelet count-to-mean platelet volume (PLT/MPV) ratio in LHct and MHct ewes increased significantly at d 20 as compared to d 7 (P < 0.05). There was a significantly higher PLT/MPV ratio in LHct ewes compared to HHct ewes at d 20 (P < 0.05). Mean platelet count-to-mean platelet volume ratio was significantly higher in LHct ewes as compared to HHct ewes and MHct ewes at d 42 (P < 0.05). There was a significant correlation (Pearson's r = 0.495285, P < 0.05) between baseline NRBC (%) and PLT/MPV ratio.

Conclusion and implications
It was concluded that baseline hematocrit level is associated with the changes in NRBC numbers and PLT/MPV ratio, caused by moderate altitude hypoxia.

Acknowledgements and funding
This work was financially supported by Bulgarian National Science Fund (grant KP-06-H26/2,04.12.2018).

doi: 10.1016/j.anscip.2023.01.281

P-004
Chlamydia abortus, Coxiella burnetii, Toxoplasma gondii and Neospora caninum in sheep before and after communal alpine pasturing

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Keywords: Sheep; Antibodies; Abortion; Pasturing

Introduction
The aim of this study was to estimate the prevalence of antibodies against Chlamydia abortus, Coxiella burnetii, Toxoplasma gondii and Neospora caninum and to determine the influence of alpine pasturing on the seroconversion of antibodies against Chlamydia abortus, Coxiella burnetii, Toxoplasma gondii and Neospora caninum in sheep in a local district in Austria.

Material and methods
Ewes were sampled for serum in March (n = 236) and September (n = 236). Sheep were pastured with their lambs on communal alpine pasture in Styria at an altitude of from 1,500 to 2,150 meters above sea level. The total size of the area was 271 hectares including 95 hectares of pure pasture during the summer. In total, 236 adult sheep, identifiable by individual earmarks, were enrolled in the study. Blood samples were taken from the Vena jugularis (Vacuette® Blood Collection Tubes; Greiner Bio-One GmbH; Austria) and centrifuged immediately after collection. Serum was analysed by commercial ELISAs (Chlamydiosis Total antibody testkit, Q Fever antibody testkit, Toxotest antibody testkit, Neospora X2 antibody testkit; all kits Idexx; Austria) for the presence of specific antibodies according to the manufacturer's instructions. Descriptive and inferential statistics were calculated using Microsoft® Excel 2010 and IBM SPSS Statistics (Version 24.0). In order to compare the results of the ELISA before and after pasturing, a cross table was compiled. Furthermore, a Chi-square test was carried out to determine the significance. The kappa coefficient was also calculated. For all analyses a p-value < 0.05 was regarded as significant. In addition Wilcoxon Test were performed.

Results and discussion
Chlamydia abortus Before pasturing 22.03% (n = 52) of samples were negative. After pasturing 78.80% (n = 41) of these 52 negative sample were still negative and 21.20% (n = 11) show a seroconversion to positive. These seroconversions during alpine pasturing were not significant (p = 0.203). Coxiella burnetii At the first time of sampling 99.60% (n = 235) animals were antibody negative. At the end of pasturing one animal (0.40%) showed a seroconversion to positive. This change was not significant (p = 0.562). Toxoplasma gondii Specific antibodies were detected in 82.28% before and 82.70% after alpine pasturing. Serum samples of 12 sheep antibody negative, or questionable, before alpine pasturing showed a definite positive result after pasturing. In contrast 11 tested serum samples that positive before pasturing showed a negative result after pasturing. Neospora caninum Specific antibodies could not be found in any of the investigated samples.

Conclusion and implications
Results of this study show that Chlamydia abortus and Toxoplasma gondii are wildly spread in the investigated area. The risk of an infection during pasturing could not be statistically proven, but also not excluded. There were no problems of abortion in the investigated area.

doi: 10.1016/j.anscip.2023.01.282

P-005
Ovine mastitis through a welfare perspective and reporting characteristics

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Keywords: Behaviour; Clinical studies; Mastitis; Pain

Introduction
A valid assessment of animal welfare is important in all aspects of animal science. The evaluation of behavioural recordings constitutes an important means for assessing and decoding animal behaviour, as the physical, social and physiological status of a sheep provides fundamental details about their welfare. The objective of this presentation is to discuss various possible effects of mastitis through the perspective of 'social' and 'physical' status of sheep life, based on welfare implications and indications.

Material and methods
A search was conducted in the Web of Science platform, using the terms 'mastitis' and 'welfare'. The reporting quality of the 22 articles that fulfilled the search terms, was assessed using the 22-item checklist of REFLECT statement: score 1 for adequate or 0 for inappropriate decription.

Results and discussion
Scientific interest in interaction of ruminant mastitis and welfare has been constantly increasing during recent years. Various protocols for recording and evaluating relevant welfare have been proposed as useful research tools. Scientific research on assessment of animal welfare relies mainly on recording and analysing behaviour; thus, it is prone to possible errors and bias. In the relevant papers, the average score based on the REFLECT principles was computed to be 11.6 ± 0.6 per paper. Impact of mastitis on animal welfare can be assessed at individual, societal and managerial approach in sheep. Animal-based changes in physical condition and behaviour of sheep, e.g., lameness, allodynia, depression, are key manifestations of the infection in affected animals. Reduced milk production, increased culling of ewes, reduced lamb growth and high treatment costs are consequences of mastitis, but also be used as indicators of the farm status during welfare assessment.

Conclusion and implications
Health, safety and respect for animal welfare are important concerns in an increasingly demanding market of animal products. In response to this, understanding, assessing and improving animal welfare at farm level are still vague issues. Development and establishment of guidelines regarding farm welfare assessment ensure ideal practices in revealing, treating and relieving sheep from health problems, including mastitis. This is of concern for improvement in the quality standards in sheep health management. Animal trials with observation recordings are a reservoir of information for understanding and accessing animal behaviour. Further publications of relevant articles will contribute to better understanding the association of animal welfare with mastitis in sheep flocks. Researchers, practitioners and farmers are morally obligated in relieving ewes form mastitis and the resulting pain. Science provides innovative means for decoding animal behaviour and monitoring animal health and husbandry. The arsenal of animal science provides integrated solutions for animal pain assessment and management removing aversive experience of pain and reduce subsequent morbidity and mortality consequently to the infection.

doi: 10.1016/j.anscip.2023.01.283

P-006
Meat quality of lambs finished in confinement or on native grasslands with greater or lesser presence of legumes

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Keywords: Antioxidant; Tannin; Tocopherol; Pampa biome

Introduction
Consumers are increasingly interested in getting quality meat from sustainable agricultural practices. In the southern region of Brazil, sheep meat production is characterized almost exclusively by production in pastoral systems, and the majority is present in the Pampa biome, one of the richest biomes in terms of biodiversity in the world, with 450 species of forage grasses and more than 150 species of legumes. This vegetation containing representatives of several botanical families produces a forage containing more secondary compounds, with emphasis on *Desmodium incanum*, a native legume with great amounts of condensed tannins and α-tocopherol (vitamin E), which have great potential for improving meat quality due to their antioxidant characteristics. This study investigated the effects of the finishing system and the presence of legumes in the diet on meat antioxidant vitamins, cholesterol content and lipid oxidation.

Material and methods
Twenty-four castrated male Texel lambs with an average of 150 days of age and initial live weight of 28.36 ± 1.37 kg were randomly assigned into three treatments: (1) lambs finished in confinement (Confinement); (2) lambs finished in native grasslands with a low proportion of legumes (Grass) and (3) lambs finished in native grasslands with a high proportion of legumes (Legume). After 82 days of exposure to dietary treatments, all animals were slaughtered with an average final weight of 34.46 ± 1.33 kg and the *longissimus thoracis et lumborum* muscle was removed from the right side of each carcass, vacuum packed, and stored at −30 °C. Lipid oxidation was measured on days 0, 3, 6 and 9 of refrigerated storage. Analyzes of variance were performed and means were compared by Tukey's test at a 5% level of significance.

Results and discussion
The deposition of α-tocopherol in the muscle was higher in animals finished on native pastures ($P < .0001$), with values of 2.67, 2.63 and 0.88 mg/kg for the Grass, Legume and Confinement treatments, respectively. Dietary treatments did not affect the deposition of γ-tocopherol and muscle cholesterol content ($P > 0.05$). Lipid oxidation after 9 days of storage was significantly lower ($P = 0.0008$) in lamb's meat finished on natural grasslands (0.20 and 0.21 mg MDA/kg meat in the Legume and Grass treatments, respectively), compared to the Confinement treatment (0.67 mg MDA/kg meat).

Conclusion and implications
In conclusion, finishing lambs on natural pastures is an alternative to improve the oxidative stability of the meat, due to a significant increase in the deposition of muscle α-tocopherol and a decrease in the lipid oxidation after 9 days display. In addition to preserving and enhancing the sustainable exploitation of native pastures in the Brazilian Pampa, which is the second most devasted biome in the country.

doi: 10.1016/j.anscip.2023.01.284

P-007
The effect of combining melatonin and progestogens sponges in Assaf ewes for out-of-season breeding

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Keywords: Melatonin; Pregnancy rate; Assaf; Out-of-season breeding

Introduction
Melatonin implants have been widely used to advance the breeding season of anoestrous ewes and goats. They induce high plasma concentrations of melatonin for 24 h every day, without suppressing the endogenous secretion of the pineal hormone during the night.
The combination of progestogens sponges and melatonin for out-of-breeding season should have the ability to maximize the pregnancy rate and reduce the lambing spread of the treated ewes, in this study the hypothesis that Melovine® administration one month before mating improves fertility performances of Assaf ewes was tested.

Material and methods
552 mature Assaf ewes were synchronized using either a 7-day or a 14-day progestagen-based program starting on April 2021.
On 300 ewes a melatonin implant (Melovine® 18 mg, natural melatonin, CEVA Sante Animale, Libourne, France) was administered at the base of the ear, 34 ± 2 before mating start day group called Melovine®+Sponges, all the ewes 16 or 9 days before mating start date received a 30–mg fluorogestone acetate (FGA) vaginal sponge (SYNCHRO-PART® 30 mg, CEVA) and at sponges removal the injection of 480 IU of eCG (SYNCHRO-PART PMSG®, CEVA).
Males were introduced to the ewes 48 h after the sponges' removal and kept for 40 days. Pregnancy establishment was evaluated by transabdominal ultrasonography 30 to 40 days after rams removal.
Data were analyzed using a non-parametric fisher exact test for two proportions.

Results and discussion
The use of Melovine® ~30 days before rams introduction in synchronized Assaf ewes, increased the fertility of the treated animals; 84% of Melovine®+Sponges treated ewes became pregnant (252/300) vs the 65% of the ewes that only received sponges and PMSG (145/222), ($p < 0.00001$).

Conclusion and implications
From the results achieved in the current study, the administration of Melovine® 30-days before rams introduction improves significantly the pregnancy establishment in out-of-breeding season synchronized Assaf ewes.

doi: 10.1016/j.anscip.2023.01.285

P-008
Influence of age and breed of sheep on the prevalence of *Salmonella enterica* subspecies *diarizonae* serovar 61: k: 1, 5, (7) in sheep

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Keywords: Prevalence; Salmonella; Sheep; Age

Introduction
Salmonella enterica subspecies *diarizonae* (IIIb) serovar 61:k:1,5,(7) (SASd) is considered to be sheep-associated, as it can be found in clinically healthy sheep. However, it has also been described as the causative agent of chronic proliferative rhinitis in sheep. In a comprehensive study in Thuringia, a federal state of Germany, pooled faecal samples from 74 (82.2%) of 90 sheep flocks were tested positive for SASd. Other *Salmonella* serovars were not found. The aim of this study was to gain insight into the intra-herd prevalence in sheep flocks of different breeds in various regions of Thuringia. Furthermore, the age at which sheep become infected with SASd was studied.

Material and methods
From 2019 to 2022, adult animals of different ages and breeds from 13 sheep flocks in different counties of the federal state of Thuringia were examined. Sample size was calculated to detect a within-herd prevalence of 5% with 95% confidence. In one of the flocks examined, 93 suckling lambs of ewes that were sampled in the last month of pregnancy were also examined. The suckling lambs were tested five times until an age of 6 weeks, at an age of 6 month, as hoggets and as adult ewes. Both, nasal swabs and corresponding faecal samples from each individual animal were taken for microbiological analysis.

Results and discussion
SASd was detected in all of the examined adult sheep flocks. On average, 74% (14–100%) of the adult animals per flock showed at least one positive nose or faecal result. However, in two breeds (Krainer Stone Sheep, Soay Sheep), there were significantly lower positive results than in the others.
Based on the herd in which both pregnant ewes) and their progeny were examined, it can be seen that there are significantly fewer positive results in the suckling lambs than in their mothers. There was a positive correlation between the age of the animals and the proportion of SASd positive animals in the respective age group. However, for adult animals we did not observe an association between a positive result of the sheep and age, nutritional status, spatial clusters or the presence of diarrhea and nasal discharges.

Conclusion and implications
While in the flocks with the dominant "production" breeds in Thuringia the proportion of SASd positive sheep is between 53% and 100%, in the flocks with rare or original breeds it is only 14% and 38%. Further investigation would be necessary to confirm this preliminary observation.
The majority of lambs become infected with SASd in the first 6 months of life. Thereafter, the incidence in the herd remains consistently low and the prevalence consistently high.

doi: 10.1016/j.anscip.2023.01.286

P-009
Welfare and biosecurity evaluation in dairy goat farms

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Keywords: Welfare; Biosecurity; Dairy goat; Check-list

Introduction
The Italian Reference Centre for Animal Welfare (CReNBA), has developed several protocols for animal welfare and biosecurity assessment on-farm, using expert knowledge elicitation. These protocols, endorsed by the Italian Ministry of Health, have been used for the development of the ClassyFarm platform. The protocol for dairy goats was applied to 33 goat farms within a research project, funded by the Italian Ministry of Health, aiming at improving the knowledge on goat welfare and biosecurity and to assess serological prevalence of Paratuberculosis (PTB), Caprine arthritis and encephalitis (CAE), Contagious agalactia (CA) and Caseous lymphadenitis (CLA) in goat farms.

Material and methods
The study was conducted in 33 dairy goat farms in northern Italy over a three-year period (2019–2021). Welfare and biosecurity were assessed using the specific check-list (57 items), which includes animal-based, management-based and resource-based indicators. Scores from 0% (very poor) to 100% (very good) were assigned to 5 sections: (A) ''management and staff training''; (B) ''housing and equipment''; (C) ''animal-based measures''; ''biosecurity'' and ''emergency management''. The collected data were uploaded to the CReNBA IT platform. Based on the item scores, the IT system calculated the percentage values of each section and the overall welfare score of the farms (considering sections A, B and C). The section values and the overall welfare score were judged satisfactory if $\geq$60%. In all the farms, serological analysis to detect antibodies against PTB, CAE and CA were performed (commercial ELISA test); 25/33 farms were also tested for CLA (home-made ELISA test).

Results and discussion
Welfare scores of the farms varied from 39.5% to 90.7%: 8/33 (24.2%) had low scores (<60%), 25/33 (75.8%) were satisfactory (>60%), but with room for improvement (20 farms between 60% and 80%). In detail, 10/33 farms (30.3%) resulted not satisfactory in (A), 18/33 (54.5%) in (B), 9/33 (27.3%) in (C), 19/33 (57.6%) in ''biosecurity'' and 11/33 (33.3%) in ''emergency management''. Biosecurity and (B) section were identified as the most critical, in particular the major weaknesses concerned ''contact with other animal species'', ''vehicles management'', ''feeding space'' and ''space availability for adult goats''. About serological analysis, 6/33 (18.2%) farms were positive for CA, 19/33 (57.6%) for PTBC, 19/33 (57.6%) for CAE, 16/25 (64%) for CLA, confirming the high prevalence of these diseases in goat farms.

Conclusion and implications
This study highlighted 1) the importance of using a valid and feasible system to evaluate goat welfare and biosecurity and 2) the presence of important critical points, like biosecurity management and space availability, in goat farms in northern Italy.

Funding
This research was funded by the Italian Ministry of Health grant RICERCA CORRENTE IZSLER 005/2018 ''Analysis of dairy goat production parameters and correlation to animal welfare levels in farms''.

doi: 10.1016/j.anscip.2023.01.287

P-010
Life cycle assessment of an endangered sheep breed in traditional extensive farming in mountain grasslands

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Keywords: Life cycle assessment; Carbon sequestration; GHG emissions; Climate change mitigation

Introduction
Traditional extensive systems are threatened by different problems which lead to their disappearance. The extensive systems of small ruminants are scarcer year by year, farms have more animals and are changing to intensive systems.
The abandonment of grazing has consequences for pastures' ecosystems because grazing extensive farming systems model pasturelands and at the same time, each territory models its own farming system.

Material and methods
This study has been conducted collecting data from 28 Lojeña extensive sheep farms in Sierra the Loja region (a hilly area with Mediterranean climate), which are 90% of farms within the native territory of this endangered sheep breed. The studied farms produce lambs at weaning (13.7 kg of live weight (LW) and 68 days old), and only some farms (28.5%) produce fattened lambs (23 kg_{LW} and 112 days old).

The Life Cycle Assessment (LCA) methodology has been followed to perform an environmental analysis. The enteric fermentation and manure handling emissions have been calculated using Tier 2 equations following the IPPC guidelines and Spanish National GHG Inventories. The not differentiable emissions have been assessed by economic approach and environmental impacts have been calculated with Ecoinvent 3, Agri-footprint and ELCD databases. The limit of the system has been "cradle to gate". The carbon sequestration of the system has been calculated according to Tier1 equations of IPCC.

Results and discussion
The carbon footprint (CF) of Lojeña weaned lambs is 27.23 ± 7.03 kg CO_2eq kg_{LW}^{-1}, and the CF for fattened lambs is 24.03 ± 13.86 kg CO_2eq kg_{LW}^{-1}, with the enteric fermentation representing the main cause of GHG emissions in both cases.
These results are consistent with the data shown in previous studies for lamb production in Mediterranean pastures. However, the results of Lojeña farms are not homogeneous because there are farms with negative CF (18% of farms) and others (4%) doubling the average CF of this breed population, with a direct relationship between CF and stocking rate (SR).

Conclusion and implications
In conclusion, this is the first study calculating the CF of near the whole population of an endangered sheep breed. The C sequestration offset the total emissions in some farm and to reduce SR would be the way to increase C sequestration to mitigate climate change.

Acknowledgements and funding
The authors are grateful to Asociación de Ganaderos Criadores de la raza ovina Lojeña del Poniente Granadino and every farmer who have provided data for this study.
This work was supported by the project Análisis de Ciclo de Vida de los productos procedentes del ovino de raza Lojeña (contract 12021118).

doi: 10.1016/j.anscip.2023.01.288

ISVA: General diagnosis to reduce Antibiotic usage

P-011
Surveillance of multidrug-resistant *Staphylococcus Aureus* in raw milk of lactating sheep in Khyber Pakhtunkhwa, Pakistan

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Keywords: Antimicrobial resistance; Mastitis; Resistance genes; Staphylococcus aureus

Introduction
Mastitis is an inflammation of the udder tissue associated with animal health and welfare concern. It is the most widely spread disease of dairy industry worldwide. *Staphylococcus aureus* is a gram-positive bacterium, responsible for causing subclinical mastitis affecting the milk quality, quantity, and health of dairy sheep, as well as causing huge economic losses. In veterinary medicine, the long-term use of antimicrobial drugs may contribute to the development of pathogenic antimicrobial resistant strains which constitute a major concern including not only to farm animals but for human health as well. The main objective of this study was to determine the antimicrobial resistance pattern of *S. aureus* and the detection of *mec*A and *tet*K genes.

Material and methods
A total of 150 milk samples were collected from mixed breeds of lactating sheep raised under sedentary and transhumant system from northern Pakistan. These samples were then screened for *S. aureus detection*. The positive samples were then evaluated for antimicrobial resistance by disc diffusion method. During antibiotic susceptibility testing eight samples were found resistant to Methicillin and Tetracycline and were confirmed by polymerase chain reaction. The resistant genes were amplified and after successful amplification the obtained PCR amplified product were checked for bands on gel electrophoresis.

Results and discussion
Out of total 150 samples, 35 (23.3%) samples were found positive for *S. aureus*. Methicillin resistance gene (*mec*A) was detected in six samples out of eight having a percentage of 87.5%. Tetracycline resistance gene (*tet*K) was found in five samples out of eight having a percentage of 62%.

Conclusion and implications
It is concluded that *mec*A and *tet*K are most prevalent resistance genes in the sheep and the reason for this resistance could be the overuse of antibiotics in veterinary practices. It is recommended that sheep farmers need awareness of adequate antibiotic usage in diseased sheep because resistant strains among dairy sheep may pose a danger to human health owing to the possibility of ingesting contaminated food, mainly raw milk.

Acknowledgements and funding
We are thankful to the owners of the sheep for allowing us to collect samples and data collection.

doi: 10.1016/j.anscip.2023.01.289

P-012
Udder defects and bacterial infection of farmed goats in Hong Kong

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Keywords: Mastitis; Small ruminant; Milk microbiological culture; Minimum Inhibitory Concentration (MIC)

Introduction
Unlike for cows and sheep, there is limited literature on udder defects of goats globally and none in Hong Kong. However, it is equally important to investigate udder defects in goats as they are one of the most common species of livestock across the globe. Udder defects can lead to pain or premature culling of does and their offspring, and therefore has important welfare implications. This study was undertaken to address local knowledge gaps by determining the prevalence and types of udder defects in Hong Kong goats, as well as identifying the bacterial species present in their milk and their antimicrobial susceptibility.

Material and methods
Thirty-four does from two smallholder goats farms in Hong Kong were involved. This prospective cross-sectional study utilized non-invasive methods to detect udder defects via visual inspection and palpation of goat udders. Milk was collected for California Mastitis Test (CMT) to screen for mastitis and for microbiological culture to identify udder bacterial pathogens and their antimicrobial susceptibility through Minimum Inhibitory Concentration (MIC) testing. Descriptive statistics were used in this study since qualitative data was involved.

Results and discussion
Udder defects identified include supernumerary teats (69.2%), scabs (7.7%), lumps (7.7%), asymmetry (3.9%), pendulous udder (3.9%), hard gland (3.9%) and subclinical mastitis (3.9%). Species of *Staphylococci, Streptococci*, *Brevibacterium, Corynebacterium,* coliforms, *Micrococcus luteus* and *Bacillus arsenicus* were detected in the milk samples. Such findings are similar to the types of visible and palpable udder defects, as well as udder bacterial pathogens identified in overseas studies. The MIC results for the tested bacterial isolates of *Staphylococcus* species showed antimicrobial susceptibility to most antibiotics, but resistance was detected against Doxycycline and Tetracycline in particular, thus careful antibiotic selection of drugs is important for treatment of mastitis to prevent development of antimicrobial resistance.

Conclusion and implications
The pilot data obtained in this study can reinforce overseas literature as it identified similar udder defects and pathogens in Hong Kong goats. Farmers should routinely examine does for udder defects as these can be detrimental to their wellbeing and productivity, predisposing them to further development of mastitis. MIC results indicated there is a wide range of effective treatment options for Hong Kong goat farmers since the Staphylococcus species isolated showed sensitivity towards most of the tested antibiotics. Resistance was however detected against some antibiotics; thus it would be recommended to avoid using these antimicrobial agents when treating mastitis caused by Staphylococcus species. Ideally, local farmers will base the treatment of their goats on milk culture results, interpreted in conjunction with their veterinarian.

doi: 10.1016/j.anscip.2023.01.290

P-013
Evaluation of the oxytetracycline concentration in milk after intramuscular administration in healthy and naturally infected with *Streptococcus uberis* Sarda ewes

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Keywords: Sheep; Mastitis; Antibiotic; Intramammary infection

Introduction
Mastitis is the most prevalent disease in dairy farming associated with antimicrobial usage and the related risk of antimicrobial drug resistance development. Unlike for cows, pharmaco-kinetic/-dynamics (PK/PD) studies on sheep are lacking, also for older antibiotics such as tetracyclines, still widely administered today in veterinary practice. Aim of this study was to evaluate the OTC concentration in the half-udder milk from 10 healthy Sarda ewes and 10 naturally affected by *Streptococcus uberis* mastitis.

Material and methods
Five milliliters of an oxytetracycline-dihydrate formulation (OTC) (217.4 mg/ml, equivalent to OTC 200 mg/ml corresponding to 20 mg/kg body weight) were inoculated by intramuscular injection in the semitendinosus/semimembranosus muscle according to the manufacturer's (Pfizer Inc., US) instructions at Time 0. Milk samples were collected every 12 hours for the first 7 days, and then once a day until the 20th day after administration. Animal testing was approved by the Italian Ministry of Health. OTC detection was performed using the ultra-high-performance liquid chromatograph high-resolution mass spectrometer technique. Non-parametric statistical analysis (i.e., Wilcoxon matched-pairs sign-rank test) was performed to investigate intergroup differences of antibiotic milk concentration between healthy and infected sheep during the follow-up.

Results and discussion
No statistical difference was observed in median [interquartile range] OTC concentration in the udder at 12 h after inoculation between healthy (2.7[2.2–3.0] mg/Kg) and infected (2.7[1.6–3.9] mg/Kg) ewes. A significantly higher ($P < 0.05$) OTC content in milk from infected animals starting from 24 up to 204 h after the antibiotic administration was noted; in particular, a prolonged plateau-like curve was observed in the infected mammary gland from 12 h to 48 h before the onset of the decrease, while the drop curve started after 12 h in the healthy animals. At 48 h the recorded OTC concentration was 2.9 [1.4–4.6] mg/Kg and 0.5 [0.5–0.6] mg/Kg corresponding with the largest difference between experimental groups; however, a wider intra-group variability of antibiotic distribution must be highlighted in infected animals compared to healthy ones. These findings could be linked with the pH value increasing in mastitic milk and with the increased permeability of the blood/milk barrier due to the damage of the mammary gland tissue. The efficacy of mastitis treatment could depend on the passage of the drug from blood to milk; therefore, the serum concentration of antibiotic cannot be associated to the therapeutic efficacy expected in the sites separated from the blood by physiological barriers.

Conclusion and implications
No evidence-based information about PK/PD and its association with specific clinical breakpoints are available for small ruminants; more research must be promoted on this topic to improve knowledge about species-specific PK/PD data on drug concentration in the tissue/liquid of the host and the clinical outcomes.

Acknowledgements and funding
In memory of Dr. Cecilia Testa. Research funded by the Italian Ministry of Health.

doi: 10.1016/j.anscip.2023.01.291

P-014
Study of the antibiotic sensitivity pattern and molecular characterization of *Staphylococcus aureus* strains isolated from mastitis in sheep and goats in Spain

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Keywords: Staphylococcus aureus; Mastitis; Antibiotics; PCR

Introduction
Staphylococcus aureus (S. aureus) is a Gram-positive bacterium and opportunistic pathogen. In milk-producing ruminants, is often the main cause of mastitis, generating considerable economic losses in the dairy industry, as it causes a substantial reduction in milk production and quality.
The aim of this study is to characterize both phenotypically and genotypically *S. aureus* isolates from different farms in order to find a solution to the rising mastitis problem and to understand the resistance profile of the isolates present in livestock.

Material and methods
The origin of the samples varied from abscesses to clinical, subclinical mastitis or unknown origin. A total of 82 isolates were collected.
For the strains characterization, different PCRs were performed to amplify the *mecA* (methicillin resistance) gene, the *clfA* (clumping factor A) gene and the agr subgroups (I, II, III or IV).
For antibiotic sensitivity testing, antibiograms were performed. The antibiotics tested were: ciprofloxacin, penicillin G, streptomycin, vancomycin, enrofloxacin and cloxacillin.

Results and discussion
Of the total isolates, 66 were of ovine origin compared to 15 of caprine origin and one of unknown origin.
The agr system was detected in 91% of the isolates, being more common type II with 65.5% and type I with 15.5% and less common type III and IV with 7.2% and 1.2% respectively. The agr system is widespread among clinical strains, agreeing with previous results (Cheung et al., 2021).
Regarding the presence of the *mecA* and the *clfA* genes, we obtained 14.5% and 80.7% of positives respectively. Only 9.6% of the isolates showed the presence of both genes. A low percentage of strains had the *mecA* gene (resistant to methicillin, MRSA). However, other studies indicate that the presence of *S. aureus* MRSA strains is increasing (Lowy, 2003).
The percentages of antibiotic resistance obtained were 6.9% for ciprofloxacin, 15.7% for penicillin G, 6.9% for streptomycin, 91.8% for vancomycin, 34.3% for enrofloxacin and 8.2% for cloxacillin. A low percentage of strains were resistant to beta-lactams (penicillin G, cloxacillin), not coinciding with previous studies (Lowy, 2003). In contrast, the strains in this study were almost entirely resistant to vancomycin, coinciding with previous research (Lowy, 2003).

Conclusion and implications
The agr group and the *clfA* gene were present in a high percentage of the strains tested.
The *mecA* gene was not very common among the strains studied.
A high percentage of the samples tested were found to be resistant to vancomycin.
Ciprofloxacin, streptomycin, cloxacillin and penicillin G had the lowest resistance rates.

Acknowledgements and funding
This investigation was supported by SYVA S.A.U. Laboratories.

References

Cheung, G., Bae, J.S., Otto, M., 2021. Pathogenicity and virulence of *Staphylococcus aureus*. Virulence 12 (1), 547–569.
Lowy, F.D., 2003. Antimicrobial resistance: the example of *Staphylococcus aureus*. J. Clin. Investigat. 111 (9), 1265–1273.

doi: 10.1016/j.anscip.2023.01.292

P-015
Experimental study for evaluation of the efficacy of a biofilm-embedded bacteria-based vaccine against *Staphylococcus chromogenes*-associated mastitis in sheep

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Keywords: Biofilm formation; Slime; Subclinical mastitis; Udder health

Introduction
The objective of this study was to evaluate the efficacy of a vaccine for protection of ewes against staphylococcal mastitis in an experimental setting. The vaccine antigen was based on a bacterin of a *Staphylococcus aureus* strain, expressing the exopolysaccharide poly-N-acetylglucosamine (PNAG) involved in biofilm formation by staphylococci.

Material and methods
Ewes in group A (n = 17) or B (n = 6) were vaccinated initially five weeks before expected lambing and given a repeat vaccination 21 days later. Ewes in groups C (n = 8) or D (n = 6) remained unvaccinated. Ewes in group A or C were challenged with a biofilm-forming *S. chromogenes*; animals in subgroups A1 or C1 were challenged intramammarily on 10th and those in A2 or C2 on 50th day post-lambing. Ewes in groups B or D remained uninoculated. The following examinations were performed: clinical examinations of animals, ultrasonographic assessment of udder, milk yield measurements, blood sampling for anti-PNAG antibody detection (ELISA), milk sampling for bacteriological and cytological examinations (conventional techniques). The animals were monitored for 52 days post-challenge. Biopsies were performed for mammary tissue collection for histopathological examination. The following statistical tests were employed according to the type of data: analysis of correlation, analysis of variance, Fisher's exact test, Kruskal-Wallis test, linear mixed models, Mann-Whitney test, Pearson's chi-square test and Wilcoxon sign-rank test.

Results and discussion
Among group A ewes, 29% developed systemic signs and 59% clinical signs in the inoculated gland; the respective figures for group C were 50% and 100% (p = 0.040 for mastitis signs). Median total clinical score was 2.0 for A and 5.5 for C ewes (p = 0.025). For A, but not for C ewes, clinical scores decreased progressively during the study (p = 0.018 and p = 0.47, respectively). Duration of mastitis was shorter in A (4 days) than in C (17.5 days) ewes (p = 0.022). Bacterial counts were lower in milk samples from A than from C ewes, for samples collected from the inoculated and the uninoculated (p < 0.01) mammary glands of these ewes. Somatic cell counts in samples from inoculated and uninoculated mammary glands of A ewes were higher than in samples of C ewes (p < 0.02). There were differences for grey-scale evaluations during ultrasonographic examination and for milk yield measurements between groups (p < 0.01). Median bacterial counts in tissue samples from A ewes (0 cfu g^{-1}) were lower than in samples from C (6.5 cfu g^{-1}) ewes (p = 0.041). Median score for histopathological findings in tissue samples from inoculated glands of A was lower than that for C ewes: 1 *versus* 2 (p = 0.014).

Conclusion and implications
The results indicate a protective efficacy of the test vaccine against mastitis, as indicated by a wide array of measures. Nevertheless, vaccination should not be the only means for controlling mastitis.

doi: 10.1016/j.anscip.2023.01.293

P-016
Bacterial prevalence in sheep conjunctiva

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Keywords: Conjunctiva; Bacteria; Bacteriology; Sheep

Introduction
The identification of conjunctival microflora is important in order to understand its influence in the development of keratoconjunctivitis. There are only a few reports describing the normal microflora of the ovine conjunctiva. The aim of the study was to determine the conjunctival bacteriological flora in clinically healthy sheep with conjunctivitis incidence in the herd during the last five years in Latvia.

Material and methods
In total 120 adult sheep, from six farms, twenty from each flock were randomly selected. Conjunctival swabbing from both eyes lower eyelid conjunctiva was wiped from the medial corner of the eye to the lateral side and immediately placed in a coal-free transport medium. All samples were transported to the accredited laboratory at 4 ± 2 °C within 4–6 hours for further standard bacterial isolation (Markey et al., 2013). Data processing was performed using Microsoft Excel and Manova test in SPSS (Version 23) software. Significance level p < 0.05 was used.

Results and discussion
Of all samples (n = 240) 22.92% (n = 55) were negative but in 57% (n = 137) there was one, 17.92% (n = 43) two, 1.67% (n = 4) three, 0.42% (n = 1) four bacterial species isolated from the sample and totally 77.08% (n = 185) of samples were positive for at least one bacterial species growth. In all sheep at least in one eye there were at least one bacterial species isolated. Totally 20 different bacterial species were isolated from which 65% were Gram-positive and 35% Gram-negative. In 29.17% (n = 70) of samples were found to contain *Acinetobacter lwoffii*, 19.58% (n = 47) *Bacillus* spp., 13.75% (n = 33) *Moraxella lacunata*, 8.75% (n = 21) *Pseudomonas fluorescens*, 7.50% (n = 18) *Pantoea agglomerans*, 5.00% (n = 12) *Moraxella catarrhalis*, 4.17% (n = 10) *Staphylococcus arlettae* and less that 3% *Staphylococcus lentus* (n = 6), *Streptococcus mitis*/oralis (n = 4), *Streptococcus pyogenes* (n = 3), *Pseudomonas fragi* (n = 3), *Mannheimia haemolytica* (n = 3), *Aerococcus viridans* (n = 2), *Staphylococcus xylosus* (n = 1), *Staphylococcus aureus* (n = 1), *Staphylococcus chromogenes* (n = 1), *Staphylococcus succinus* (n = 1), *Streptococcus pneumoniae* (n = 1), *Moraxella bovis* (n = 1), *Corynebacterium glutamicum* (n = 1). A significant difference in the prevalence of different bacterial species between farms (p < 0.05) were observed. *Acinetobacter lwoffii*, *Pantoea agglomerans*, *Pseudomonas fluorescens* were more isolated in the farms growing local sheep breed, *Moraxella lacunata*, *Bacillus* spp. and individual species of staphylococci and streptococci in the farms working with meat breeds and frequent importing of animals.

Conclusion and implications
We conclude that the prevalence of conjunctival bacterial species differ between farms and sheep species and that animal importing increases the presence of *Moraxella* spp., known as a potentially contributing factor to keratoconjunctivitis development.

Reference

Markey BK et al. 2013. Clinical Veterinary Microbiology. 2nd ed. Mosby Elsevier Ltd. 916p.

doi: 10.1016/j.anscip.2023.01.294

P-017
Identification of aerobic bacteria from palpably defective udder halves and their persistence over time in lactation in non-dairy (Romney) ewes

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Keywords: Aerobic bacteria; Change over time; Non-dairy ewe; Palpable udder defect

The aims of this study were to identify associations between udder half defect (hard or lump) and bacteria isolated from milk samples and to assess persistency of the bacterial species over time during lactation. Milk samples were aseptically collected from each udder half weekly for the first six weeks of lactation (day 7 to day 42), at weaning, and three weeks post-weaning from 46 non-dairy (Romney) ewes (92 udder halves). The ewes had a history of either having udder half defects (n = 70 udder halves), or not having udder half defects (n = 22 udder halves), over the previous two years. The milk samples were cultured, processed, and Matrix-assisted laser desorption/ionization time-of-flight (MALDI-ToF) mass spectrometry was used for bacterial identification. The Chi-square test of independency and multinomial logistic regression were applied for analysis. Almost half of the udder halves did not express milk during the study, ranging from 42.4% (39/92) on day 7 to 47.8% (44/92) three weeks post-weaning. In udder halves that did express milk, the frequency of udder halves that were bacterial culture positive decreased as lactation progressed, with the highest frequency being on day 7 of lactation while the lowest frequency was on the day of weaning. The relative risk ratio (±SE) of an udder half being bacterial culture positive at weaning was significantly less (RRR (SE) = 0.39 (0.45)) than at day 7 of lactation. *Staphylococcus aureus, Streptococcus uberis,* and some coagulase-negative staphylococcus (CNS) species were observed on both one occasion as well as more than two occasions in an individual udder half. However, *Mannheimia haemolytica, S. xylosus,* and *S. pluranimalium* were only isolated from an individual udder half on more than four occasions, apparently indicating persistence of these organisms over time. The association between udder half defect (hard/lump/normal) and bacterial culture positivity (positive/negative) or species involved at each time point was not significant (p > 0.05). But, descriptively *Mannheimia haemolytica, Streptococcus uberis,* and *Staphylococcus aureus* were more frequently isolated from milk from defective udder halves (hard/lump) whereas CNS were more frequently identified from normal udder halves. Overall, the results show that the isolation of bacteria from palpably defective udder halves was higher in the early weeks of lactation, and bacteria persistency over time was dependent on the species of bacteria involved.

doi: 10.1016/j.anscip.2023.01.295

P-018
Modern ultrasonographic techniques (Doppler ultrasonography, contrast-enhanced ultrasonography, three-dimensional ultrasonography, elastometry) in the study and disease diagnosis of the mammary glands of sheep

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Keywords: Diagnosis; Imaging; Sheep; Ultrasonography

Introduction
Ultrasonographic examination is a simple, reliable, non-invasive and non-disruptive imaging technique. Objective of this work is the description of modern ultrasonographic imaging techniques and their application in the study of the mammary glands of ewes.

Material and methods
B-mode ultrasonographic examination of mammary glands can provide information about the dimensions of the organ and the echotexture of the mammary parenchyma; however, it is unable to provide information regarding tissue perfusion and gland functionality. The modern ultrasonographic techniques: Doppler ultrasonography, contrast-enhanced ultrasonography, three-dimensional ultrasonography and elastography, achieve this evaluation and can be usefully applied in ewes.

Results and discussion
Doppler ultrasonography is an accurate method for measurement of mammary blood flow. There are two modalities: colour Doppler, which provides information about localization of vascularization and identification of the type of the vessel, and pulsed-wave Doppler, which provides information about haemodynamic characteristics of blood flow. The technique has been applied in healthy mammary glands and in mammary glands of ewes with mastitis to improve diagnosis, to study pathogenesis of the infection and to monitor the course of treatment. In contrast-enhanced ultrasonographic examination, perfusion by microbubbles is analyzed based on the presence or absence of contrast in the examined tissue in relation to time. A reduced perfusion of the mammary parenchyma by the contrast agent has been associated with reduced amount of functional tissue in cases of long-standing mammary lesions in ewes. Three-dimensional ultrasonography can be useful for visualization and characterization of the mammary gland structures in lactating animals. However, the high cost of the technique, due to the need of using particularly expensive equipment, can be a limiting factor in its application in clinical conditions in sheep health management. Elastography can evaluate the elasticity of tissues, with the aim to increase diagnostic sensitivity of imaging techniques. Several types of elastography techniques can be applied, depending on the force applied to the tissue and its deformation; these include real-time elastography, acoustic radiation force impulse imaging, transient elastography, point shear wave elastography and shear wave elastography. The stiffness or softness of the tissue is transposited in colour mode and subsequently the evaluation of colours and scores of elasticities can be calculated.

Conclusion and implications
Various modalities have been proposed for exporting tissue information of mammary glands of ewes. Of these, Doppler examination is the one mostly used, while the other techniques (contrast-enhanced ultrasonography, three-dimensional ultrasonography and elastography) sofar have had limited application in sheep. The imaging techniques can be used to improve diagnosis of diseases of the udder, which will contribute to improved milk production within the context of sheep health management.

doi: 10.1016/j.anscip.2023.01.296

P-019
Prevention of meconium plug and watery mouth syndrome by colostrum feeding and enema in anorectic newborn lambs

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Keywords: Meconium plug; Enema in anorectic lambs; Watery mouth syndrom; Suckling reflex

Clinical history
According to own experiences with my own flock of Dorper sheep, a ewe will stand up and clean her lamb from mucus with her tongue soon after delivery. Some minutes later a healthy lamb will try to get up and the mother will encourage him to suckle by moving the lamb towards her udder. Most often the ewe will give a massage with her tongue to the anus of the lamb. This stimulates the lamb to suckle and to remove the meconium, which is eaten by the mother. In the past lambing seasons we saw, that if this behaviour is disturbed, lamb might fail to get colostrum with the consequence of meconium plug syndrome or even ileus, eventually followed by watery mouth syndrome.

Investigations
During August to September 2022 in total 108 Dorper gave birth to 141 lambs, of which 7 lambs were stillbirth, and 7 lambs showed anorexia after birth. The lambs probably died due dystocia caused by overweight of the lambs. There was no full time monitoring of the lambing. The 7 anorectic lambs developed a light distended abdomen due to the lack of colostrum and the delayed passage of the meconium. In addition the lambs showed no suckling reflex.
All 7 anorectic lambs were clysterized to remove the meconium and 4 of them were fed with 30 to 50 ml of colostrum by a feeding tube. In all 7 lambs the suckling reflex started within 24 hours after treatment.

Differential diagnosis
Delayed passage of the meconium is often one cause or symptom for watery mouth in lambs, which may occur as consequence of the lack of colostrum. These lambs were anorectic from birth on, due to dystocia. Meconium ileus could not be distinguished from meconium plug syndrome, in which a tenacious mass of mucus prevents the meconium from passing. In humans the failure to pass meconium is a symptom of several genetic defects including Hirschsprung's disease and cystic fibrosis as well as congenital malformations. There are no indications for similar genetic effects in the affected lambs.

Discussion
Enema and colostrum given by feeding tube to anorectic new-born lambs resulted in an increased survival rate. The lack of colostrum in lambs is crucial. Thus there is a circulus vitiosus. Without colostrum no passage of the meconium. Without delivery of the meconium, reduced or missing suckling reflex. Without suckling reflex no colostrum intake. By giving colostrum by a feeding tube and removing meconium by enema this vicious circle can be broken.

Acknowledgements
This study has been supported by Prof. Dr. Martin Ganter, Clinic for Swine and Small Ruminants, University of Veterinary Medicine Hannover, Foundation, Hannover, Germany. ++49 511 8567585, Martin.Ganter@tiho-hannover.de.

doi: 10.1016/j.anscip.2023.01.297

P-020
The validation of a PCR method for *Streptococcus dysgalactiae* infection in sheep and its application for on-farm disease transmission studies

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Keywords: Sheep; *Streptococcus dysgalactiae*; PCR; Infectious arthritis

Introduction
Streptococcus dysgalactiae subspecies *dysgalactiae* (SDSD) is the predominant cause of infectious arthritis, or (joint ill), a debilitating condition of one or more of the synovial joints of young lambs. Not only a welfare concern, joint ill is a major contributor to antibiotic use in the UK sheep industry. Difficult to isolate in mixed bacterial samples by traditional culture methods, the sources and routes of transmission of SDSD to the young lamb have been poorly described. Rapid and reliable, PCR can be a useful additional tool to aid detection and diagnosis of bacterial diseases. Therefore, this study aims to validate a PCR test for SDSD and test its applicability in field sample collection from farms with a history of SDSD joint ill.

Material and methods
Five published primer sets for PCR were compared. To determine a method suitable for screening for the presence of SDSD in clinical isolates, rudimentary testing for strain diversity, sensitivity, specificity, and cross-reactivity was conducted. Further confirmation of primer sensitivity and specificity was conducted by DNA quantification and sequencing of the PCR product, respectively. Swab samples were collected from ewes (vagina (n = 350), faeces (n = 350), and teat skin (n = 349)), joint taps were taken from joint ill lambs (n = 6), and farm environmental samples were collected (n = 253) across 4 farms with a history of SDSD joint ill.

Results and discussion
Two PCR primer sets were successful through initial stages of testing, producing visible bands via agarose gel electrophoresis up to and including a dilution factor of 10^{-3}, from an original 4.4 ng/μl suspension. The PCRs were screened against a panel of 20 different bacterial species, featuring a variety of Streptococcal species, including the closely related subspecies *Streptococcus dysgalactiae* subspecies *equisimilis* (SDSE). No products were formed by either primer set for any of the non-*Streptococcus dysgalactiae* bacteria featured; one PCR was cross-reactive for SDSE and was excluded from the study. 16s sequencing of the PCR product was conducted, confirming a 100% match to known SDSD genomes. The remaining primer set was adapted into a real time approach for screening field samples. The proportion of positive tests from ewe swabs, lamb joint taps, and the farm environment are reported.

Conclusion and implications
Rapid detection of SDSD in clinical isolates aids treatment plans and allows researchers to investigate transmission routes and bacterial sources, without the challenge of relying on culture. Following further validation, the PCR method described could be utilised as a rapid diagnostic tool for the positive confirmation of SDSD in joint ill cases, allowing for suitable treatment and control plans to be prescribed.

Acknowledgements and funding
The author acknowledges funding from University of Liverpool and AHDB Beef and Lamb.

doi: 10.1016/j.anscip.2023.01.298

P-021
Survival of *Streptococcus dysgalactiae* on soil and bedding substrates, and the efficacy of calcium oxide (lime powder) as a disinfectant

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Keywords: Bedding; *Streptococcus dysgalactiae*; Bacterial survival; Infectious-arthritis

Introduction
Streptococcus dysgalactiae subspecies *dysgalactiae* (SDSD) is the leading cause of infectious arthritis (joint ill) in young lambs. The route of transmission is currently unknown, though exposure of lambs to environmental contamination could be a potential source of infection. Enhanced hygiene practices, including bedding/pen management are recommended for prevention, however, outbreaks still occur on farms with good hygiene. Previously, studies have looked at the survival of SDSD on bedding materials under laboratory conditions. This study aims to: (i) build on current work by replicating the farm lambing environment *in vitro* to determine the survival of SDSD on soil and commonly used bedding substrates, in damp and dry states, and (ii) provide farmers with practical guidelines for disinfection.

Material and methods
For laboratory modelling of the farm environment, soil (5 g) and unused bedding substrates, straw (2 g) and wood shavings (3 g), were autoclaved and added to sterile universals. Straw, wood shavings and soil were either dry or dampened by adding 5 ml, 2 ml, and 1 ml of sterile water, respectively. A suspension of a 0.5 McFarland clinical SDSD isolate was added to each substrate and stored aerobically in a humidity-controlled incubation chamber, across 7 time points: 1, 2, 4, 7, 10, 14, and 21 days, following an initial day 0 reading. Prior to the study, a data logger was placed in a lambing shed for 3 weeks during lambing to continuously record humidity and temperature. Average temperature and humidity was deduced and were cycled in two-hour intervals over a 24-hour period (range: 8–13 °C, 82–87% RH). Survival studies were repeated with the addition of calcium oxide at laboratory conditions, for 10, 20, 40, and 60 minutes. All samples were cultured on Streptococcal-selective media (COBA) at 37 °C for the recovery of SDSD.

Results and discussion
At day 14, there was a decrease in SDSD of 2.1 and 2.0 log average colony forming units per ml (cfu/ml) in straw and damp straw, respectively; SDSD was unculturable by day 21. Soil and damp soil maintained SDSD survival across all 7 time points; there was 0.5 and 1.3 log decrease in cfu/ml respectively, by day 21. In wood shavings, SDSD was unculturable at all time points. With the addition of calcium oxide (lime powder), SDSD was unculturable after 10 minutes.

Conclusion and implications
At temperature and humidity conditions similar to the indoor lambing environment, SDSD was able to survive on straw and damp straw for 14 days, and on soil and damp soil for the duration of the study. On wood shavings, SDSD was unculturable. The importance of a dry, clean lambing environment is highlighted, further supporting current advice on bedding/pen management.

Acknowledgements and funding
The author acknowledges funding from University of Liverpool and AHDB Beef and Lamb.

doi: 10.1016/j.anscip.2023.01.299

P-022
Anaplasmosis in small ruminants: Molecular assay and histological findings

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Keywords: Anaplasmosis; Small ruminants; Tick-borne disease; Zoonosis

Introduction
Anaplasma genus includes tick-borne pathogens that impact human and animal health. In sheep and goats *A. ovis*, *A. centrale* and *A. marginale* can be detected as intraerythrocytic species, *A. bovis* and *A. phagocytphilum* as intragranulocytic and intramonocytic bacteria, respectively. From 2018 to 2022, 156 spleens were collected from small ruminants at the end of their productive life. No clinical signs compatible with anaplasmosis were observed, probably because they came from an endemic area. For *Anaplasma* species identification a molecular panel was carried out. Histological evaluation was performed to increase knowledge about anaplasmosis.

Material and methods
The DNA, extracted by a commercial kit, was submitted to a PCR specific for *Anaplasma* spp. Positive samples were analysed through a molecular panel consisting of two $sPCR_s$ for *A. ovis* and *A. marginale*, a multiplex-PCR for *A. bovis* and *A. centrale*, and a nested-PCR for *A. phagocytophilum*. Spleen tissue samples were collected from 17 animals showing mild to severe splenomegaly. Samples were fixed in 10% neutral buffered formalin, embedded in paraffin wax, sectioned at 4 μm and stained with hematoxylin and eosin and Perls.

Results and discussion
Out of 156 spleens examined, 92 were positive for *Anaplasma* spp. (59%), with a 88% (n = 81) of success into species identification. Concerning 74 sheep, 53 were positive for *A. ovis* and one for *A. bovis*; in the other samples co-infections were observed: 13 *A. ovis* + *A. bovis*, 4 *A. ovis* + A. *phagocytophilum*, 2 *A. ovis* + *A. marginale*, and one animal showed simultaneous presence of *A. ovis* + *A. bovis* + *A. phagocytophilum*. Concerning 7 goats, 6 were positive for *A. ovis* and one for *A. ovis* + *A. bovis*.
Eleven of 17 sampled animals for histological examination were positive for *Anaplasma spp*., showing a variable grade of hemosiderosis (Perls staining). Erythrophagocytosis, plasmacytosis and local eosinophilia were detected inconstantly. Hemosiderosis can be considered suggestive of anaplasmosis caused by *A. ovis*, *A. bovis*, and their co-infection. The lack of positive cases for only *A. phagocytophilum* did not allow for clarification of the lesions associated with this species in small ruminants. The inconstant presence of erythrophagocytosis was supposed relating to the acute/chronic phases of infection. Instead, plasmacytosis, previously reported in anaplasmosis of cattle and other haemoparasitic diseases, is an interesting finding that needs further studies on larger cases studies.

Conclusion and implications
Data obtained were not enough to allow a statistical analysis of frequency but showed a high spread of *Anaplasma spp.* (almost 60%), particularly for *A. ovis*. The panel can be used as a diagnostic tool to reveal co-infections and zoonotic species (such as *A. phagocitophylum*). Splenomegaly and hemosiderosis seem to represent gross and histological lesions suggestive of anaplasmosis, respectively.

doi: 10.1016/j.anscip.2023.01.300

P-023
A molecular panel for identification of anaplasma in ticks collected from ruminants

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Keywords: Anaplasmosis; PCR; Ruminants; Tick

Introduction
Anaplasmosis is caused by a group of obligate intracellular bacteria, spread in tropical, sub-tropical and some temperate regions. *Anaplasma* can be transmitted by ticks or mechanically by biting flies and blood contaminated fomites. Ticks involved into anaplasmosis belong to the genera *Ixodes*, *Rhipicephalus, Dermacentor*, *Haemaphysalis*, *Amblyomma, Hyalomma.* During one year sampling, ticks collected from ruminants were investigated about the presence of *Anaplasma* spp. by molecular methods. The study was performed in Basilicata region, Italy.

Material and methods
One hundred and sixty-one ticks were collected from bovine, ovine and caprine farms. The ticks, stored in 70% ETOH, were identified at species, sex, and developmental stage. Subsequently, genomic DNA was extracted and a PCR was carried out for a screening investigation. A molecular panel was applied to typing positive samples.

Results and discussion
Data showed a high percentage of *Anaplasma* genus. Out of 161 ticks examined, 80 were positive for *Anaplasma* spp. (49.7%), 31 females and 49 males. PCR's panel was useful to identify *Anaplasma* species in 25 positive screening samples (31.2%). *Anaplasma marginale* was detected in 9 ticks (36%), *A. ovis* in 6 ticks (24%), *A. centrale* in 4 ticks (16%) and A. *phagocytophilum* in 2 ticks (8%). In the other samples, co-infections were observed: *A. marginale* + *A. centrale*, *A. ovis* + *A. central*, and *A. ovis* + *A. marginale*, were detected in 2 (8%), 1 (4%), and 1 (4%) ticks, respectively. Concerning ticks, *A. ovis* was detected in *H. detritum*, *H. marginatum*, *I. ricinus*, *R. bursa*, and *R. turanicus*. *Anaplasma marginale* was detected in *I. ricinus*, *R. bursa, R. sanguineus*, and *R. turanicus*. *Anaplasma centrale* was detected in *H. marginatum, I. ricinus, R. bursa, R. turanicus*, and *R. sanguineus*. *Anaplasma phagocytophilum* was detected in *H. marginatum* only.

Conclusion and implications
The large amount of positive samples (almost 50%) suggests the high spread of *Anaplasma* in the investigated area. The panel was successful in 25 samples, supposing that ticks are not a suitable matrix for DNA extraction or hypothesizing species not included in this panel (*A. capra* or *A. platys*). Nevertheless the panel allows to detect co-infections and zoonotic species, like A. *phagocytophilum* responsible of human granulocytic anaplasmosis. *Anaplasma phagocytophilum* was detected in *H. marginatum*, whereas according to other authors *I. ricinus* is the main european vector (Battilani et al., 2017). These preliminary data focus on tick as an important pathogen reservoir and potential vector of

Anaplasma genus, independently from sex: the *Odds Ratio* evaluation (females *vs* males) was not statistically significant (1.50, IC95%). No other statistical data can be discuss in this study.

Reference

Battilani, M., De Arcangeli, S., Balboni, A., Dondi, F., 2017. Genetic diversity and molecular epidemiology of *Anaplasma*. Infect. Genet. Evol. 49, 195–211.

doi: 10.1016/j.anscip.2023.01.301

P-024
The boots as carriers of parasites in sheep farms

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Keywords: Sheep; Biosecurity; Parasites diseases; Footwear

Introduction
To date, contrary to what happens in other livestock chains, there are no scientific studies on literature exploring the application of the basic principles of biosecurity in sheep farms. The footwear contamination is one of the main dynamics considered more at risk in the spread of diseases. In this study we report the results on the parasitc research with the specific objective to define the degree of contamination by some important etiological agents in the soil / litter and the footwear used in sheep farms.

Material and methods
A total of 10 sheep farms were selected considering availability of sanitary informations. As inclusion criterium parasites presence should have been already tested. The litter in the box of ewes during the lambing period by a selection of a 60 m^2 surface divided in 3 unit has beed used as unit and sampling has been executed by a "walk" with 4 pairs of boots within each sample unit. Litter and faeces from the sole of the boots were processed with a quantitative parasitological examination (FLOTAC® Dual tecnique) to evaluate the difference between the footwear and the ground.

Results and discussion
We found *Eimeria spp*. and *Gastrointestinal Strongyles (GIS)* in all the samples. *Trichuris spp.* Was present in 2 boots and 1 litter, while *Nematodirus spp*. only in 1 litter. *Pulmonary nematodes* were detected in 3 boots and 5 litters, and *Strongyloides spp.* in 7 boots and 3 litters. We also found *Dicrocoelium dendriticum* in 5 boots and 5 litters samples, and *Tenia spp*. in 5 boots and 3 litters.
The analysis of the oocyst and egg per gram of feces for *Eimeria spp*. and *Gis* for each farms shown a really interesting differences between boots and litter: for *Eimeria spp.* boots were more contaminated in 40% of samples and really similar in another 40%, while in *Gis* the boots were more contaminated in 70% of samples.

Conclusion and implications
Among all the parasites observed in all the samples *Eimeria* and *Gis* result the more intereting considering their direct life cycle and their known pathogenicity. The results obtained clearly highligh the role of the footwear as a collector of these parasites. It was not possible to assess the concentration in which they are released in the environment from the contaminated boot, but assuming that the infectious dose is rather small, the mere presence of the same must be considered a risk for their diffusion. In conclusion, evaluating the data achieved, we suggest an increase in cleaning of the footwear as strategic actions in management of specific sanitary problems.

doi: 10.1016/j.anscip.2023.01.302

P-025
The management of Coccidiosis in lambs

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Keywords: Sheep; Eimeria; Parasites diseases; Coccidiosis

Introduction
Coccidiosis is a disease due to the protozoa Apicomplexa, genus *Eimeria* with a worldwide distribution. In sheep represents an important issue, especially for young animals, and causes important economic losses. The aim of this study was to investigate the effect of diclazuril treatment on weight gain and parasitic fecal load in lambs.

Material and methods
We enrolled in the study 67 Lacaune lambs and 36 Comisana lambs, approximately 30–40 days-old, from 3 and 1 dairy sheep herds, respectively. At day (d) one of the study, we randomly selected two groups for each farm: A (treated) and B (control). Age, weight and sex were registered for each lamb and fecal samples were collected to evaluate the initial load of oocyst per gram (o.p.g.) of *Eimeria spp*. Lambs in group A were treated with diclazuril. After 30 days (60/70 days-old) and 60 days (90/100 days-old) information (age, live weigh, o.p.g.) and fecal samples were collected. All fecal samples were analyzed for quantitative parasitological examination with FLOTAC® (Dual technique). Student T test was used to evaluate the differences between groups ($p < 0.05$) considering sampling time, after verifying the assumptions of independence, normality and homoscedasticity. Since we found a high number of o.p.g. in Comisana group A and in order to evaluate through morphological examination the *Eimeria* species, we performed a new trial at the same farm in 8 lambs (4 treated with diclazuril and 4 control) of 30 days-old, sampling the animals at d0, d14 and d28 of treatment.

Results and discussion
No differences were observed for weight and o.p.g. in Lacaune lambs, while at d60/70 the media weight gain of Comisana lambs was of 39.6% and 29.6% in group A and B, respectively ($p < 0.05$). As regards to o.p.g. of *Eimeria,* group A showed a media count of 10.902 o.p.g. compared to the 7.153 o.p.g. of group B ($p < 0.05$). At d90/100, the media weight gain was of 20.5% in A and 17.7% in B (not significant), while for *Eimeria* 6.799 o.p.g and 4.185 o.p.g. were described in group A and B, respectively.
In the second trial, we found *E. ovinoidalis* in each group at d0, while only in the control groups at d14 and d28 of the study. We supposed that the different origin of the Lacaune lambs had an influence on data, and high number of o.p.g. in group A of Comisana lambs was due to non pathogenic *Eimeria*.

Conclusion and implications
The results suggest that coccidiosis is much more complex than we actually know. However, the spread of oocyst among young animals can be mitigated by the adoption of good management practices, including a correct use of treatment in terms of times and choice of treatment molecules.

doi: 10.1016/j.anscip.2023.01.303

P-026
The managemant of litter in ovine Coccidiosis

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Keywords: Sheep; Eimeria; Parasites diseases; Litter

Introduction
Coccidiosis is a parasitic disease due to protozoa Apicomplexa, genus *Eimeria* with a worldwide distribution. In sheep were identified 15 species of *Eimeria* spp.; *E. ovinoidalis, E. crandallis, E. bakuensis* and *E. anshata* appear the most pathogenic ones. Coccidiosis rapresents a very big issue, especially for young animals with an important economic impact on the farm's production. In this work, we tried to understand if some substance for the litter treatment could help in managing the spread of protozoa in young livestock.

Material and methods
We enrolled 109 lambs in the same farm of about 25 days old dividing them randomly in 3 groups according to the type of treatment of the litter: Group **C (Control)** of 53 lambs in whitch was used only lime under the litter as usually is done; Group **A (Adsorbent)** of 28 lambs in whitch was used an adsorbent mixture, and Group **D (Disinfectant)** also of 28 lambs in witch was used a sanitizing mixture. In the first week of the study, we prepared the litter following the instruction of the 3 mixtures. Then, on the first day of housing all the lambs were treated with diclazuril and litter of each group was sampled and a pool of faeces from the lambs was collected for quantitative parasitological examination (FLOTAC® Double technique). We repeated the same sampling for three weeks in a row.

Results and discussion
We found a different number of oocysts per gram of *Eimeria* spp. in each litter and pool of faeces analysed. First sampling: Litter **C**: 85.000 oocyst per gram (o.p.g.); Lambs in **C** 28.080 o.p.g. ;Litter **A**: 14.256 o.p.g.; Lambs in **A:** 4.128 o.p.g. ; Litter **D**: 55.296 o.p.g.; Lambs in **D:** 35.280 o.p.g.

Second samplig, 7 days after: Litter **C**: 888 o.p.g; Lambs in **C:** 288 o.p.g. ; Litter **A**: 360 o.p.g.; Lambs in **A**: 0 o.p.g. ; Litter **D**: 1320 o.p.g.; Lambs in **D**: 528 o.p.g.
Third samplig, 7 days after: Litter **C**: 410 o.p.g.; Lambs in **C** 6 o.p.g. ;Litter **A**: 112 o.p.g.; Lambs in **A** 6 o.p.g. ; Litter **D**: 160 o.p.g.; Lambs in **D** 30.000 o.p.g.
Fourth and last samplig, 7 days after: Litter **C**: 108 o.p.g.; Lambs in **C** 18 o.p.g. ;Litter **A**: 240 o.p.g.; Lambs in **A** 24 o.p.g. ; Litter **D**: 56 o.p.g.; Lambs in **D** 6 o.p.g.

Conclusion and implications
Statistical analysis shows that the litter in Group D and A are more suitable for environmental coccidiosis control showing very low numbers of o.p.g between the second and the third sampling (lambs of 30–40 days of age). The results suggest that a litter treatment against coccidiosis in association with lambs treatment is useful to reduce consistently oocysts burden.

doi: 10.1016/j.anscip.2023.01.304

P-027
Comparation of antibiotic resistance of *E. coli* in female sheep and goats and their respective lambs

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Keywords: Antibiotic resistance; Sheep; GOATS; Lambs

Introduction
The resistance to antibiotics of bacteria is an emerging problem. The question here was, if the bacterial flora of new born animals already shows antibiotic resistance and if this flora is similar to their mother and if it changes when they grow up.

Material and methods
In 2019 faecal swabs were taken in 1 goat and 12 sheep farms in Bavaria (2 of them with organic farming). From 2 to 5 female animals with their approximately 3-day old twins/triplets were sampled in every herd. The lambs were healthy and nursed directly with the mother, no antibiotics were applied to these animals in the past months. From every swab, 3 different *E. coli* types were isolated and tested to their antibiotic resistance by microdilution in Micronaut plates (DVG Großtierplatte 4) from Merlin Diagnostic (www.merlin-diagnostika.de). So, a total of 426 antibiograms were analysed.

Results and discussion
All isolated *E. coli* were complete resistant to Erythromycin, Penicillin G, Tiamulin, Tilmicosin und Tulathromycin. All samples were sensitive to Gentamicin.
Comparing the samples of all lambs to all of the mothers it shows, that they have similar resistance to the other antibiotic groups (Amoxicillin Clavulanic acid, Ampicillin, Ceftiofur, Colistin, Cephalothin, Enrofloxacin, Florfenicol, Spectinomycin, 3 concentrations of TrimethoprimSulfa, Tetracycline). In nine of the groups the young animals had slightly higher resistances than their mothers, only in Colistin, Enrofloxacin und Florfenicol the mothers showed more resistances.
There were clear differences between the antibiotic resistance patterns in the different herds, but no special diverging in the goat farm or the organic farms.
In Bavarian sheep and goat herds very few antibiotics are used, only in approximately 3% of the animals, but mostly tetracycline. In this study, only 5 of the 13 herds showed resistance to tetracycline, but with very different percentages. The goat farm had 11.1% resistance, 3 transhumance sheep herds with foot rot problems and usage of tetracycline for long years (25%, 9.7%, 3.7%) and one milk sheep farm (55.6%).
In the goat farm and one sheep farm the animals could be sampled several times, one until 11 weeks of age. The resistances of the newborn lambs were mostly higher than when they were older. Also the resistances patterns of their mothers changes in time.
Only 12 from the 426 isolated *E. coli* were *E. coli var. haemolytica*, but did not showed special resistance patterns.

Conclusion and implications
All lambs were delivered naturally and in the first sample held individual only with their mother, no contact to other animals, so the bacterial flora could only come from the mother with its resistances getting into the immature immune system of the lamb and declining resistances afterwards.

doi: 10.1016/j.anscip.2023.01.305

P-028
Challenges encountered in the evaluation of non-antibiotic treatments for housed neonatal lambs

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Keywords: Neonatal lambs; Probiotic; Watery mouth; Mortality

Introduction
Removal of authorised oral antibiotic treatments for neonatal lambs has lead UK sheep farmers to consider nonantibiotic products to prevent 'watery mouth' (colibacillosis). Farm trials of two popular supplements were undertaken at lambing 2022 but the findings were limited by poor records and lack of power.

Material and methods
1. There were 103 twin bearing ewes on three Welsh farms in this trial; ewe body condition score, age and breed were recorded, ewe colostrum quality measured on a Brix refractometer and 205 lambs weighed at birth. One twin was treated with a dose of probiotic (beneficial bacteria, egg powder and vitamins) at birth and their twin received no treatment. Further lamb weights were recorded at eight weeks old and mortality data collected.
2. Six farmers were recruited on the basis that they expected to have at least 10% of lambs succumb to 'watery mouth' and they wanted to use tablets (containing dextrose, microcrystalline cellulose, super oxide dismutase, salts). They were asked to complete a simple tally system to record lamb births and whether or not they were treated with a tablet at birth. Further tallies recorded numbers of cases of watery mouth and number of lamb deaths during the lambing period. In total, 1289 lambs were given a tablet at birth and 1101 did not receive a tablet.

Results and discussion
1. Out of the 205 lambs recorded at birth, there were no cases of watery mouth and six deaths over the following two months. There was no difference in lamb daily live weight gain (DLWG) between treated and untreated lambs though DLWG was significantly influenced by ewe body condition at lambing.
2. Data was received from six farms though there was only one farmer who actually treated alternate lambs as directed. There was no 'watery mouth' on two farms and lamb mortality below 2.5% on all but one of the farms. When data from all six farms were combined, there was a mean of 3.7% 'watery mouth' cases in lambs not given a tablet and 4.7% in lambs given a tablet; this was not a significant difference ($p = 2.64$; Fishers Exact). Overall mortality in lambs not given a tablet was 4.0% and 2.6% in lambs given a tablet (not significant: $p = 0.065$; Fisher Exact).

Conclusion and implications
Despite selection of farmers who were specifically concerned about levels of 'watery mouth', there was limited disease on the majority of the farms. There is still a lack of good data and insufficient evidence to justify sheep farmer spend on neonatal lamb supplements in lieu of investment and focus on the quality and quantity of ewe colostrum.

doi: 10.1016/j.anscip.2023.01.306

P-029
Ultrasound diagnosis of pregnancy disorders in dairy sheep, incidence and correlations

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Keywords: Transrectal Ultrasonography; Embryonic death; Reproductive efficiency; Dairy sheep

Introduction
In Mediterranean area, mating of adult ewes usually starts at the end of seasonal anestrus period, and pathologies which lead to pregnancy interruption are often underestimated and generally referred to as undefined animal infertility (Spezzigu et al., 2013a). In recent decades, dairy sheep farming system has undergone a significant managerial and genetic improvement, leading to an increase in per-head production which is not reflected in an increase in ewes' days in milk. In fact, poor reproductive performance results in an increased delay on

deliveries among flocks (Spezzigu et al., 2013b), and hence in lower income for farmers. This delay often results from pathologies as late embryonic death (ED) between 18 and 40 days, presence of pseudo pregnancies (PP), pyometras (PY) and early fetal death (EFD) between 40 and 60 days. These pregnancy disorders are often undetected during regular pregnancy check, usually performed by transabdominal ultrasound scanning (TAUS) (Spezzigu et al., 2013a). This study aims at elucidating the incidence of pregnancy disorders within 65 days from the rams introduction, using Transrectal ultrasonography (TRUS) for early clinical diagnosis, that might be considered the gold standard for high-level gynecology in small ruminants (Spezzigu et al., 2013c).

Material and methods
For the purpose of the study, 7600 mated ewes were considered. Animals were allocated among 17 farms, located in northern Sardinia, Italy. For each farm, TRUS gynecological checkups were performed within 65 days from rams introduction using an Aloka Prosound 2 ultrasound scanner, fitted with transrectal linear probe. During the examination, data collection was carried out on a per-animal basis, and possible pathological status (ED, PP, PY and EFD) were checked.

Results and discussion
The study showed that during a routinary pregnancy diagnosis with TRUS, a total incidence of reproductive pathology 15.7 ewes out 1000 were detected. These disorders mostly consisted in ED, with an incidence of 10 ewes out 1000, whereas both PP and PY showed 2.2 and EFD 0.1. TRUS also enabled us to diagnose ED, i.e the most prevalent pathology, at an early stage.

Conclusion and implications
In conclusion, ED has been shown to be the main pathology present in the farms considered in the study. The use of TRUS allows to diagnose it earlier and act quickly, with an adequate therapy to improve repruductive performences and to avoid considerable economic losses. The next steps of the study will be to evaluate more animals using TRUS and to improve our knowledge on the etiology of the pathologies considered till now.

References

A. Spezzigu, S. Sale, S. Bua, 2013a. Diagnosi ecografica di morte embrionale e morte fetale nei piccoli ruminanti.
A. Spezzigu, S. Sale, S. Bua, 2013b. Ultrasonografia e management aziendale nei piccoli ruminanti.
A. Spezzigu, S. Sale, S. Bua, 2013c. Gli ecografi e le sonde.

doi: 10.1016/j.anscip.2023.01.307

ISVA: Global threat to sheep

P-030
Organophosphate poisoning in sheep

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Keywords: Dichlorvos; Delayed polyneuropathy; Neurologic signs; Toxicology

Clinical history
An outbreak of sheep mortality due to organophosphate poisoning is reported. The herd had 150 Lacaune sheep, raised in a semi-intensive system, where sixty sheep were kept in ten stalls with 12 m^2 each (slatted floor and wooden door, concrete walls and ventilation near the roof) and were released during the day, returning to the installations at night. Removal of waste from the stalls had been performed daily and the stalls cleaned every two weeks with sodium hypochlorite; however, with the increased presence of flies, cockroaches, and other insects, daily cleaning was instituted using a product containing dichlorvos at 82.5%, an organophosphate, and a pyrethroid. Fifteen days after daily cleaning of the stalls was started, forty sheep aged between three and 36 months died within a 40-day interval. Clinical signs were bradycardia, bronchoconstriction, diarrhea, salivation, nasal discharge, apathy, prostration, incoordination, head pressing, neck rigidity, paresis, flaccid limb paralysis, permanent decubitus, pedaling movements in lateral recumbency, and death.

Investigations
For diagnosis, four animals were necropsied, blood samples were collected for measuring hepatic and renal metabolites, and toxicological analysis was performed. Steatohepatitis was observed on serum biochemistry. On necropsy, there was pneumonia, congested leptomeningeal vessels, and edema and congestion in lungs, pericardium, and brain convolutions. On histopathology, there was hepatic, renal, and pulmonary congestion, microsteatosis and hyperplasia with hepatocyte hypertrophy, pulmonary edema and hemorrhage, and congestion, edema and presence of red neurons and neuronal death in the central nervous system. Toxicological analysis by thin layer chromatography of a pool of organs from the necropsied animals showed organophosphate compounds and no pyrethroids, leading to a diagnosis of

delayed poisoning because of exposure to an insecticide containing dichlorvos at 82.5%, which may have occurred via inhalation in the stalls, ingestion from the animals' habit of gnawing on the slatted floors, or from skin contact when lying down.

Differential diagnosis
The differential diagnosis for intoxication by organophosphate should be made, for example, with diseases that present clinical signs of salivation, muscle tremors, paresis and paralysis of limbs, as observed in intoxication by Claviceps paspali and carbamates, rabies, botulism and tetanus. However, it is worth mentioning that all these conditions have characteristics that allow them to be differentiated. Information on the use of organophosphate would be the main way to suggest intoxication by this chemical group.

Discussion
In Brazil, organophosphate poisoning is described as one of the major causes of pesticide poisoning in humans; however, it is rarely reported in ruminants. Although clinical, biochemical, anatomical and histopathological findings were non-specific for intoxication by this chemical compound, a positive result on chromatology demonstrates a chronic course of poisoning that correlates with organophosphate-induced delayed polyneuropathy (OPIDP).

doi: 10.1016/j.anscip.2023.01.308

P-031
Nasal pythiosis associated with *Acinetobacter baumannii* bronchopneumonia in sheep

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Keywords: Histopathology; Bacterial isolation; *Pythium insidiosum*; Granulomatous rhinitis

Clinical history
An outbreak of respiratory disease is reported in sheep herd raised in the state of Sergipe, Brazil, in August 2021. The herd had a history of similar cases for three years, with animals dying with respiratory signs. During the presentation of these new cases, three sheep had died, and at the time of the visit there were two symptomatic sheep. One male sheep (Sheep 1) with coughing, sneezing, bilateral nasal discharge, abdominal breathing, and weight loss for fifteen days, which progressed to permanent sternal and lateral recumbency, and one sheep (Sheep 2) with obstructive neoformation in both nostrils, with an irregular appearance and bloody discharge, associated with increased volume in the rostral region of the nostril.

Investigations
The sheep were euthanized and necropsy revealed lesions of varying degrees in the nostrils. Sheep 1 had hyperemic nasal cavities, a necrotic lesion (1 cm) in the right nasal cavity and several small nodules on the floor under the ventral nasal concha. Sheep 2 had a hyperemic nasal cavity and a necrotic area bordered by foul-smelling granular tissue at the base of the nasal septum and conchae. Both sheep had lung involvement characteristic of multifocal pneumonia, with nodules filled with purulent material (Sheep 1) and granulomatous material (Sheep 2), pleural adhesions, congestion, and mild edema. There was also mild hepatomegaly and splenomegaly. Histopathological lesions found in the nasal cavity of both sheep were multifocal to coalescing necrotic areas, with marked inflammatory infiltrate composed of eosinophils, neutrophils, and macrophages, as well as multifocal hemorrhage. In the necrotic areas, there were negative images of structures morphologically compatible with oomycete hyphae in transverse and longitudinal sections, suggestive of *Pythium insidiosum*. In the lungs, there was accentuated, multifocal to coalescing pyogranulomatous (Sheep 1) and granulomatous (Sheep 2) bronchopneumonia, and in the liver, there were signs of mild mononuclear or granulomatous hepatitis. In the sample from the purulent content of the pulmonary nodule of Sheep 1, a gram-negative rod bacterial agent classified as *Acinetobacter baumannii* was isolated. Cases of lethal chronic granulomatous rhinitis caused by *P. insidiosum* associated with bronchopneumonia by *A. baumannii* were diagnosed.

Differential diagnosis
Chronic granulomatous rhinitis can be caused by fungi (*Conidiobolus* sp., *Cryptococcus* sp., *Aspergillus* sp), algae (*Prototheca wickerhamii*) and neoplasms (enzootic nasal adenocarcinoma, myxoma) and pyogranulomatous bronchopneumonia by *Mannheimia haemolytica*, *Pasteurella multocida*, *Bibersteinia trehalosi* and *Mycoplasma* spp.

Discussion
Phythiosis occurs due to contact with agents present in the environment, especially in the soil during periods of humidity and high temperatures in Northeast, Brazil. *A. baumannii* this opportunistic agent is rarely reported in animals, but is responsible for different types of infections in hospitalized immunocompromised humans and has a high capacity for antimicrobial resistance.

doi: 10.1016/j.anscip.2023.01.309

P-032
The role of CD163-positive macrophages in the pathogenesis of atypical proliferative lesions caused by ORF virus in sheep

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Keywords: Macrophage; ORF virus; Contagious ecthyma; Sheep

Introduction
Orf virus (orfV) is a large double-stranded DNA virus belonging to the genus Parapoxvirus (PPVs) that causes contagious ecthyma (orf), a disease affecting sheep, and a wide host species range preserving equal pathological aspects. OrfV, after infecting the epidermal keratinocytes, triggers a sequence of self-resolving changes in the skin and mucosae, especially in the buccal fissure and in the mouth cavity, that begins as erythema with vesicles and pustules, up to severe papilloma-like lesions. The tumor-like changes during orfV infection are considered to be atypical forms that are described in different species, including man.
Here we studied the role of infiltrating activated macrophages in the pathogenesis of the productive tumor-like lesions of atypical cases of orfV.

Material and methods
Ten Sarda breed lambs aged between 10 to 20 days and an adult ram, all showing severe lesions indicative of orfV infection, were enrolled in the study. The animals were submitted to anatomo-pathological examination and adequately sampled from the lesioned areas of the skin and mucosae. In addition, 5 orfV-affected lambs, belonging to one of the flocks under study, were EDTA blood sampled weekly for 21 days after the onset of the clinical signs.

Results and discussion
By PCR and isolation in cell culture, orfV was detected in all the examined cases. Isolation was possible both from the skin and mucosae as well as, in most of the cases, also from other tissues including blood. In clinically affected lambs orfV was isolated in cell culture, from the blood until the 21st day after the lesion onset. By histological examination, we find a markedly pseudo-papillomatous proliferation of the epithelium while the derma and lamina propria were expanded by the presence of a proliferating neovascular component. The immunohistochemical results demonstrated that CD-163+ macrophages were by far the most represented inflammatory cells. The high expression of CD163 indicates that this macrophage could be classified as M2-polarized phenotype, which is considered promoting tumor.
We found linear or punctate immunohistochemical cytoplasmatic signals of vascular endothelial growth factor (VEGF) and of its VEGF-receptor 2 which evidenced numerous newly formed blood vessels. Interestingly, double confocal immunofluorescence staining confirmed that numerous CD-163 positive macrophages over-expressed epidermal growth factor receptor (EGF-R). These findings suggest that orfV activates an inflammatory reaction characterized by CD-163 positive macrophages which also expressed EGF-R, thus might play an oncogenic-promoting role through synergistic action with the viral VEGF, which leads to angiomatous and papillomatous changes in the mucosa and skin.

Conclusion and Implications
To sum up, orfV triggered a pathogenetic mechanism previously described in non-viral-associated neoplasia.

Acknowledgements and funding
This study was funded by the Italian Ministry of Health (grant RC IZS SA 03/19 – RC IZS SA 03/20)

doi: 10.1016/j.anscip.2023.01.310

P-033
Permissiveness of different TMEM154 genotype cell lines to different SRLV genotypes/subtypes

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Keywords: Small ruminant lentivirus; Gene TMEM154; Genetic resistance; Sheep

Introduction
Small ruminant lentiviruses are a heterogeneous group of viruses that infect goats and sheep worldwide. In the absence of cures or effective vaccines, control measures have been based on early diagnosis and accurate management. However, an association between the genetic variation in the ovine transmembrane protein 154 (*TMEM154*) gene and infection susceptibility was demonstrated. Two *TMEM154* haplotypes containing a glutamate (E) at position 35 were associated with infection while the haplotype with lysine (K) at position 35 was associated with resistance. Thus, the selection based on the polymorphism of *TMEM154* gene represents a possible control tool for the reduction of the prevalence of infection in sheep. Moreover, Italy displays at the same time a (genetically) highly heterogeneous sheep population infected by a wide spectrum of SRLV subtypes.
In this context, the identification of the susceptibility/resistance spectrum of different *TMEM154* haplotypes towards different SRLV subtypes becomes crucial.

Material and methods
In the study, 10 fibroblastic cell lines, from animals encoding the three possible genotypes of the *TMEM154* gene (4 K/K, 3 E/K and 3 E/E), were infected with 8 SRLV viral strains and tested for the presence of retrotranscriptase (RT) activity and cytopathic effect. Moreover, viral pseudotypes were used to evaluate SRLV entry.

Results and discussion
Two out of eight viral strains showed a statistically significant difference among the three cell lines (Wilcoxon rank sum exact test $p < 0.05$). Within genotype A, the It-561 strain produced fewer syncytia, a reduced degree of cell fusion, and a lower RT-activity in the supernatant of the 4 homozygous K/K cell lines, suggesting a resistant pattern.
Interestingly, within viral genotype B, only subtype B1 showed a similar pattern of resistance in KK lines, while subtypes B2 and B3, typically associated with interstitial pneumonia in sheep, did not show significant differences between the different cell groups.
The entry assay using the *env* gene form a different strain of B1 subtype confirmed restriction in resistant lines in contrast to the permissive lines, suggesting an entry blockade as the main restriction factor.

Conclusion and implications
These results offer different insights. The B1 subtype is considered one of the most virulent for goats, so much so that it is the target of specific eradication programs in different Countries, in which sheep population is usually not tested. The possibility to control the infection in sheep through genetic selection simplifies the management of sheep, reducing the risk of being a B1 reservoir.
Moreover, these results suggest the use of *ex-vivo* approach as a valid tool for the study of resistance patterns against different viral strains. This is the first study unveiling *TMEM154* mechanisms responsible for SRLV resistance in vivo, by describing in vitro restriction patterns related to viral entry.

doi: 10.1016/j.anscip.2023.01.311

P-034
Fasciola hepatica – Case report on triclabendazole resistance

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Keywords: Fasciola; Fasciolosis; Resistance; Triclabendazole

Clinical history
Fasciola hepatica may lead to severe production losses in livestock when not treated effectively. During recent years, there have been numerous cases of confirmed flukicide resistance worldwide; however, no reports on flukicide efficacy from German livestock farms were published. In November 2021, complete failure of triclabendazole (TCBZ) treatment against *F. hepatica* was found for the first time in Germany.
In a flock (consisting of ~1300 ewes and lambs) from northern Germany numerous acute deaths occurred daily in until recently clinically healthy animals. Post-mortem examinations of several perished sheep revealed massive infections with *F. hepatica* juvenile stages. Subsequently, the flock received treatment with TCBZ.

Investigations
Within the course of a field study to evaluate the anthelminthic efficacy of flukicides on German sheep farms, 50 animals of the flock (randomly selected as a study population) were weighted and administered orally with the exact dose of 10 mg TCBZ/kg b.wt., and individual

faecal samples were collected from the rectum on the day of treatment and 14 days thereafter. Faecal samples were examined coproscopically and with a coproantigen-ELISA to determine the individual faecal egg counts (FEC) and the coproantigen levels pre- and post-treatment.
Despite treatment, FEC and coproantigen levels rose drastically until day 14 and the daily animal losses did not decrease. Hence, the study population was treated again with the double dose of TCBZ (20 mg/kg) and faecal samples were re-examined on the day of second treatment and 14 days later. However, the double dose of TCBZ did not affect FEC and coproantigen-levels. Overall, approximately 23% of the flock perished in a few weeks. Accordingly, the shepherd administered closantel (CLOS) to the remaining flock (8.8–20.3 mg/kg) resulting in 95% FEC reduction as well as a negative coproantigen-ELISA.

Differential diagnosis
Except from acute fasciolosis there is no plausible differential diagnosis for the severe events observed in this flock. Triclabendazole has been used frequently without individually adjusted dosing and monitoring the efficacy by post-treatment coprological examinations on this farm. Presumably, that led to the development of TCBZ resistance.

Discussion
Since TCBZ is the only flukicidal compound effective against the highly pathogenic juvenile stages of *F. hepatica*, TCBZ-resistance results in major implications for the health of the flock. There is, at present, no alternative drug to eliminate the juvenile stages in order to confine the liver damage induced by the migrating flukes. All other flukicides, including closantel, only affect the mature stages of the parasite. Thus, the herein reported TCBZ-treatment failure represents a serious therapy emergency in small ruminants exposed to *F. hepatica*.

Funding
This study is co-funded by the Federal Office of Consumer Protection and Food Safety (BVL), Germany.

doi: 10.1016/j.anscip.2023.01.312

P-035
Association of staphylococcal populations on teatcups of milking parlours with vaccination against staphylococcal mastitis in sheep farms

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Keywords: Biofilm; Mastitis; Milking parlour; Teatcup

Introduction
The objectives of the study were (a) to describe the populations of staphylococci on teatcups in milking parlours in sheep, during an extensive crosse-sectional investigation performed throughout Greece and (b) to potentially associate the findings with the use of anti-staphylococcal mastitis vaccinations in the farms visited during the investigation.

Material and methods
A total of 255 farms across Greece were included in the study. During the visit to farms, swab samples were collected from 1116 teatcups. From each teatcup, two swab samples were collected: from the upper (1–1.5 cm deep) and the lower (approx. 10–12 cm deep) part, i.e., 2232 samples were obtained. The samples were processed for staphylococcal recovery and identification. Conventional microbiological techniques were employed for staphylococcal isolation; identification of staphylococcal species was performed by using MALDI TOF MS. Then, all staphylococcal isolates recovered were tested for biofilm-formation. Health-management related variables applied in the farms were evaluated for potential associations with the recovery of staphylococci from the teatcups. Among these practices, the use of vaccines against staphylococcal mastitis was also included. Univariable analysis of associations was performed by using Pearson's chi-square test, Fisher exact test or McNemar's test, as appropriate. Subsequently, multivariable models were constructed using mixed-effects logistic regression.

Results and discussion
A total of 241 contaminated teatcups (21.6%; 95% CIs: 19.3–24.1%) were found in 105 sheep farms (41.2%; 95% CI: 35.3–47.3%). Staphylococci were recovered more frequently from the upper part than from the lower part of teatcups: 199 (17.8%) *versus* 97 (8.7%) teatcups ($p < 0.001$). After identification, 186 staphylococcal isolates were found; staphylococcal species more frequently identified were *Staphylococcus aureus*, *S. equorum*, *S. lentus* and *S. capitis*. Of the above 186 isolates, 87.6% were biofilm-forming. The proportion of contaminated teatcups was smaller in farms where vaccination against anti-staphylococcal mastitis in general or vaccination specifically against mastitis caused

by biofilm-forming staphylococcal strains was applied: 20.2% or 10.7%, respectively, *versus* 25.8% in farms where no vaccination was applied.

Conclusion and implications
Staphylococci were recovered from teatcups in milking parlours of sheep farms, despite the regular post-milking cleaning of these parlours. The great majority of staphylococci recovered from the teatcups referred to biofilm-forming isolates; biofilm-formation helped the bacteria to attach on the teatcups and multiply on there and to survive the unfavourable conditions (e.g., use of disinfectants). A reduced staphylococcal isolation was noted in farms where anti-staphylococcal vaccination was performed; this was possibly the effect of reduced excretion of staphylococci in the milk of vaccinated animals. This finding confirms that anti-staphylococcal mastitis vaccination can reduce staphylococcal dissemination in the farms.

doi: 10.1016/j.anscip.2023.01.313

P-036
Bacterial etiology of small ruminant pneumonia in Spain 2020–2022

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Keywords: Pneumonia; Pasteurellaceae; Mycoplasma; Characterization

Introduction
Pneumonic pasteurellosis is a multifactorial disease whose acute form causes deaths but overall leads to chronic bronchopneumonia related with high morbility, increased cost of antimicrobials and fall of productive rates. *Pasteurella multocida* [PM], *Mannheimia haemolytica* [MH] and *Bibersteinia trehalosi* [BT] are considered the etiological agents of this process. Furthermore, important genetic differences have been described among the different strains of these bacteria. Moreover *Mycoplasma ovipneumoniae* [MO] is usually found in pneumonic lesions of small ruminants with a relevant role in the development of the disease.

Material and methods
A collection of 826 respiratory outbreaks coming from sheep ($n = 633$) and goats ($n = 193$) were investigated by qPCR for PM, MH, BT and MO. Additionally capsular PM serotypes A, B, D, E and F and capsular MH serotypes 1, 2 and 6 were tested. Those outbreaks were located in 427 different farms based in 38 different Spanish provinces. The samples submitted to the laboratory were lungs ($n = 361$), traqueobronchial lavages ($n = 390$) and respiratory swabs ($n = 67$) which were analyzed individually ($n = 260$) or conforming pools ($n = 566$). The specimens belonged to animals from different ages: adults (>12 months, $n = 175$), fattening (6w–16w, $n = 370$), suckling (<6w, $n = 123$), replacement (3m–12m, $n = 95$) and 63 which had no available data.

Results and discussion
Similar rates of detection (%) were found for sheep and goat: MO(80;81), MH(76;69), PM(62;42) and BT(34;42). Suckling lambs and kids resulted in a less often detection of all the studied bacteria whereas fattening category confirmed the highest prevalences in ovine (MO:93%; MH:93%, PM:77% and BT:45%) and replacement was the highest one for caprine (MO:95%; MH:82%, PM:60% and BT:43%). Lavages were proven to be an useful and sensitive tool for detecting all these agents, overall for goats: (MO:99%, MH:97%, PM:65% and BT:67%) where significative differences ($p < 0.05$) were found when comparing with analyzed lungs. Although MH and PM were massively detected in both host species, important differences were noticed regarding their serotypes. MH serotypes 1, 2 and 6 were detected in both species, nevertheless goat samples barely resulted positive for serotype A1, even this serotype was not detected among suckling animals. Only PM capsular serotypes A, D and F were detected. Serotypes A and D were frequently found in ovine whereas serotype A was rarely detected among goats. Sheep and goats showed minor prevalences (<10%) for serotype F.
Several vaccination options are available on field, nevertheless, none of them contains complete range of pathogens which have been detected in this work in a single product. Moreover, neither MO nor PM serotype D and F are present in any of the commercial vaccines.

Conclusion and implications
This survey provides updated epidemiological information and confirms the diverse infectious etiology of respiratory processes. These results might help practioners to implement specific control measures.

doi: 10.1016/j.anscip.2023.01.314

P-037
Q fever in French small ruminant farms: an abortive disease too often underestimated

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Keywords: Q fever; Abortive outbreaks; Survey; Perception

Introduction
Q fever, a bacterial zoonosis caused *by Coxiella burnetii,* is considered as enzootic in French small ruminant farms. However, its involvement in abortive outbreaks remains poorly referenced and the weak perception from stakeholders on the associated risks is not in favor on increasing awareness or stimulating actions on this topic. The objectives of this study were to review the incidence of Q fever in abortive episodes in France and to investigate the knowledge and perception about this disease by small ruminant breeders, vets and physicians.

Material and methods
An harmonized approach to search for the main infectious abortive etiologies has been proposed since 2017 to voluntary French *départments*. Q fever was included in a first line differential diagnosis in case of abortive episodes: 3 or more abortions within 7 days or less (closed abortions) or 4% of abortions occurring within 3 months (spaced abortions). The results can thus contribute to specify the impact of the disease. In addition, a survey was conducted by an independent polling institute (Via Voice) among various stakeholders: 100 veterinarians, 100 physicians and 234 small ruminant farmers randomly selected in rural areas <20,000 inhabitants.

Results
Based on our results, Q fever appears as the first disease involved in abortive episodes in goats and the second or the third in sheep depending on the year. In 2021, it was attributed to 27.3% and 19.0% of the 139 and 295 abortive episodes investigated in goats and sheep respectively. However, the disease remains insufficiently known and the risks are underestimated. Most farmers are aware of the disease (90% and 84% in goats and sheep respectively) and its zoonotic risk (74% and 65%), but clinical signs remain not well-known (abortions reported by 48% in average). Furthermore, only 62% and 45% of the goat and sheep farmers facing Q fever, state that they have implemented control measures, essentially hygienic ones (85%). Vaccination is reported as a risk management tool by less than a third of the breeders and 35% of veterinarians, isolation of sick animals being the first action in place. Only 22% of farmers and 44% of veterinarians mention the role of airborne transmission, contributing probably to the low perception of the risk of introducing the disease (9% of all farmers but 18% among those receiving public, 30% of veterinarians). Finally, only 38% of physicians are aware of the clustered human cases that have occurred in France and possible risks to humans are not fully known.

Conclusion
Despite the ethiological importance of Q fever in abortive diseases, the level of knowledge remains insufficient. Thus, it seems important to continue awareness-raising activities on the disease by promoting cross-sectoral approaches allowing for dialogue between all stakeholders.

doi: 10.1016/j.anscip.2023.01.315

P-038
Serological, molecular characterization of SRLV in Morocco

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Keywords: Small ruminant lentivirus; Genetic variability; Genotyping; Surveillance

Introduction
Small ruminants have an important economic and social role in Morocco. Farms practicing sheep and goat production represent 98% of livestock farms, with an estimated population of 16 million sheep and 5 million goats. Sheep and goat breeds are well adapted to the local

environment and represent the native breed, while limited introduction of French meat breeds occurred in the last decades for terminal crossbreeding. Small Ruminant Lentivirus infection in this population is underestimated, although some incursion may have occurred by introduction of breeds known to be carrier of well characterized European strains.

Material and methods
We examined a subset of frozen sera and whole blood samples collected during the 2019–2021 Bluetongue surveillance programs, by serological and molecular tools respectively.
A total of 724 serum samples (578 sheep and 146 goat), aged >2 years, were selected from 51 farms in different geographical locations and tested by screening ELISA (In3diagnostic). Positive and doubt samples were additionally tested by genotyping ELISA (In3diagnostic), which is normally able to discriminate among genotype A, B and E in many European Countries. Paired whole blood samples were used for DNA extraction and nested gag PCR. Positive samples are currently undergoing to NGS amplicon sequencing.

Results and discussion
Prevalence of antibody positive sheep and goat was 5.3% and 0.7% respectively. Sample size allows an estimation of prevalence lower than 20% (CI 95%) in 17 sheep and 10 goat flocks. Surprisingly a large proportion of screening positive samples were not correctly serotyped leading to suppose the presence of antigenically distinct variants, at least in the immunodominant epitope of capsid antigen. This finding is also supported by the low number (n = 6) of PCR positive samples, currently under sequence investigation.

Conclusion and implications
Taken together, these data support the evidence of a low prevalence of infection in the population, with an intrinsic difficulty of SRLV to spread, due to management practices. However, the normal rate of success by genotyping ELISA is close to 80% while in this study did not reach 40%. In addition the low number of PCR positive samples may reflect the low DNA concentration obtained from whole blood, the low viral load, or presence of mismatches in the primer binding sites or a combination of these factors. Thus we cannot exclude that highly divergent strains might have escaped from diagnostic tools.
The small ruminant population in Morocco is believed to have originated about 7000 years before present, domesticated outside Africa and entered via the North-West African migration route (5). The full characterization of autochthonous SRLV, if any, in this ancient population, will represent an excellent source of information to understand SRLV evolution after domestication and improve our knowledge on genetic diversity of this heterogeneous viral population.

doi: 10.1016/j.anscip.2023.01.316

P-039
Pharmacokinetic profiles of eprinomectin after a single subcutaneous or intramuscular injection in non lactating ewes

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Keywords: Pharmacokinetic; Eprinomectin; Efficacy; Route of administration

Introduction
Eprinomectin is highly important to the dairy sheep industry as it can address internal and external parasitic infections with limited distribution in milk (zero-day milk withdrawal period). Recently, an injectable formulation has been licensed for subcutaneous administration in sheep (“Eprecis® 20 mg/mL Solution for Injection, Ceva Santé Animale”). Whenever possible, the injectable formulation should be preferred to the pour-on to limit the risk of under-exposure and environmental toxicity (Rostang et al., 2022). Although subcutaneous route is the preferred way for many users, certain circumstances make intramuscular route more appealing. To gain more insights about the safety and efficacy of the intramuscular route, a comparative pharmacokinetic study was performed in non-lactating ewes.

Material and methods
Following a two-week acclimatation period, 24 non-lactating dairy ewes in good health were weighed one day prior treatment and randomized accordingly to be allocated into 2-treatment parallel groups (subcutaneous or intramuscular). At day 0, all animals received 0.2mg/kg of “Eprecis® 20 mg/ml” according to their group. Local reactions were assessed once daily for 1 week then every 2 days until disappearance of signs (corresponding to 2 consecutive observations with no signs). The following criteria were used (0 to 3 scoring): pain at injection, swelling, erythema, induration. Blood samples were collected at the following time points: D-1, 6 h, 8 h, 10 h, 12 h, 24 h, 36 h, 48 h, 60 h, 72 h, 96 h, and on D7, D14, D21, D28 and D35 after treatment. Plasma specimen analyses for eprinomectin were performed according to a specific LC-MS/MS method with a lower limit of quantification of 0.50 ng/mL. The pharmacokinetic analysis was performed using Phoenix® WinNonlin® 8.3 software (Certara, USA).

Results and discussion
Regarding the local tolerance, some signs were observed in 8 out of 24 animals: 5 animals after subcutaneous injection and 3 animals after the intramuscular injection. These signs were mostly swelling at the injection site during the first 3 days post-dosing. Following intramuscular administration of eprinomectin, the median time above 2 ng/mL was 7 days and the mean C_{max} was increased by 144% compared to

the subcutaneous way route of administration. The $AUC_{0\text{-}7d}$ and $AUC_{0\text{-}t}$ were also increased by +71% and +26% after dosing intramuscularly compared to subcutaneously. The same inter-individual variability was reported for the pharmacokinetic parameters whatever the route of administration.

Conclusion and implications
"Eprecis® 20 mg/ml" was well tolerated, whatever the route of administration. The pharmacokinetic profile of eprinomectin was different after intramuscular administration compared to the subcutaneous route as the rate and extent of absorption were increased by 144% for C_{max} and by 71% for AUC_{0-7d}. Taken together these results suggest that intramuscular route at the currently registered dose is safe and efficacious in sheep.

doi: 10.1016/j.anscip.2023.01.317

P-040
Supplementation of protected methionine improves milk yield and milk composition of crossbred sheep

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Keywords: Protected amino acids; Ovine; Dairy; Rumen undegradable protein

Introduction
In dairy sheep an optimum nutrition is required to maintain a positive energy and nitrogen balance to obtain an adequate dairy performance. In this sense, supplemental rumen-protected methionine (RPMet) has also been a nutritional strategy to improve the availability of AA in sheep to milk production. Therefore, the aim of the current study is assessing the effect of RPMet supplementation on milk yield and composition of crossbreed dairy sheep.

Material and methods
A completely randomized experimental design with repeated measures was used in the current study. Twenty crossbreed sheep (Pelibuey X East Friesian) were randomly assigned to one of three treatments: control (0 g/d), 3.0 g/d (3g) and 6 g/d (6g) of protected methionine (Mepron ®) added to the basal diet for 120 days post-lambing. Individual milk production was recorded every 15 days and chemical analysis of milk was performed by an ultrasound analyzer. A mixed model of repeated measurements was implemented to analyze the effect of methionine inclusion on milk yield and chemical composition. The level of methionine inclusion and the repeated measure were considered as fixed effects and sheep were the random effect. The mixed models were fitted using the lmer function of the lme4 package) of the R statistical language.

Results and discussion
Milk production was linearly affected by RPMet supplementation ($p = 0.046$). The 6g treatment showed the best milk yield performance (0.979 l/day) with a lower dispersion of their response. Also, the use of 6g of RPMet increases protein yield ($p = 0.04$), lactose yield ($p = 0.02$), and non-fat solids yield ($p = 0.03$). The results of the current study support the previous findings of the positive effect of RPMet supplementation on milk yield and composition in sheep, which can be associated with the increased absorption of limiting nutrients of the diet, improving protein balance and higher availability of AA (Goulas et al., 2003).

Conclusion and implications
The level of response of RPMet supplementation in dairy sheep is dependent on supplementation dosage with the best effect in the 6 g/day treatment. Our findings allocate this feed strategy as an option to improve the feed efficiency, associated with a better protein milk synthesis and availability of nutrients, of dairy sheep farms using crossbreeds in regions with an incipient dairy sheep industry.

doi: 10.1016/j.anscip.2023.01.318

P-041
Insulin sensitivity in lambs from ewes supplemented with high doses of vitamin D in the prepartum period

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Keywords: Insulin resistance; Metabolic diseases; Sheep farming; Productive performance

Introduction
One of the consequences of intensive production systems is the increase in metabolic diseases. There is an important relationship between obesity, insulin resistance (IR) and metabolic problems in obese or overweight pregnant women, including consequences for the health of their children. Studies involving vitamin D showed that individuals with IR have low levels of vitamin D. Considering that ewes are an experimental model for this metabolic condition in humans, the objective of this work was to evaluate the parenteral use of vitamin D in the insulin sensitivity of lambs born to ewes that received or not vitamin D during pregnancy.

Material and methods
In a 2 × 2 factorial arrangement, 29 newborn lambs, were distributed in four groups:DD-lambs from ewes supplemented with 70,000 IU/kg of vitamin D, intramuscularly (IM), on the 108th day of pregnancy and who also received vitamin D (70,000 IU/kg) at 24 hours of life(n = 9); DC- lambs from ewes supplemented like anterior group and that did not receive vitamin D (n = 8); CD- lambs from ewes that did not receive vitamin, but received, in the same dose, vitamin D on the first day of life(n = 6); and CC- lambs from ewes that did not receive vitamin D and that also did not receive vitamin supplementation(n = 6). Plasma vitamin D concentrations were determined on the day of birth and after 4 weeks by liquid chromatography coupled to triple-quad mass spectrometry (LC-MS/MS). At the same points, serum calcium levels were determined. The glucose tolerance test was performed in four-week-old lambs, and the areas under the curve (AUC) for glucose, beta-hydroxyburyrate (BHB), non-esterified fatty acids (NEFAs) and insulin were determined. Statistical analysis was performed by SAS. The model included fixed effects of ewe administration, lamb administration, sheep*lamb interaction, as well as the respective interactions.

Results and discussion
The AUCs of insulin, NEFAs, BHB and calcium levels were not influenced by treatment. Neither ewe (P = 0.7157) nor lamb (P = 0.3042) effects were observed for glucose AUC, but sheep*lamb interaction (P = 0.0104) was observed in the glucose test, therefore in lambs born from ewes that received vitamin D, the injection of the vitamin improved insulin sensitivity, as it reduced blood glucose (smaller AUC), while for lambs born from ewes that did not receive the vitamin, administration of this led to lower insulin sensitivity.

Conclusion and implications
Therefore, observing only the glycemic curve, one month after birth it is recommended to administer vitamin D to lambs only if their mothers receive vitamin D in the final third of pregnancy. More studies should be conducted following the long-term impact of this vitamin on the lives of these animals, evaluating aspects of health and production.

Acknowledgements and fundings
To the FAPESP, for supporting the research project (process number 2014/17297-9).

doi: 10.1016/j.anscip.2023.01.319

P-042
Oxidative metabolism in lambs from ewes supplemented in pregnancy and that were supplemented with vitamin D 24 hours of birth

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Keywords: Antioxidant; Sheep; Reactive oxygen species; Cholecalciferol

Introduction
In the adaptation to extrauterine life, physiological and metabolic changes occur, as well as an increase in blood perfusion with rapid exposure of tissues to high concentrations of oxygen. There is a higher metabolic, which if not compensated by antioxidant, can lead to oxidative stress. In humans, beneficial effects of vitamin D administration have been shown to minimize oxidative stress. Thus, the objective was to evaluate the parenteral use of vitamin D on the oxidative metabolism of lambs born from ewes supplemented or not with vitamin D, throughout the gestation period, until the first month of life.

Material and methods
In a 2 × 2 factorial arrangement, 29 newborn lambs, confined in pens without access to sunlight from conception, were distributed in four groups: DD-lambs from ewes supplemented with 70,000 IU/kg of vitamin D, intramuscularly (IM), on the 108th day of pregnancy and who also received vitamin D at 24 hours of life (n = 9); DC-lambs from ewes treated with vitamin D, but not supplemented (n = 8); CD-lambs from ewes that did not receive vitamin D, but were supplemented with the same dose of vitamin D at 24 hours of age (n = 6); and CC-lambs from ewes that did not receive vitamin D and that also did not receive the vitamin (n = 6). Blood samples were collected at two and 28 days of age to evaluate the activities of the superoxide dismutase (SOD) and glutathione peroxidase (GSH-Px) and for the determination of total

antioxidant status (TAS), ferric reducing ability of plasma (FRAP) and thiobarbituric acid-reactive substances (TBARS). The statistics analyzes were performed using Proc Mixed for repeated measures, using the SAS package. The model included fixed effects of administration to sheep, administration to lamb, sheep*lamb interaction and the respective double and triple interactions with the time factor.

Results and discussion
Lambs from ewes that received vitamin D, regardless of having received vitamin D, had higher levels of vitamin D after 48 hours (P = 0.0001). After four weeks, vitamin D levels were higher in lambs supplemented 24 hours after birth, regardless of ewe supplementation (P = 0.0001). As there was no sanitary or oxidative challenge for these animals, which remained healthy throughout the study period, vitamin D supplementation did not influence the activities of SOD and GSH-Px, nor the values of TBARS, TAS and HRFP (P > 0.05).

Conclusion and implications
Vitamin D supplementation was not beneficial for lambs kept from conception to the first month of birth with no access to sunlight and no sanitary and/or health challenges. More studies should be carried out so that animals supplemented in this way are challenged with health and/or higher oxidative metabolism.

Acknowledgements and funding
To the FAPESP, for supporting the research project (process number 2014/17297-9).

doi: 10.1016/j.anscip.2023.01.320

P-043
Evaluation of the efficacy of an inactivated vaccine in a sheep farm with historic presence of *Salmonella* Abortusovis abortions

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Keywords: Abortions; Salmonella; Sheep; Vaccine

Introduction
Abortions caused by *Chlamydia abortus* and *Salmonella* Abortusovis are an important cause of economic losses in ewes. In endemic areas, *S.* Abortusovis may cause reproductive disorders in up to 50% of ewes of the flock[1]. Field veterinarians are concerned that vaccines may fall behind the endemic presence of these pathogens; thus, they habitually attempt to reinforce immunity by giving a further booster dose. The aim of this study was to evaluate the efficacy of different vaccination plans against abortions in a farm with a historic presence of *S.* Abortusovis abortions.

Material and methods
A breeding sheep farm with reproductive disorders in up to 60% of the flock in previous years was selected for the study. It was located 2 km from Bellac (France), in an area where *S.* Abortusovis was considered endemic. The presence of this pathogen on the farm was confirmed in the previous year by ELISA. Ewes were recruited for the study and allocated into 4 groups. Group A (n = 24) and B (n = 23) were vaccinated with an inactivated vaccine (INMEVA®,HIPRA) at 5 and 2 weeks before mating, and the second group (B) also received a booster dose at 3 weeks after the pregnancy test; Group C (n = 24) was administered with two doses of the vaccine (INMEVA®,HIPRA) during the pregnancy test and 3 weeks after; Group D (n = 48) was not vaccinated and used as control group. The reproductive performance of the ewes was monitored up to the lambing period. Births were classified as successful lambing or reproductive disorders; the latter entailed stillbirth (even if just one lamb of two was aborted) and missed lambing. Group performances were compared by Chi-square with Bonferroni's correction.

Results
Reproductive disorders were detected in around 51% of Group-D ewes. The tested vaccination plans showed different grades of reduction of the reproductive disorders, though no statistically significant differences were observed among them. Group A, B and C presented, respectively, 53.46%, 72.08% and 64.46% fewer ewes with reproductive disorders in proportion to group D.
When the vaccinated animals (groups A–C) were merged into one single group for data analysis purposes, the reproductive disorders were significantly reduced by 63.35% compared to group D. Despite the historic records suggesting that *S.* Abortusovis was likely the causing agent of the observed reproductive disorders, it was not possible to confirm its presence during the study as no diagnostic test was performed.

Conclusion
In conclusion, this inactivated vaccine (INMEVA®,HIPRA) was shown to reduce the reproductive disorders in ewes and thus to be a reliable solution for improving reproductive performance in a breeding farm with reproductive disorders likely associated with *S.* Abortusovis[2] or *C. abortus*[3].

doi: 10.1016/j.anscip.2023.01.321

P-044
Vaccination with an inactivated vaccine against abortion during the latest month of pregnancy do not jeopardize the reproductive performances of ewes

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Keywords: Abortions; Chlamydia; Salmonella; Vaccination

Introduction
Abortion caused by *Chlamydia abortus* and *Salmonella* Abortusovis are an important cause of economic losses in ewes. The disease is usually presented during the late pregnancy period and thus vaccination is generally recommended before mating. Despite this, vaccines are used sometimes in field as emergency measure in face of outbreaks and this might imply to vaccinate during the latest month of pregnancy. One of the mayor concerns of this last-minute solutions is its safety. The present study pretended to evaluate the safety of the administration of an inactivated vaccine during the latest pregnancy period.

Material and methods
Pregnant and synchronized ewes were recruited for the study and allocated into 5 groups. Group 1 (n = 18) was vaccinated with an inactivated vaccine (INMEVA®) at respectively 5 and 2 weeks before lambing (wbl); group 3 (n = 10) and group 4 (n = 10) were vaccinated at 2 wbl with a single dose of 2 ml and 4 ml of the vaccine, respectively. The vaccine was not indicated to be administered during the latest month of pregnancy and thus at 2 wbl. Groups 2 (n = 10) and 5 (n = 9) were injected with 2 doses of PBS (2 ml each) at respectively 5 and 2 wbl and a single dose at 2 wbl. The reaction at the site of injection, systemic and the rectal temperatures were monitored before the administration of each dose of the vaccine, 4 and 24 hours later. The reproductive performances of the ewes were recorded.

Results
Results showed that vaccination with any of the tested plans did not produce any visible local or systemic reaction. A temporal increase of rectal temperature was observed 24 hours after vaccination which recover back 24 hours later. This increase was observed in all vaccination plans and at each dose administered; on average the increase was between 0,76°C and 0,9°C. An ewe aborted in group 4 and 5 and another one delivered a stillborn lamb in group 2. Beside this, some ewes of group 1 and 4 did not lamb, but no foetal expulsion was observed. It is likely these ewes showed foetal mortality during mid-pregnancy which resulted in resorption of the foetus.

Conclusion
The reproductive disorders observed during the study were not due to vaccination as presented also in control group.
In conclusion, the inactivated vaccine (INMEVA®) does not compromise ewe health or reproductive performances when administered during the latest month of pregnancy; therefore, it is a safe solution to control abortion storms caused by *Chlamydia abortus* and *Salmonella* Abortusovis in ewes.

doi: 10.1016/j.anscip.2023.01.322

P-045
Development of a therapeutic subunit vaccine for contagious ovine ecthyma

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Keywords: Orf Virus; Recombinant DNA; Leukocyte; Antibodies

Introduction
Contagious Ecthyma is caused by a dermatotropic virus – Orf virus (ORFv) – of the genus *Parapoxvirus*, Poxviridae family. It is an agent with zoonotic potential. It is highly prevalent around the world and causes productivity losses and negatively affects animal welfare. The main commercial vaccines worldwide are of live attenuated virus technology, which lead to major undesirable side effects. These vaccines are known for not inducing long-lasting memory responses, leading to temporary protection, moderate efficacy. The objective of this work is to develop a vaccine alternative, using recombinant viral fragments

Material and methods
The vaccine is based on recombinant DNA technology, on the prediction of the most antigenic peptide sequences within the target proteins. Immunogens were formulated using recombinant fragments of structural and non-structural portions (nsp) of the virus. The viral peptides were produced in fusion with a PHB-binding region, a biopolymer used as a vaccine adjuvant. Plasmids were transformed into *E. coli* BL21 DE3 bacteria for expression in culture. The vaccine antigens were purified by affinity chromatography and differential centrifugation. For the evaluation of immunogens in the target species, fifty lambs of 38–42 days of age were immunized with two full doses -200 μL of the experimental vaccine, applied intradermally, with an interval of 21 days between doses. Another fifty animals, contacts received half-dose-100 μL, and another 50 animals were used as non-immunized control group.After 15 days of vaccination of the second dose, blood was collected from all animals. Leukocyte number and phagocytosis activity were measured by flow cytometry (FACScalibur, BD), using pHrodo zymozan beads and CountBright (ThermoFisher Scientific). The humoral response of infected sheep was evaluated against the recombinant peptide. The serum of animals clinically affected or not by ecthyma (within the same herd) were tested in indirect ELISA. Secondary antibody was a rabbit anti-sheep Ig (Abcam). The avidity test repeated the protocol of the indirect ELISA, with the difference of diluting the samples in 1M urea in PBS. Statistical analysis was performed using GraphPad Prism (GraphPad, Inc.) by Kruskal Wallis at $P < 0.10$.

Results and discussion
Anti-nsp antibodies were strongly induced, comparing serum samples before and after vaccination.Furthermore, an avidity test was performed to assess whether there was affinity maturation of antibodies against the vaccine antigen. Vaccinated animals demonstrated high avidity after vaccination, in opposition to control lambs.

Conclusion and implications
The experimental vaccine against Contagious Ecthyma induced the production of specific antibodies with high avidity following a two-dose immunization protocol. Ecthyma lesions disappeared in both experimental groups. However, this positive natural history of the infection – with rapid resolve of the outbreak – is different from historical controls for the same parental herd.

doi: 10.1016/j.anscip.2023.01.323

P-046
Serological status of Brucellosis in smallholder small ruminant farms in Punjab, Pakistan

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Keywords: Brucellosis; Serology; Indirect ELISA; Zoonosis

Introduction
Sheep and goats are a major source of livelihood, employment, and income for millions of rural households in Pakistan. Diseases like brucellosis hamper productivity due to the loss of milk production, abortion, and reproductive failure. Brucellosis is mainly caused by *Brucella melitensis* in sheep and goats, and other *Brucella* infections may be due to some other species.

Material and methods
Sera were collected from goats and sheep managed in small-scale farming systems in a village in northern Punjab, Pakistan typical of small ruminant farming across Punjab and Sindh. There is no history of vaccination against Brucellosis in this area. Households were sampled in a semi-convenience design, based on previous participation in applied small ruminant farming research in the area, on four occasions (December 2019, February, August, and November 2020). Sera were analyzed for the presence of antibodies to *Brucella melitensis.* using the Rose Bengal Plate Test (RBPT), and indirect ELISA kit (Cat# BRUS-MS-5P, IDVET®, France). The RBPT test was performed according to the procedure described by Alton et al. The tests used for the detection of *Brucella* antibodies had a sensitivity of 89% and specificity of 96% in the case of RBPT and 92.9% and 99.11% in the case of I-ELISA respectively. According to the manufacturer's protocol, results were categorized based on the S/P ELISA result into 3 categories: negative, suspect, and positive.

Results and discussion
A total of 325 animals (goat = 267 and sheep = 58) from 10 households in the village were sampled. The results show that there is little or no infection in the area. We found no seropositive animal and 321/325 animals were seronegative both by RBPT and I ELISA. The total num-

ber of adult animals tested was 229. Four animals (3 goats and 1 sheep) were classified as suspects in which there were 3 adult animals. Based on the reported test sensitivity and specificity, the estimated true prevalence of the disease was 0.36%. Conversely, fewer than six positives in the sample size suggest freedom from *Brucella* infection at a design prevalence of ≥3%.

Conclusions and implications
Although not from a truly random sample, our results suggest that Brucellosis occurs at low prevalence in this area. Longitudinal studies are required to identify whether this is a steady-state situation, or whether prevalence increases in some years. This prevalence likely represents an ongoing zoonosis risk to smallholders, even if its production impact is smaller. Considerable emphasis is typically placed on Brucellosis as a widespread cause of abortion in small ruminants, but our results show that investigations into causes of pregnancy loss and abortion outbreaks must consider all plausible differential diagnoses and that *Brucella* infections should not be considered ubiquitous in smallholder goat and sheep farming systems in Pakistan

doi: 10.1016/j.anscip.2023.01.324

P-047
Randomized controlled trial: impact of an inactivated vaccine against biofilm-forming *Staphylococcus* spp. on udder health parameters in yearling dairy goats

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Keywords: Mastitis; Saanen; Goat; Vaccine

Introduction
Staphylococci are the main pathogens causing clinical and subclinical mastitis in dairy goats.
Implementing a mastitis control program helps to improve milk quality and disease prevention. One of the measures that can be included in control programs is vaccination. The study evaluates the impact of an inactivated vaccine against biofilm-forming *Staphylococcus spp* (VIMCO®, HIPRA) on udder health parameters in yearling goats.

Material and methods
A longitudinal, randomized field trial was performed on the commercial dairy goat farm called "De Römer Dairy Goats" (Heythuysen, Netherlands) with 3,000 mainly Saanen goats. A group of 349 pregnant yearling goats (12–16 months) was randomly divided into a control group (n = 180) and a vaccinated group (n = 169). Animals in the vaccinated group were vaccinated (VIMCO®) two times at least 14 days before kidding with a 21 days interval. All goats gave birth within a 5-week kidding period (most on February, 2022). On March 10, 2022, all yearling goats were mixed into a group with 1,600 non-vaccinated adult goats.
All goats were scored at the first milking after kidding (T = 0) for clinical mastitis by fore stripping and inspection of the udder for udder symmetry. Milk yield, somatic cell count (SCC), udder symmetry scores, clinical mastitis cases and death due to gangrenous mastitis were recorded within the 4-month period from the start of vaccination. Overall asymmetry was defined as the percentage of goats with at least one asymmetric udder score at T0, T1 (March 7, 2022) or T2 (April 26, 2022). All data were statistically processed to make a comparison between the intervention and the control group.

Results
At kidding (T0), 5.6% of goats in the control group and 0.6% of goats in the vaccinated group had clinical, non-gangrenous mastitis (p = 0.008). Overall asymmetry was detected in 16% and 7.7% of goats in the control and vaccinated group, respectively (p = 0.016). Completely dried up udders were present in 5 goats in the control group and 2 goats in the vaccinated group (p = 0.5). Death due to gangrenous mastitis was seen in 8 goats in the control group and 4 goats in the vaccinated group (p = 0.3). Milk yield and SCC did not differ between the vaccinated group and the control group.

Conclusion
This trial shows that the vaccine assessed in this study (Vimco®) prevents in yearling goats clinical mastitis at first milking, as well as udder asymmetry during first two months after kidding, but an effect on SCC and milk yield remains to be demonstrated. Altogether, vaccination has a positive impact on the udder health of yearling dairy goats.

doi: 10.1016/j.anscip.2023.01.325

P-048
Effects of humic acids on performance, immune responses and parasitic infection of lambs: Preliminary results

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Keywords: Humic acid; Lamb health; Gastrointestinal nematode; Sheep production

Introduction
The control of parasitosis is based upon anthelmintics. However, its long-term and indiscriminate use can select populations of resistant nematodes. Among other alternatives, humic acids (HA) are being studied to manage this global problem. HA have been successfully used to modulate rumen activity and increase blood parameters as total protein and globulin in goats, as well as stabilize intestinal flora in broilers. Also, HA act forming a protective film on the mucosa of the gastrointestinal tract. However, research in sheep is scarce. This study aimed to investigate the effects of a humic acids (Huminsäuren WH67® – Pharmawerk Weinböhla) upon blood biochemistry and parasitological parameters in lambs.

Material and methods
Twenty weaned ½ Hampshire Down crossbred lambs aged 102.1.0 ± 6.8 days and with body weight of 24.2 ± 3.5 kg were randomly allocated into two groups (n = 10 lambs). The control group (CG) received the basal diet without feed supplement and the treated group (TG) received the same basal diet supplemented with the HA into the feed at a dose of 500 mg/kg/day. The experimental period was 56 days. The lambs were naturally infected with gastrointestinal parasites. Every two weeks the following parameters were evaluated: body weight (BW), average daily gain (ADG), white blood cell differential count (WBC), haematocrit (Ht), plasma protein (PP), faecal egg count (FEC) and diarrhea score (score 0 = normal consistency – well-formed and slightly moist dung to score 4 – watery consistency). Data were analysed using ANOVA and Tukey's test ($p \leq 0.05$).

Results and discussion
Haemonchus sp. was recovered most frequently from the larval culture (95%). HA in the diet of lambs did not alter ($p > 0.05$) BW (CG: 34.6 ± 4.6 Kg; TG: 33.1 ± 4.5 Kg) or ADG (CG: 0.182 ± 0.101 g; TG: 0.166 ± 0.123 g) in this study. The Ht, PP and WBC did not differ ($p > 0.05$) among the two groups, as well as it didn't affect the parasitic infection (CG: 1525.0 ± 2517.4 eggs per gram of feces (EPG); TG: 1022.2 ± 1233.0 EPG), although FEC was not statistically significant, our results showed that TG lambs had numerically lower EPG compared to CG. This may be due to the immunomodulatory properties of HA, which can affect both the morphology and fertility of female parasites (Jooné et al. 2003; Rowe et al. al., 2008; Hernández et al., 2017). The HA didn't change fecal consistency

Conclusion and implications
HA treatment under the presented experimental conditions with 500 mg/kg/day of HA for 56 days didńt change the evaluated parameters in comparison with the control group. The study is at the moment being complemented with histological, immunohistological and microscopically tissue evaluation to further understand action of HA in the sheep.

Acknowledgements and funding
We thank WH Pharmawerk Weinböhla GmbH for sponsoring this study.

doi: 10.1016/j.anscip.2023.01.326

P-049
Ovine tonsillar bacteriology – A summary of findings in ewes submitted as part of the APHA thin ewe investigation project

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Keywords: Commensal; Tonsils; Bacteria; Disease

It is well recognised that the tonsils are an area of commensal bacterial carriage in sheep with many of these organisms being potentially pathogenic and associated with diseases that have significant economic and welfare impacts on the sheep industry, such as respiratory disease and joint ill.

During autumn 2020 and spring 2021, the APHA Small Ruminant Expert Group ran a Thin Ewe Project investigating potential causes of poor condition in sheep flocks across England and Wales Bell et al. (2021). Private Veterinary Surgeons (PVS) were invited to recruit farms and submit up to three thin ewes for post mortem examination (PME) from which various samples were collected in order to determine if the "iceberg diseases" (specifically Johnes, Maedi Visna, CLA, OPA and Border Disease) were present in the flock. In addition to the investigative sampling protocol swabs were collected and cultured from the tonsillar crypts from all the submitted animals to identify the range of potentially pathogenic bacteria that inhabit this area.
Swabs were cultured onto 5% sheep blood and MacConkey agar and incubated aerobically overnight (16–20 hours) at 37 °C. Plates were then examined by experienced bacteriologists. Any predominant colonies and/or those of likely pathogenic significance were sub-cultured and fully identified. Disc diffusion antimicrobial susceptibility testing was performed on each isolate.
A total of 198 sheep were examined. The most commonly detected organism was *Bibersteinia trehalosi*, followed closely by *Mannheimia haemolytica*. Other organisms of interest isolated included *Pasteurella multocida, Streptococcus dysgalactiae dysgalactiae, Trueperella pyogenes* and *Staphylococcus aureus*. Interestingly, an antigenic variant of *Salmonella enterica* subspecies *diarizonae* 61:-:1.5 was detected in two sheep.
The results confirm that many pathogenic organisms reside as commensals in the upper respiratory tract, and more specifically in the tonsillar crypts. As this project only used a culture-based method additional bacterial species may have been recovered if sequencing technologies were used. How these commensal bacteria populations change over time and during disease is an interesting area of further study, which could help to increase our understanding of the pathogenesis of disease and may provide insights into future control strategies. In addition, understanding the role these organisms may play as potential reservoirs and/or donors of antimicrobial resistance genes between themselves and other ovine pathogens is an extremely important subject requiring further research.
Funded by Defra scanning surveillance project ED1100.

Reference

Bell, S., Carson, A., Collins, R., Dunnett, L., Reichel, R., Richey, M., 2021. APHA thin ewe investigation project. Veterin. Record. 189 (3), 106–108.

doi: 10.1016/j.anscip.2023.01.327

P-050
Unveiling the factors associated with ewe death, casting in an extensively farmed sheep flock

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Keywords: Ewe mortality; Wastage; Longevity; Survival

Introduction
Ewe deaths affect the productivity and profitability in sheep farming systems and have issues in terms of potential animal welfare implications and consumer perceptions. Internationally, there is scant data on the timing and causes of ewe deaths in extensive grazing systems. Reported ewe mortality rates are in the range of 2.8–27%, and few studies have described relationship between productive parameters and ewe mortality in outdoor grazing systems. There is no published literature on the incidence and risk factors associated with casting (ewe in late gestation accidentally immobilised, often in dorsal recumbency). This study reports some factors associated with production parameters (live weight, body condition score, and litter size) on both ewe mortality, which becomes cast through an almost two-year period, along with causes of death during peripartum periods.

Material and methods
This study utilised a cohort of 1789 ewes on a New Zealand farm, the ewes were 16 to 19 months of age. Ewes were weighed and body condition score assessed at eleven key management times. Additionally, ewes were monitored for a period of time over lambing (20–24 days). During these observations, dead or compromised ewes were identified. The compromised ewes that required intervention were restrained and assessed based on the severity of presenting conditions and either treated if possible or euthanized on welfare grounds. Scoring systems were developed to record interventions for compromised ewes.

Results and discussion
Ewe deaths occurred throughout two years of the study but were most frequent during the peripartum (pre-lambing to mid-lactation) period. Over the study period, in the absence of intervention, it was assumed that 222 of the 1789 ewes would have died (12.4%). However, due to intervention during the lambing monitoring period, 180 ewes died (10.1%).

Casting was the most commonly identified cause of death, responsible for approximately a quarter to a third of potential annual mortality. This study identified other causes including vaginal prolapse and dystocia. Few risk factors for death or casting were identified. The factor associated with increased odds of becoming cast was litter size, such that triplet-bearing ewes were more likely to become cast than single-bearing ewes (OR 13.53, 95% CI 1.50–122.36; $p = 0.03$).

Conclusion and implications
The peripartum period is a high-risk time period for ewe deaths (and, by extension, will also contribute to lamb perinatal mortality). In extensively grazed flocks where casting events occur, it is recommended that all ewes are monitored daily during the peripartum period. It would be remarkable for farmers to routinely check ewes during lambing to proactively reduce mortality rates.

Acknowledgements and funding
The authors wish to acknowledge Geoff Purchas for his invaluable technical assistance and Limestone Downs staff. The C. Alma Baker Trust funds this research.

doi: 10.1016/j.anscip.2023.01.328

P-051
Assessment of signs compatible with caprine arthritis-encephalitis in three farms

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Keywords: Lentivirus; Health risk; Productivity; Caprine arthritis-encephalitis

Introduction
The virus of caprine arthritis-encephalitis is worldwide distributed, being the main route of transmission the colostrum and milk intake. Horizontal transmission can also occur by direct contact with fomites. The infection can also be shared between farms, usually due to the introduction of new animals that spread the disease. Most of the animals remain asymptomatic for long periods, however, neurological and respiratory signs may occasionally appear in kids, and more commonly in adults; signs such as polyarthritis, chronic pneumonia and indurative mastitis affect significantly milk production and animal weight.
In Colombia, there is little information on the presentation and epidemiology of the viral disease, nor its financial impact on the goat production systems. Although some laboratories diagnose the presence of antibodies against the virus, there is a lack of diagnostic tests for the antigen in the goat population. Due to the scarce information about the epidemiological situation of this disease, this project undertakes a first approach to its prevalence on three goat farms in an area of milking production in Colombia. The present study aimed to establish the prevalence of caprine arthritis-encephalitis through blood samples for ELISA analysis of goats that present relevant clinical signs compatible with the disease.

Material and methods
This project evaluated the presence of symptomatic signs of caprine arthritis-encephalitis on the goat population of three farms in the department of Cundinamarca. The assessed variables were: Body condition score, Famacha®, Respiratory frequency, Cardiac frequency, osteoarticular system evaluation, reproductive system (mammary gland) evaluation and temperature. In addition, 40 blood samples were taken for diagnosis through ELISA. The animals sampled were between 2 and 12 years old, and their breeds were Alpine and Saanen.

Results and discussion
Preliminary results have shown a significant presence of symptomatic signs of caprine arthritis-encephalitis. There was severe inflammation of the carpal area in 35% (14/40), and moderate inflammation in 52.5% (21/40) of the sampled population, which can be a cause of claudication and abnormal gaits. Inflammation of the mammary gland was shown in 17.5% (7/40) of the sampled females, which generated a significant reduction in milk production. The ELISA results showed 18 individuals tested positive.

Conclusion and implications
These partial results suggest that caprine arthritis-encephalitis might be a disease with an important incidence in the goat production system in Colombia. Undoubtedly, it affects the productivity and rentability of the farms. It is important to undertake studies about the epidemiology and association factors of the disease in different areas of Colombia as well as diagnosis tests accessible to producers and animal professionals. Additionally, there is a lack of knowledge of the disease including prevention measures by the producers.

Acknowledgements and funding
The authors wish to acknowledge Fundación Universitaria Agraria for funding this project.

doi: 10.1016/j.anscip.2023.01.329

P-052
Clinical evaluation of respiratory disease in sheep from the Western Amazon

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Keywords: Bronchopneumonia; Thoracic ultrasound; Hematological analysis; Ovine

Introduction
Brazilian sheep farming, remarkably family farming, has been increasing recently. To date, respiratory disease is one of the major causes of economic losses and should be better understood. Therefore, this study aimed to conduct a clinical survey of respiratory conditions in sheep from the Western Amazon region in Brazil, using different diagnostic methods.

Material and methods
Forty male and female, six months to one-year-old sheep raised in family farms were evaluated. Physical examination was conducted in all sheep, which were characterized as healthy and showing respiratory illness (by showing two or more of the following symptoms: respiratory rate greater than 30 movements per minute, presence of cough or positive cough reflex, rectal temperature greater than 40 °C, areas of silence, fine crackles, thick crackles, snoring and/or wheezing on lung auscultation, and presence of mucous, mucopurulent or purulent nasal discharge.). In addition, thoracic ultrasound and hematological analysis were also performed.

Results and discussion
Twenty-three sheep were characterized as healthy and 17 as sick. A few clinical manifestations (respiratory rate, nasal discharge, pulmonary auscultation) were associated with the disease ($P < 0.05$). Also, the body condition score was associated with illness; 58.82% of the sick animals showed a score equal to or less than two ($P < 0.05$). The body condition score is helpful, and any disease, including the respiratory ones, leads to weight loss and delay in time to slaughter, affecting the sector's profitability. In addition, the hematological evaluation showed sick animals had more significant leukocytosis than healthy animals ($P < 0.05$). The hematological analysis provides relevant information, mainly regarding guidance on infectious causes. Finally, the ultrasound revealed thoracic alterations in healthy (21.73%) and ill (35.29%) sheep.

Conclusion and implications
Thoracic ultrasound is a non-invasive, fast and effective diagnostic tool that evaluates lesions and alterations in the lung parenchyma, pleura and interpleural space in real-time. The presence of thoracic alterations in healthy animals may be related to old respiratory diseases. The physical evaluation efficiently identifies respiratory illness, and the complementary exams help diagnose it. Respiratory disorders have a high incidence in sheep farming in Brazil's northern region, and this study provides new information on the subject in the area.

Acknowledgments and funding
The authors would like to thank the Research and Extension Group of Veterinary Clinics and Immunology of the Federal University of Rondônia Foundation (GPEC-UNIR), the Microbiology Laboratory of UNIR - Campus Rolim de Moura and the Laboratory of Research in Milk Quality (QUALILEITE) of the University of Sao Paulo, and the National Council for Scientific and Technological Development (CNPq). LMSC (PVC375-2021) and JMSS (PVC376-2021) are research fellows of CNPq. NCG is a research fellow of the São Paulo Research Foundation (protocol # 2020/15008-0).

doi: 10.1016/j.anscip.2023.01.330

ISVA: Teaching and transfer

P-053
Telemedicine interpretation of sonogram recordings of suspected lung and pleural pathologies

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Keywords: Telemedecine; Ultrasound; Diagnosis; Training

Introduction
Telemedicine is defined as the remote diagnosis (and treatment) of patients by means of telecommunications technology. Telemedicine allows veterinary practitioners to communicate reports, images, and video recordings of problematic cases with species and discipline specialists. Smart phone technology enables access to expert opinion even when on the farm. This study investigates the uptake of telemedicine in small ruminant practice in the United Kingdom (UK) by reporting the number and quality of sonogram recordings submitted for confirmation of suspected lung and pleural lesions including ovine pulmonary adenocarcinoma (OPA).

Materials and methods
Over six years (2015–2021) 89 veterinary practitioners attended a one day small ruminant ultrasonography practical course. Sixty video recordings of sonograms representing the common lung and pleural pathologies were described during the course then provided to all delegates on a memory stick allowing future study. Delegates examined between 12–16 sheep during a 2–3 hours' ultrasound practical session and were shown how to record significant lung and pleural pathologies using Elgato video capture software. Delegates were strongly recommended to purchase this software programme (cost approximately 110 euro) for reflective learning purposes and telemedicine where necessary. Sonogram recordings could be e-mailed to the authors at any time with an expected reply within 24 hours at no cost.

Results and discussion
Only eight video recordings were received; six recorded the ultrasound machine screen using a smart phone and two Elgato recordings; only the Elgato recordings were of diagnostic quality and both recordings were consistent with advanced OPA. Smart phone video recordings were poor quality caused by background reflections. Two screen-grab images were received; one image was consistent with moderate OPA while the other clearly showed liver parenchyma. Despite the excellent reflective learning experience afforded by good quality video recordings of lung and pleural pathologies only three veterinary practitioners referred any scans to a free, same day expert telemedicine service.

Conclusion and implications
Confidence in ultrasound diagnosis of lung and pleural pathologies necessitates repeat examinations to monitor changes and where appropriate, such as in OPA, a large number of necropsies with laboratory confirmation (gold standard) and/or supportive interpretation of video recordings by someone with published specificity results of several hundred cases. A recent publication, where the veterinarian had conducted no necropsy confirmation of any suspected OPA cases, reported very poor lung lesion identification highlighting the necessity of clinical audit and continuing education. Most UK small ruminant practitioners failed to engage with a free expert telemedicine service; cost was not a confounding factor as the service was offered *gratis*. Promotion of telemedicine is necessary to improve uptake and thereby diagnostic accuracy in small ruminant ultrasonography.

doi: 10.1016/j.anscip.2023.01.331

P-054
Teaching and transfer: Contribution to development of students' skills to work in sheep farming

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Keywords: University extension; Sheep farming; Graduation; Learning

Introduction
Sheep farming is a traditional activity of high socioeconomic importance in the extreme south of Brazil. Despite this, sheep meat production chain can be considered in transition and still suffers with low competitiveness in the international market and faces difficulties to supply domestic demand. This situation is due to low quality meat produced, high costs, low production scale and informality of products distribution. In order to increase local State sheep flock, turn the activity competitive and take advantage of the development opportunities in this production chain lacks a sum of efforts between producers and technicians. Producers training, herd genetic selection according to the property focus, pastures preparation orientated to each animal category, adequate reproduction programming and production optimization are crucial points to have a profitable and competitive sheep farming in the foreign market. Therefore, RuminAção Nucleus has been working on student's skills improvement, developing applied researches and extension activities with local sheep farmers.

Material and methods
RuminAção consists of undergraduate and graduate students and is coordinated by professors from the Faculty of Veterinary Medicine of the Federal University of Rio Grande do Sul. Veterinary and animal husbandry students develop activities at the faculty's sheep production unit and at the farm-school, and later the learning is consolidated in extension actions on assisted commercial properties. The major activities performed are: (1) Gastrointestinal Worms Control; (2) Clinical care and health management; (3) Reproductive management with obstetric and neonatal follow-up and (4) Etiology of mastitis and antimicrobial resistance in dairy sheep. At the sheep production unity, the students are also responsible for nutritional management and maintenance of facilities. Symposiums and lectures related to sheep farming, nutrition, health and reproduction for producers, technicians and students are also activities developed by the team.

Results and discussion
Since 2015, more than 50 students have passed through the team. Besides technical training, an effective students participation on all activities allows them to develop other skills such as: teamwork, communication, ability to diagnose problems and offer solutions. The extension actions encourages student's adaptability, creativity and self-confidence. Properties problems are used as a basis to develop researches by graduate and scientific initiation students in order to understand and solve these problems and also to contribute and consolidate partnerships with sheep farmers and private companies.

Conclusion and discussion
To conclude, those practical experiences provides a formation of skilled professionals that dominate the knowledge of field realities and either helps to contribute for a proper students professional insertion in different sectors. Furthermore, favors sheep farms development and future professionals careers establishment in the field.

doi: 10.1016/j.anscip.2023.01.332

P-055
The effect of polyandroalbumin vaccination and an injectable trace mineral to P-up pre-mating and pre-lambing on scanning rates in high performing composite ewes

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Keywords: Polyandroalbumin; Scanning rate; Productivity; Antioxidants

Introduction
Improving productivity in the face of increasing input costs is essential for the profitability of sheep farms. The main drivers are reproductive and survival rates (lamb and ewe).
Geldard et al. (1984) reported an average improved lambing rate of 23% by using a polyandroalbumin vaccination program. Management and genetics have improved significantly since then, leading to questions on the validity in high performing composite ewes – have we reached the biological limit?
Gonzalez-Rivas et al. (2021) reported a 9% improvement in marking rates giving an injectable trace mineral four weeks pre-mating and four weeks pre-lambing.
The hypothesis of this study was that treating ewes with androstenedione pre-mating, and an injectable trace mineral pre-mating and pre-lambing, will improve scanning and marking rates in already high performing composite ewes.

Materials and methods
The study was conducted in 2021 on a farm that regularly scans more than 160%, with triplet survival rates on average above 67%.
1,905 mixed age, mature ewes were randomly allocated to four treatment groups, tagged with electronic ear tags, weighed and condition scored at the start of the study:

1. Untreated control
2. Polyandroalbumin (Ovastim®) treatment only
3. Injectable trace mineral (ITM) (Multimin® plus Copper for Sheep) four weeks before mating and lambing.
4. Polyandroalbumin and Injectable trace mineral (ITM) treatments as per group 2 and 3

The pregnancy status and timing of conception were determined by ultrasound. The ewes were then separated into lambing status mobs and provided feed on offer (FOO) levels consistent with their pregnancy status.
Data were analysed using ANOVA, and significance was defined at $p < 0.05$.

Results and discussion
Initial blood copper levels prior to mating were adequate, selenium levels were marginal to adequate. Pasture trace elements levels were normal. The average condition scores of all ewes were 4.1.
There was a highly significant effect of all treatments on the number of lambs scanned ($p < 0.05$) and the timing of pregnancy ($p < 0.0001$).

Group 1: Litter size of 1.65 ± 0.033
Group 2: Litter size of 1.91 ± 0.032
Group 3: Litter size of 1.76 ± 0.027
Group 4: Litter size of 1.89 ± 0.031

Conclusion
The results confirm the hypothesis that treating ewes with androstenedione and an injectable trace mineral, improve scanning rates and the timing of pregnancy, even in high producing flocks.

Acknowledgements and funding
Virbac commissioned and funded the study.

References

Geldard, H. et al., 1984. Immunisation of ewes with polyandroalbumin to improve fecundity. Aust. Vet. J. 61 (4), 130–132.
Gonzalez-Rivas, P.A., Swaney, S., Evans, R., Chambers, M., Liu, J., 2021. Effect of a trace mineral injection before joining and lambing on conception rate, marking rate and lamb weights in diverse farms in Victoria. Animal Prod. Aust. 33, cxxviii.

doi: 10.1016/j.anscip.2023.01.333

P-056
Updating a 20-year-old code of practice for the care and handling of goats

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Keywords: Goats; Welfare; Guidelines; Handling

Introduction
The National Farm Animal Care Council (NFACC) is a Canadian organization that brings together diverse stakeholders to develop Codes of Practice for the care and handling of farm animals. Codes of Practice represent guidelines for responsible care and serve as the national understanding of animal care requirements and recommended practices. Codes are developed in agreement with a standardized Code Development Process and require consensuses between diverse stakeholders. Completed Codes provide a basis for animal care assessment programs and are frequently referenced within provincial animal welfare legislation.

Material and methods
A multi-stakeholder Code Development Committee (CDC) and a Scientific Committee (SC) consisting of international goat scientists were created in 2019. The committees agreed on priority welfare issues that the SC would then review and prepare a report.
From 2019 to 2020, the CDC, in conjunction with the SC and their report, completed a draft Code of Practice that was made available for a 60-day Public Comment Period (PCP). The PCP was an opportunity for those interested in Canada's goat sector to offer feedback on the proposed draft. Feedback from 230 responses was then reviewed and taken into consideration by the CDC to complete the update of Canada's 2003 *Code of Practice for the Care and Handling of Goats* in 2022.

Results and discussion
Consensus was obtained on requirements and recommended practices outlined in sections dedicated to roles and responsibilities, housing and handling facilities, emergency preparedness and management, feed and water, husbandry practices, health management, transport, and on-farm euthanasia and slaughter. This presentation will provide an overview of the process and subsequent outcomes of the new *Code of Practice for the Care and Handling of Goats,* including how a wide range of multi-sector-related interests was addressed and how such a diverse array of stakeholders successfully collaborated to reach a consensual agreement.

Conclusion and implications
In addition to the Code's role as a foundation of teachings for goat producers and industry stakeholders, the guidelines will also inform provincial animal welfare legislation and may serve as the basis for a future animal care assessment program. The Code will be publicly available in English and French, and copies will be distributed across the country. While the CDC members' official roles will have ended, they now take on the responsibility of spreading the word of the Code, sharing justification for chosen requirements and recommended practices, and encouraging practice adoption. The Code and SC report will also be utilized to direct future research and teaching endeavours.

Acknowledgements and funding
Funded in part by the Government of Canada under the Canadian Agricultural Partnership's AgriAssurance Program, a federal, provincial, territorial initiative.

doi: 10.1016/j.anscip.2023.01.334

P-057
Treatment and prevention of needlestick injuires from vaccinating livestock with vaccines containing oil based adjuvants

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Keywords: Needlestick; Oil; Adjuvant; Surgical

Introduction
Every year, across Australia, farmers and agricultural workers experience preventable needlestick injuries (NSI) with 80% of livestock farmers reporting a NSI at some time. Whilst most cause negligible problems, some have serious consequences. These injuries (while unintentional) have several factors in common. These factors include the use of vaccines, unpredictability of animals, poor animal restraint, dangerous injection technique, inappropriate first aid, inappropriate medical treatment, difficulty finding information on vaccines or on the material safety data sheets, and treatment delay resulting in various complications particularly where vaccines with mineral oil adjuvants have been used (e.g., Johnes, Pinkeye, Vibriosis vaccines). Reasons farmers cite for not reporting NSI or not changing behaviour include not remembering to do so, lack of employer support or instruction regarding safer technique, believing reporting wouldn't make any difference, and considering the injury insignificant. Medical assistance was often only sought when the inability to function due to pain, infection and requirement for surgery occurred.

Material and methods
During the 10-week period between September and early December 2018 the Emergency Department at a Regional Hospital saw five new cases of NSI (due to animal husbandry activities) and several patients with longstanding unhealed NSI seek resolution. This paper reviews two of these NSI cases that presented for treatment. Case 1 had been treated elsewhere at two hospitals. At first hospital treatment was ''washout" under general anaesthetic and intravenous antibiotics (IVI) . Did not improve and treated at second hospital with IVI and raised arm again without success. Case 2 the farmer reported "brushing past the needle", with no inoculation noted or believed as had no significant pain at the time. First sought medical advice 12 months later for marked finger swelling

Results and discussion
Both cases underwent surgical excision to remove all the granulation reaction and all traces of oily material. These cases highlight the need for prompt surgical debridement and removal of all traces of the injected vaccine material in NSI involving vaccines with highly irritant oil based adjuvants. Case 2 emphasizes the difficulty distinguishing between NSI where no material is injected and NSI where vaccine material is injected. This is critically important when vaccines with oil based adjuvants are involved.

Conclusion and implications
Globally, farmers and agricultural workers who incur a NSI risk serious impairment, infection and the high likelihood of repeated injury. This presentation will discuss educating farmers to prevent injury and appropriate first responses if a NSI occurs. Additionally communicating with and upskilling local health services, GP clinics, and Accident and Emergency Nurses, in how to respond so limited delay and appropriate treatment is provided.

doi: 10.1016/j.anscip.2023.01.335

P-058
Severe polycythemia vs. severe anemia in sheep – A retrospective study of 21 hospitalized sheep

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Keywords: PCV; Hematology; Haemonchosis; Dehydration

Introduction
Changes in the red blood count are often observed in diseased sheep, probably most prominent being the decrease of PCV in life-threatening anemia due to haemonchosis. Much more seldom sheep can suffer from elevated PCV which is called polycythemia. As there is little

information available on polycythemia in sheep so far, the aim of this study was to obtain clinical and laboratory findings from hospitalized sheep suffering from severe polycythemia and compare them with data from sheep suffering from severe anemia.

Material and methods
Retrospectively data of sheep hospitalized at the clinic within the last 6 years were evaluated. Inclusion criteria were PCV <0.10 L/L (group "A") or >0.50 L/L (group "P"), as well as the presence of data on general clinical examination, laboratory findings, confirmed or suspected diagnosis as well as duration of hospitalization and outcome (survived or not). P and A were compared by t-test or Wilcoxon-two-sample-test for clinical scores or data that failed normal distribution.

Results and discussion
PCV of <0.10 L/L (A) and >0.50 L/L (P) were found in 12 and 9 sheep patients. Main diagnosis in A was haemonchosis in 10 of the 12 animals; one sheep was suffering from leukemia, for another sheep no final diagnosis was determined. The main diagnoses in P were more diverse with hypoglycemia, diphteroid, urolithiasis, hypocalcemia, ruminal acidosis, plant intoxication, abomasitis and mesothelioma. Polycythemia in those sheep was probably a relative one, due to dehydration. Only one sheep revealed polycythemia vera due to myeloproliferative neoplasia with a PCV up to 0.77 L/L. Sheep with P had a poorer probability of survival, seven of the nine animals died or were euthanized, among the animals with A, this proportion was only four out of twelve. Sheep suffering from P revealed higher erythrocytes, Hemoglobin (Hb), PCV, neutrophils, total protein (TP), albumin (Alb), magnesium and lower body temperature, FAMACHA©-score and lymphocytes compared with sheep suffering from A. Erythrocytes from A revealed higher degrees of anisocytosis, poikilocytosis and polychromasia than from P. MCV, MCH and MCHC did not differ between A and P.
Differences in erythrocytes, Hb and PCV might be explained due to selection criteria. Elevation of TP and Alb supports the assumption of dehydration in P, higher neutrophils indicate the acute character of disease in P. Differences in magnesium and body temperature remain unclear.

Conclusion and implications
Severe polycythemia as well as severe anemia can occur in sheep. While A is often due to haemonchosis and has a fair prognosis if treated (e.g. by blood transfusion and antiparasitica), P can appear in sheep as a severe symptom of various underlying diseases and seem to have a worse prognosis.

doi: 10.1016/j.anscip.2023.01.336

P-059
The use of stromal vascular fraction in long bone defect healing in sheep

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Keywords: Animal model; Long bone defect; Orthopaedics; Surgery

Introduction
The objective of this study was the evaluation of the feasibility of using stromal vascular fraction (SVF) for the treatment or augmentation of the healing process of segmental bone defect in the metatarsus in an ovine model.

Material and methods
Unilateral, segmental mid-diaphyseal bone defect was created on the right metatarsus of skeletally mature sheep animals, under anesthesia (D0). Residual segments were stabilized by stainless-steel plate and appropriate screws. Defects were managed as follows: i) use of hydroxyapatite (HA) bone paste to filling (group A, n = 5); ii) use of autogenous bone graft mixed with HA bone paste, placed in defect (group B, n = 6); iii) use of SVF mixed with HA bone paste injected into defect (group C, n = 6); iv) use of bone graft and SVF with HA bone paste before apposition in bone defect (group D, n = 6). SVF had been previously isolated from adipose tissue of the animals intra-operatively after digestion with collagenase solution and neutralization. Animals were evaluated clinically (Kaler scale scoring) and by X-raying and ultrasonographic examination of the defect, at regular intervals until D90. For X-ray findings, the Modified Lane and Sandhu radiological system (0-10 score) was used in two orthogonal views. Ultrasonographic assessment of longitudinal scans with linear transducer along length of the defect included calculation of the length of the bone defect and assessment of vascularization. Statistical analysis included analysis of variance and analysis of covariance for comparison between groups.

Results and discussion
SVF was successfully isolated from group C and D animals, with the average yield being 1.77×10^6 mononuclear cells. In group B, C and D animals, no lameness was clinically evident after D15; in group A animals, lameness was clinically evident until D30 (in one animal up to D90) (p<0.0001 between groups until D30). In X-ray examination, scoring on D90 was as follows: 3.3 ± 0.6, 5.2 ± 0.7, 7.0 ± 0.4 and 6.2 ± 0.5

for group A, B, C and D animals (p = 0.038 between groups). There was a correlation between clinical and X-ray findings ($p \leq 0.049$ throughout the study). Bone defect length, as assessed ultrasonographically on D70, was 6.4 ± 0.2, 4.5 ± 0.4, 2.8 ± 0.6 4.0 ± 0.5 mm for group A, B, C and D animals (p = 0.0006 between groups). There was also correlation between bone defect length assessed ultrasonographically and X-ray findings ($p \leq 0.037$ throughout the study). Vascularization in bone defect region, also assessed ultrasonographically on D70, was 1.0 ± 0.0, 0.3 ± 0.2, 0.2 ± 0.2 and 0.2 ± 0.2 for A, B, C and D animals (p = 0.020 between groups).

Conclusion and implications
SVF isolation was an easy and effective technique for long bone healing augmentation and might be used as an alternative to bone grafting. Animals with SVF application showed faster post-operative rehabilitation.

doi: 10.1016/j.anscip.2023.01.337

P-060
Imaging examination in Small Ruminant Lentivirus Infection

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Keywords: Lentivirus; Imaging diagnosis; Computed tomography; Ultrasonography

Introduction
Small ruminant lentivirus (SRLV) is a group of viruses that infect and transmit among ovine and caprine species. This disease is debilitating, progressive and longstanding disease, associated to high economic losses in livestock farms. Diagnosis is largely made with laboratory methods however and not being a common daily practice. Imaging examination can be a useful tool for the diagnosis of SRLV lesions. Imaging modalities can be used in an on-farm setting and can be easily implemented for further best-practices in identifying sheep with signs of clinical disease as early as possible.
The main aim of this work was characterizing lesions of SRLV infection using imaging diagnostic techniques.

Material and methods
This study was carried out at the Pedagogical Animal Husbandry Unit of the Escola Superior Agrária de Bragança (Universities of Applied Sciences). The sheep flock was submitted to indirect ELISA test (ID Screen® MVV/CAEV Indiret) to determine positivity of the animals. Positive animals and with characteristic symptomatology were submitted to complementary imaging exams.

Results and discussion
In ultrasound examination (US), different regions of the lung were explored to understand the distribution of lesions. Chronic interstitial pneumonia was found to show an evident increase and homogeneous in echogenicity due to consolidated parenchyma. Chronic indurative mastitis is characterized by a high and homogeneous echogenicity in mammary parenchyma.
Radiography (X-ray) and computed tomography (CT) were also used in this study, despite the limitations associated with health, safety regulations, associated costs and the use of ionising radiation. These examinations were useful to understand the pathological processes of SRLV infection, mainly at respiratory level. In advanced stages, X-ray showed a widely distributed unstructured diffused interstitial pattern, with airspace opacification in lungs. Increased opacity in lungs can be due to infiltration of lymphocytes in the interstitial tissue. Thoracic-CT provides a better detail of the lesion scan which enable visualising a uniform increment of radiopacity in several planes minutely.

Conclusion and implications
With this work we describe imaging SRLV lesions in sheep to support the clinician in the identification of these disease features. These tools can be used in addition to clinical and laboratory examination to avoid underdiagnosis and allow the implementation of suitable measures to control its spread. Some of these techniques (radiography and CT) will not be applicable in field conditions but are useful for academic purposes. Ultrasound is a non-invasive modality already used on farms for reproductive diagnosis. So, ultrasound, with the increased availability of portable digital probe allows professionals to immediately evaluate images on the farm, making this diagnostic tool potentially more accessible and thus play a more important role in daily clinical practice.

Acknowledgements and funding
Projeto: 0687_OVISPID_2_E POCTEP – Programa de Cooperação Transfronteiriço Portugal – Espanha.

doi: 10.1016/j.anscip.2023.01.338

P-061
A behavioral method to assess pain memory in sheep: Preliminary results

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Keywords: Sheep; Pain; Memory; Behavior

Introduction
Among ruminants, sheep are classified as stoic animals, they perceive pain stimuli, but do not show obvious signs. There are no studies proving that sheep are less sensitive to pain. Behavioral change is an indication of pain, which can be obtained non-invasively. The difficulty of interpreting pain signals in sheep is due to the subjectivity of the presented signals, being necessary to create species-specific and standard methods for the evaluation of pain.

Material and methods
Healthy Ile de France and Texel lambs, aged 15 days, underwent tail docking by rubber (Group A1 and A2) or surgery (Group B1 and B2). Both groups A and B received local anesthesia with 2% lidocaine, differing within the group only by the use (A1, B1) or not (A2, B2) of non-steroidal anti-inflammatory drugs (meloxicam, 10 mg/kg, i.m.). Group C1 was the control group receiving intramuscular injection of saline solution and group C2 remained without manipulation.
The lambs and their mothers were housed in two different pens: the PEN I, characterized by orange stripes painted on the wall, was left as a neutral place, that is, without any intervention. PEN II, with walls with drawings in the form of pink and green circles, was used as the intervention site. Both environments were the same size (3x4 meters) connected by an access corridor between the pens, 6 meters long and 1.80 meters wide, with free circulation. A camera (Internal Wi-fi Smart Camera Full HD iM3 C Intelbras) monitored the behavior of the lambs with the mothers for 72 hours, recording the behavior for later evaluation.
The time of the lamb spent in each environment (place of intervention x neutral place) was measured. The difference in time that the lamb remained in one or another place was calculated using Chi-square with $P < 0.05$, following recommendations by Ede et al. (2019).

Results and discussion
In the pilot project carried out with 3 pairs each, lambs and mothers of groups A and B, A1 and B1 avoided entering PEN II between 10 and 15 minutes after the procedure. The behavior of the lambs was totally dependent on the mother's behavior, regardless of whether the intervention pen was recognized or not. The control group did follow the behavior of A and B, also avoiding the intervention pen. The memory of discomfort with any procedure did not last more than 15 minutes. The use of anti-inflammatory drugs did not modify the behavior. The study model is currently being replicated with 4 groups of sheep, with 2 pairs in each group. Statistical results are not available at the moment.

Conclusion and implications
Memory of stressful interventions are short termed. Behavior of lamb and mother sheep are mutual influenced.

doi: 10.1016/j.anscip.2023.01.339

P-062
Impact of administration of vitamin D on imune response in ewes in the peripartum period

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Keywords: Cholecalciferol; Tocopherol; Transition period; Innate immunity

Introduction
Due to homeorhesis, the peripartum period is characterized by health challenges for the female. There are metabolic and infectious problems that tend to be minimized with the use of proper management and nutrition. The use of vitamins D and E have been linked to improve some risks in this period. Therefore, the objective of present study was to verify the impact of the application of high doses of vitamin D and vitamin E on aspects of the immunity of peripartum ewes.

Material and methods
Eighteen healthy ewes, with ECC between 3 and 3.5; on the 108th day of gestation were divided into three groups of six animals and received, by deep intramuscular route, a single application or an oily vehicle (GC); or 70,000 IU/kg of vitamin D3 (GD); or 60UI/kg of vitamin E (GE). Blood samples were collected 30 days before delivery (-30); up to two hours after delivery (0); 30 days after delivery (30) to evaluate, in vitro, the production of reactive oxygen species (ROS) by monocytes and neutrophils without stimulus (basal burst) and with stimulus by Staphylococcus aureus lipopolysaccharides conjugated to propidium iodide (SaPI) and Phorbol 12-Myristate 13-Acetate (PMA). Data were analyzed for mixed models by SAS for repeated measures. Included fixed effect of 'Treatment', 'Time', interaction 'Time and Treatment' and the covariate 'Number of Lambs Born'. For tests performed, a significance level of 5% was adopted.

Results and discussion
For the analyzed parameters, the use of high doses of vitamin E and D had no effect. Regardless of the treatment used, an effect of time was observed for the variables.Before delivery there was a lower oxidative burst of neutrophils both basal ($P = 0.0008$) and stimulated by PMA ($P = 0.0051$). The basal oxidative burst of monocytes ($P = 0.0001$), the one stimulated by PMA ($P = 0.0003$) and the percentage of phagocytosing monocytes ($P < 0.0001$) were higher at delivery than at other times ($P < 0.0001$). Both the intensity of phagocytosis of neutrophils and monocytes was lower 30 days after delivery ($P = 0.0006$ and $P = 0.0002$, respectively). The production of ROS by neutrophils after SaPI stimulation was higher before delivery than in the two subsequent moments ($P < 0.0001$) and the production of ROS by monocytes stimulated by SaPI was gradually lower after birth throughout the study ($P < 0.0001$). The percentage of neutrophil phagocytosis was higher during childbirth compared to just the postpartum period ($P = 0.0166$).

Conclusion and implications
High-dose injections of vitamins E or D in the final third of pregnancy did not influence aspects of the innate immune response of ewes in the peripartum period.

Acknowledgements and funding
To the FAPESP, for supporting the research project (process 2014/17297-9).

doi: 10.1016/j.anscip.2023.01.340

P-063
Characterization, typification of goat milk producers

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Keywords: Goats; Animal production; Milk; Small farmers

Introduction
Recently, Goat production has been perceived as a relevant way for food security in Colombia. In this country, goat population count with approximately 1136839 animals, where the Cundinamarca region contributes with 1.94% of the inventory with significantly growth shown in recent years. Although goat production provides several products such as meat, milk, leather, the lack of investment in this sector has been perceived as a lost opportunity. Due to the investment goes to other animal systems that are traditionally considered more productive. Additionally, there is lack information about the goat production systems. The following study aims to characterize both small and medium producers of goat milk in the Cundinamarca region in Colombia.

Material and methods
Twelve goat productions were visited in the Cundinamarca region where interviews were undertaken to the farmers. The collected information included land use, water resources, animal stock, level of education and management practices of farmers, reproduction factors, genetics and milk production of goats.

Results and discussion
Preliminary results of this study have shown that Alpine is the predominant breed in all the goats production visited, being a breed that meets the needs of producers. The 82% of the farms had less than 5 hectares available for the goat production which correspond to small producers. The farms included in the study had preferences for indoor management (73%), over raise their animals under grazing conditions (27%). Conversely, the level of education of the producers is low; only 2% of those farmers have attended higher education institutions. In 90% of the farms, the main material of the pens is wood. Likewise, some farmers (30%) distribute the animals according to their age and physiological state, being a relatively low rate. Additionally, 80% of the producers do not adopt forage conservation practices, due to the lack of training in this type of technique. Similarly, 90% of the surveyed farmers reported health problems in their goat population, which might suggest defective or no technical assistance, most of the farms are irregularly checked by a veterinarian.

Conclusion and implications
These partial results suggest that despite the rise of the goat production in this region of the country, goats are still marginalized and are considered a secondary production compared to sheep and cattle. There are health, nutritional and management practices that goat's farmers need to consider to improve the productivity on their farms. It is important to undertake studies about the sources, level, and use of knowledge of the goat farmers that allows a collective action along with research and veterinarians to improve goat's productivity, emphasizing factors of animal welfare and rentability among of their production system.

Acknowledgements and funding
The authors wish to acknowledge Fundación Universitaria Agraria for funding this project.

doi: 10.1016/j.anscip.2023.01.341

P-064
Effect of parenteral use of vitamin E on serum uric acid levels of lambs supplemented with vitamin E, born to ewes supplemented during pregnancy

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Keywords: Ruminants; Alphatocopherol; Ovine; Antioxidant

Introduction
Pregnancy is a physiological event characterized by abrupt changes due to the high energy demand for fetal development. Consequently, the mother and fetus are more susceptible to oxidative stress that damages biomolecular structures. Uric acid is one of the endogenous antioxidants that help prevent oxidative stress. In ruminants, the use of vitamin E (VIT-E) as an exogenous antioxidant is frequent in conditions of high metabolic challenge to avoid oxidative stress. Thus, the aim of this study was to analyze the effect of parenteral use of VIT-E on serum uric acid concentration in lambs born to ewes supplemented with VIT-E during pregnancy and that received VIT-E after birth.

Material and methods
In a 2 × 2 factorial arrangement, 28 lambs were distributed into four groups: EE(n = 9)-lambs from ewes supplemented with 60 IU/kg of vitamin E, intramuscularly (IM) on the 108th day of gestation and that received vitamin E in the same dosage (60 IU/kg) up to 24 hours after birth; EC(n = 8)-lambs from ewes that received vitamin E during pregnancy, but were not supplemented; CC(n = 6)- non-supplemented lambs and ewes; and CE(n = 5)-lambs born to ewes that did not receive vitamin E but were supplemented with vitamin E. Serum uric acid concentration was determined in blood samples collected in the first and after 28 days of life using the commercial Uric Acid (TBHBA) FS kit (Diasys®), in the biochemical analyzer LABMAX (LABTEST®). The statistics analyzes were performed using Proc Mixed for repeated measures, using the SAS package. The model included fixed effects of administration to sheep, administration to lamb, sheep*lamb interaction and the respective double and triple interactions with the time factor.

Results and discussion
There was interaction between ewe*lamb (P = 0.0082), indicating that when ewe and lamb are supplemented there is a small increase in the concentration of uric acid, however, only the lamb receives vitamin E, the increase will be greater. There were no more interactions for this variable (P > 0.05). Although generally considered just waste generated from the degradation of purines, used for different metabolic processes, uric acid is an important low molecular weight antioxidant in biological fluids and it is present in all body tissues probably related to its antioxidant role.

Conclusion and implications
The parenteral use of vitamin E in lambs improved the reserve of endogenous antioxidants, measured by uric acid. The use of the vitamin in the ewe, during the final third, although also positive, was not of the same magnitude as when only the lamb received the vitamin in the first day of life. More studies must be carried out with situations of important oxidative challenge for this management measure to be recommended.

Acknowledgements and funding
To the FAPESP, for supporting the research project (process number 2014/17297-9).

doi: 10.1016/j.anscip.2023.01.342

P-065
Salmonellosis in sheep

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Keywords: Salmonella; Great Britain; Abortion; Zoonosis

Introduction
We present a review of Salmonellosis in sheep, describing *Salmonella* strains typically identified in sheep in Great Britain (GB) and outlining the relative significance of these isolates and the associated clinical disease.
Salmonella infection, in most cases, occurs following ingestion and invasion of the small or large intestine with subsequent systemic dissemination. There are over 2500 known *Salmonella* serotypes or serovars worldwide (World Health Organization data) and most of these are potentially zoonotic. Salmonellae can infect a wide array of living species, but there are a smaller number of specific *Salmonella* that are recognised as infecting, and potentially causing disease in livestock. Some *Salmonella* strains are considered well-adapted to specific hosts, establishing endemically within those host populations.

Materials and methods
We examined APHA scanning surveillance sheep salmonella data (England and Wales) (687 cases) and national Zoonosis order data (a further 312 cases) for a 10-year period (2012 to 2021).

Results and discussion
From recorded cases *Salmonella* was a relatively infrequent cause of disease in sheep, diagnosed in only 4% of abortions and 1% of enteric/systemic disease cases. Abortion was the most common recorded clinical sign (55% of diagnoses), diarrhoea and enteric disease were identified in 18% of cases and sudden death was the main presenting sign in 13% of cases. *Salmonella enterica* subspecies *diarizonae* was the most frequently identified *Salmonella* isolate, isolated from 57% of cases. *Salmonella diarizonae* establishes easily within the intestinal flora of sheep and although this organism is considered an incidental isolate in healthy sheep, concurrent disease or stress can induce clinical disease. *Salmonella* Montevideo was the next most frequent diagnosis, found in 13% of cases, and can establish a carrier state in sheep. *Salmonella* Dublin, a cattle-adapted *Salmonella*, was isolated in 11% of cases, and *Salmonella* Typhimurium was identified in 7% of sheep cases. Although most S.Typhimurium isolates in sheep are DT104, other serotypes can occur sporadically. A novel S. Typhimurium strain (whole genome sequence snip address t5. 3225) emerged in GB sheep flocks during 2017, causing high mortality on two sheep holdings and some linked human disease cases. Mixing of multisourced, recently transported sheep potentially contributed to the severity of these outbreaks. Since 2013 Salmonella Agama has been associated annually with disease in a small number of sheep flocks, S. Agama is typically associated with wildlife reservoirs, with some spillover into livestock.

Conclusion and implications
Although the incidence of *Salmonella* in sheep in GB is relatively small, individual flock outbreaks can result in significant losses. Understanding the epidemiology of *Salmonella* and the behaviour of the specific strains occurring in sheep can guide measures to prevent and control disease, improving sheep health and welfare and reducing the risk of zoonotic infection.

doi: 10.1016/j.anscip.2023.01.343

P-066
Findings from the APHA “Thin Ewe Project”

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Keywords: Illthrift; Ewes; Iceberg diseases; Management

Introduction
We present the findings from a "Thin Ewe Project", a project to investigate the flock-level incidence of "Iceberg diseases" (Maedi visna (MV), Ovine Pulmonary Adenocarcinoma (OPA), Johne's and Border disease (BD)) and to determine the overall causes of ill thrift in adult sheep, across England and Wales.

Material and methods
Free post mortem examination and testing was offered for up to 3 recently euthanased ill thriven sheep, between November 2020 and May 2021. 198 adult sheep (1-7 year old) were received from 76 holdings for examination and testing. To ensure consistency a standardised testing protocol was used.

Results and discussion
Twenty three different diseases were identified during the project. 31% of flocks were positive for Johne's, 10% OPA, 5% Chronic Liver Fluke, 2% MV and 3% Haemonchus. The remaining 49% of flocks had either flock-level issues with Parasitic gastroenteritis (PGE), dental disorders, chronic pneumonia, abscesses or mixed other "individual sheep" diseases (such as intestinal adenocarcinoma, abomasal emptying defect, Tuberculosis and lungworm). Dental disorders were found in 28% of all submitted sheep, this was considered a flock level issue in 14% of lowland flocks. Gastrointestinal damage caused by PGE (supported by histological evidence) was identified in 24% of all sheep, this was considered a flock level issue in 19% of hill flocks and 12% of lowland flocks. 29% of individual sheep diagnoses had chronic bacterial infections (abscesses, chronic pneumonia, chronic mastitis, chronic skin infection, "other chronic infections"). 40% of individual sheep had one disease diagnosed, 40% had two or more diseases diagnosed. Some individual flocks had 4 diseases diagnosed, including multiple "iceberg" diseases. The project demonstrated the range of flock-level diseases causing or contributing to ill thrift in adult sheep, that can be identified using post mortem examination of batches of 3 sheep. Submission of multiple sheep per holding allowed assessment of the flock significance of issues such as PGE, dental disorders and chronic bacterial infection/abscesses.

Conclusion and implications
Johne's disease was the most commonly diagnosed flock-level disease causing illthrift in sheep flocks in England and Wales, OPA and chronic fluke were the next most diagnosed diseases, MV and Haemonchus worms were only identified in a small number of lowland flocks. Our findings suggest these diseases could be contributing to ill thrift in potentially half of flocks in England and Wales. PGE, dental disease and chronic bacterial infection are potentially also significantly contributing to ill thrift in flocks suggesting improved pasture management, careful selection of breeding stock and improved general health and management could significantly reduce breeding stock losses due to ill thrift in England and Wales.

doi: 10.1016/j.anscip.2023.01.344

ECSRHM (European College of Small Ruminant Health Management)

P-067
Long and short term survival following obstructive urolithiasis in small ruminants – A retrospective analysis of treatment outcomes in a veterinary hospital

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Keywords: Urolithiasis; Treatment; Survival; Cystostomy

Introduction
Obstructive urolithiasis is a common and frequently fatal disease in male small ruminants. Most survival analyses are however based on small patient numbers. The aim of this study was to analyze a larger cohort of cases to assess long and short term survival rates as well as potential predictors for treatment success.

Material and methods
The clinical records of 148 small ruminants with obstructive urolithiasis (79 goats, 69 sheep) were analyzed retrospectively. Species, castration status, age, body condition, animal purpose, husbandry conditions, duration of disease prior to presentation, general condition on arrival, blood values, flushing success during tube cystostomy and general condition following the operation were documented. These parameters were tested on all animals receiving tube cystostomy by simple logistic regressions for their potential use as survival predictors. Multivariate models failed due to limited case numbers within the different categories. Telephone interviews were performed between two months and eight years after hospital discharge to determine long-term outcomes. Results were considered significant for $p \leq 0.05$; $p > 0.05$ and ≤ 0.1 was considered a tendency.

Results and discussion
Treatment choices depended on clinical assessment and owners' decisions. Thirty animals (30/148, 20.3%) were euthanized immediately, 29 were treated conservatively (29/148, 19.6%), while 89 animals (89/148, 60.1%) received tube cystostomy. Anterograde urethral flushing was attempted during 72 operations (72/89, 80.9%) and successful in 27 (27/72, 37.5%). Due to the presence of complications only 71 of the 89 animals survived the operation (13 euthanized, 5 died), and only 59 survived until the first blocking of the catheter around day seven post surgery (7 euthanized, 5 died). Thirty-six animals (36/59, 61.0%) passed urine at the first blocking attempt, another three succeeded in follow-up attempts. Twenty animals were euthanized due to continuous ischuria, and an additional three due to severe cystitis and/or peritonitis. Significant predictors for decreased survival were a prolonged duration of disease prior to presentation, high blood urea and creatinine levels and decreased blood chloride. Significant predictors for a positive short-term outcome were successful urethral flushing and an uncompromised general condition following surgery. Statistical analyses did not identify any significant predictors for a positive long-term outcome. In total, 36 (36/89, 40.4%) animals that received tube cystostomy and ten of the 29 animals treated conservatively (34.5%) were discharged alive (46/148, 31.1%). In 19 of the 46 recovered animals (41.3%), urethral obstruction recurred within a median time of 9 months following hospital discharge.

Conclusion and implications
Prognosis for animals with obstructive urolithiasis remains poor. A short duration of disease prior to treatment, successful urethral flushing, low urea and creatinine levels and unaffected blood chloride were associated with positive short term outcomes for animals following tube cystostomy. The risk of recurrence was however high.

doi: 10.1016/j.anscip.2023.01.345

P-068
A survey of anthelmintic use among sheep and goat farmers reveals surprising habits

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Keywords: Anthelmintic drugs; Small ruminants; Deworming habits; Nematodes resistance

Introduction
Gastrointestinal nematode infestation is a frequent disease in grazing small ruminants. Internal parasites are an economic problem as they lead to drops in production (milk and/or meat), reduced body condition and negative effects on animal welfare. For years, studies have demonstrated the widespread emergence and development of parasitic resistance. However, certain deworming habits (frequency of deworming, route of administration…) can also reduce the efficacy of anthelmintics treatments. The aim of this study is to assess the deworming habits of Belgian breeders to find out if it can explain this phenomenon.

Material and methods
An online survey was sent to the Belgian sheep and goat breeders registered on the breeders' associations databases (*Association Régionale de Santé et d'Identification Animales* for Wallonia and *Dierengezondheidszorg Vlaanderen* for Flanders). Questions were asked about the most common problems or diseases they have to deal with, their deworming habits (frequency, timing, use of fecal analyses…) and what they think about the efficacy of anthelmintic drugs they use.

Results and discussion
Ninety farmers participated and completed the online form. The respondents were mostly men, sheep farmers, belonging to Flanders with a flock size of less than 10 female animals. For both Flemish and Walloon breeders, the main cause of disease over the last 5 years in females that have never given birth was infestation by internal parasites. According to the Walloon breeders, infestation by internal parasites was also the first cause of disease in females that have already given birth, whereas for the Flemish breeders it was the second cause of disease. Amongst these 90 farmers, 80% of them used systematically anthelmintic drugs at "herd-scale" to treat gastrointestinal nematodes. Vermifuges were mainly administered at specific times of the year (during the grazing period, at the time of changing pasture and after lambing) and motivated by the observation of diarrhea and lack of body condition. More than one in two breeders suspected losses in drugs' efficacy while 52% had never done fecal analyses and 78% had never tested the efficacy of any anthelmintic drug. These data highlight the widespread use of anthelmintics, most often systematically at specific times of the year and not following a coprological analysis.

Conclusion and implications
The deworming habits reported by the breeders do not correspond to those recommended in the scientific literature. It could explain their feeling about the decreasing efficacy of anthelmintics.

Acknowledgements and funding
The authors will particularly thank the Belgian Sheep and Goat Health Fund for its financial support.

doi: 10.1016/j.anscip.2023.01.346

P-069
Composition of small ruminant uroliths from 90 cases presented to a Southern German veterinary hospital

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Keywords: Urolithiasis; Urolith analysis; Infrared spectroscopy; Predisposing factors

Introduction
The anatomy of the genital tract in combination with nutritional and other factors predisposes male small ruminants to the occurrence of obstructive urolithiasis. It is commonly assumed that struvite calculi are predominant, but there is very little published information regarding urolith composition in small ruminants in Europe.

Materials and methods
Uroliths were recovered and available for analysis from 90 small ruminants diagnosed with obstructive urolithiasis at a veterinary hospital (41 sheep, 49 goats). Urolith analyses were performed by infrared spectroscopy at a commercial laboratory (Harnsteinanalysezentrum Bonn, Germany). For statistical analyses, the urinary calculi were categorized as calcium-based (calcium carbonate and calcium oxalate), phosphatic (struvite, calcium phosphate, calcium magnesium phosphate, magnesium phosphate), silica uroliths and others (mixed calculi with <80% of one component, or other material). Mixed calculi containing >80% of a substance were classified according to their main component. Statistical analyses were carried out using R Studio (Version 3.6.3) and were limited to simple logistic regressions, as multivariate models failed due to low case numbers. $p \leq 0.05$ was considered significant, while $p > 0.05$ and ≤ 0.1 was considered a tendency.

Results
Calcium carbonate (39/90; 43.3%) was the predominant urolith type, followed by silica (15/90; 16.6%), calcium phosphate (11/90; 12.2%), magnesium calcium phosphate (3/90; 3.3%), struvite (3/90; 3.3%) and magnesium phosphate (2/90; 2.2%). Mixed uroliths accounted for 16.6% (15/90) of the cases, with mixed calcium carbonate the predominant mixed type (8/15; 53.3%). In total, calcium based uroliths (47/90; 52.2%) were the most frequent urolith category, followed by phoshatic calculi (20/90; 22.2%), silica (27/90; 18.8%) and others (6/90; 6.7%). Phosphatic calculi were significantly more frequent in sheep, young and intact animals of normal weight, and associated with high amounts of concentrated feed. Calcium based uroliths were more frequently found in goats, older animals, castrated animals, pets, animals with access to pasture, low or intermediate concentrate rations, and overweight animals.

Discussion
Pets were over-represented in the studied cohort and more frequently suffered from calcium based (or silica) uroliths, which can serve as an explanation for calcium-based calculi being the most frequently observed urolith category in this study. This is in accordance with previous studies from hospitalized populations in the USA. Young, intact animals commonly either kept for breeding or fattening and on high concentrate rations were more frequently diagnosed with phosphatic calculi, but pure struvite, which is often assumed to be the most frequent urolith type in small ruminants, was only rarely observed even within this animal group.

Conclusion
Even though the studied cohort is not representative for the entire small ruminant population in Germany, the results indicate that calcium based and silica uroliths are more frequent than commonly assumed, and that urolith analysis is always required to determine the true nature of urinary concrements.

doi: 10.1016/j.anscip.2023.01.347

P-070
Effect of extender type, cooling rate, storage temperature on semen quality and pregnancy rate after transcervical AI in Kail sheep

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Keywords: Liquid storage; Artificial Insemination; Kail rams; Extenders

Introduction
Artificial insemination (AI) is not used as widely in sheep as in other livestock because of inconsistent fertility results and poor semen quality after thawing. Alternatively, insemination with chilled semen is preferred over frozen semen. However, inseminations can be done over a short period with chilled semen. Different temperatures ranging from 4 to 20 °C (Menchaca et al., 2018) and extenders (Kulaksiz, et al., 2012) are used to improve the semen quality for a longer duration. Moreover, it has been demonstrated that reduced temperature, and egg yolk supplementation better preserved the sperm quality. Therefore, current experiment was design to evaluate the effect of extender, cooling rate, storage temperature on semen quality and pregnacy rate after transcervical insemination in Kail sheep

Material and methods
In experiment 1, semen was collected from five adult Kail Rams using an artificial vagina. After the initial assessment, semen was pooled and diluted with Tris-based, Sodium citrate-based (SC), and skim milk-based extender (SM). The diluted semen was subjected to different (−2.1 °C, −1.1 °C, −0.5 °C and −0.3 °C/min) cooling rates and stored at 5 °C and 12 °C. Semen was evaluated every 24h up to 96 h using CASA (SCA®, version 6.2.0.1 Microptic S.L., Barcelona, Spain). In experiment 2, sheep (n = 31) were synchronized using intravaginal sponges for 11 days and fixed time transcervical artificial inseminations (FTCAI) were done after 52–54 h of sponge removal using a Tris-based extender. Data were analyzed through generalized linear model (repeated measure ANOVA) using statistical software SPSS.

Results and discussion
The slow cooling group −0.3 °C/min had a higher ($P < 0.05$) percentage of motility, progressive motility, and medium progressive spermatozoa as compared to the other three cooling groups. All three extenders stored at 5 °C had improved ($P < 0.05$) semen quality as compared to 12 °C. Moreover, Tris-based extender had higher ($P < 0.05$) percentage of motility (60.6 ± 4.6), viability (63.2 ± 3.1), membrane (57.4 ± 3.5), and acrosome integrity (62.4 ± 2.6) at 48 h post storage (5 °C) as compared to SM (49.9 ± 4.3; 53.1 ± 3.2; 42.2 ± 2.3; 51.9 ± 2.8) and SC (46.7 ± 3.7; 55.1 ± 2.4; 47.8 ± 2.1; 53.5 ± 3.3) extender, respectively. The pregnancy rate was 58.1% (18/31).

Conclusion and implications
In conclusion, slow cooling, and storage at 5 °C using a Tris-based extender had improved chilled semen quality as compared to SC and SM and had an acceptable pregnancy rate with FTCAI in Kail sheep.

References

Kulaksiz, R., Çebi, Ç., Akçay, E., 2012. The effect of different extenders on the motility and morphology of ram sperm frozen or stored at 4 C. Turk. J. Vet. Anim. Sci. 36, 177–182.
Menchaca, A., Pinczak, A., Queirolo, D., 2018. Storage of ram semen at 5 C: effects of preservation period and timed artificial insemination on pregnancy rate in ewes. Anim. Reprod. (AR) 2, 195–198.

doi: 10.1016/j.anscip.2023.01.348

P-071
Occurrence of Chlamydia abortus in goats and sheep

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Keywords: Clamydia abortus; Stillbirth; Infertility; Clinics of small ruminants

Introduction
Enzootic abortion is described as an infectious disease caused by Chlamydia abortus that affects goats and sheep and has a cosmopolitan distribution causing economic losses in several countries. This agent is an important pathogen associated with the cause of abortion in goats and sheep on rural properties and is responsible for significant impacts on animal health. Due to its zoonotic potential, its occurrence constitutes a risk to public health. In humans, this bacterium induces abortions and a systemic flu-like illness. Few studies are carried out in Latin America on the prevalence of reproductive diseases and their causes. Studies on chlamydiosis cases in Brazil are rare and the presence of the agent has already been observed in some states. In this context, the objective of this work was to determine the presence of Chamydia abortus in goats and sheep associated with the history of herds with abortion in the states of Pernambuco and São Paulo.

Material and methods
A vaginal swab sample was collected from fifteen goats and nineteen sheep with a history of low generation, abortion and/or stillbirth, from seven properties located in the municipalities of Vinhedo-SP, Garanhuns-PE, Sertânea-PE, Sanharó - PE and Venturosa-PE. Also, prior to collection, the animals were selected for general and specific physical examination of the reproductive system. The pathogen research was carried out using the real time PCR (qPCR) technique, being carried out at the Bovine Virus Laboratory, at the Biological Institute, São Paulo-SP. For DNA extraction, the commercial MagMAX CORE™ Nucleic Acid Purification Kit (Thermo Fisher Scientific) was used in an automated DNA/RNA extraction system (KingFisher™ Flex Purification System). For amplification, the commercial kit EXOone Chlamydia abortus oneMIX (EXOPOL SL, Zaragoza, Spain) was used, following the manufacturer's instructions.

Results and discussion
According to the results, it can be seen that none of the thirty-four samples collected were found to have Chlamydia abortus. However, although the pathogen was not identified in this study, a few previous studies carried out in Brazil have already described the occurrence of this agent in the national territory (São Paulo, Minas Gerais, Alagoas and Piauí), however studies on enzootic abortion in goats and sheep in Brazil are still insufficient. In view of this, it appears that there is a need to carry out further studies on the occurrence of Chamydia abortus in herds in the country, in order to elucidate the participation of this bacterium in the reproductive problems faced in goat farming.

Conclusion and implications
Control programs are necessary for the adoption of measures that allow the control and prophylaxis of reproductions diseases in Brazil.

Acknowledgements and funding
My special thanks to Company Exopol SL.

doi: 10.1016/j.anscip.2023.01.349

P-072
Comparative study of indirect ELISA and AGID for serological detection of small ruminant lentiviruses in goats sera

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Keywords: Lentivirus; Diagnostics; Clinical of small ruminants; Virology

Introduction
The caprine arthritis encephalitis virus (CAEV) and Maedi Visna virus (MVV) are currently referred to as small ruminant lentiviruses (SRLVs) and are widely spread in several continents of the world. The search for serological screening methods with greater detection capacity of the truly infected animals is considered a fundamental step for disease control. The objective of this study was to perform a comparative study between the imported commercial indirect ELISA kit and the agarose gel immudiffusion test (AGID) in goats serum from Brazil.

Material and methods
A total of 118 serum samples were obtained between the years 2020 and 2021 in two goat herds in northeastern and southeastern Brazil. The detection of antibodies was simultaneously evaluated by the Eradikit Screening (EradikitTM SRLV Screening Kit, IN3 Diagnostics, Turin, Italy) and AGID (Biovetech Kit, Recife, Pernambuco, Brazil). Both tests were performed following the protocols recommended by the manufacturers. According to the seroprevalence obtained by Eradikit Screening

Results and discussion
39.8% (47/118) of the samples were considered seropositive, while in AGID, only 15.25% (18/118) were reactive. In the discordant group, one sample was seropositive by AGID and negative by ELISA, while 30 sera were identified with seronegative by AGID and positive by ELISA. The sensitivity and specificity values for the ELISA were 94.4% and 70.0%, respectively, with the AGID technique as the comparison parameter. Between the two tests, the Kappa index was 0.388 ($p < 0.0001$), with a degree of agreement of 73.7%.

Conclusion and implications
The combination of antigens derived from different genotypes in a single test may increase diagnostic sensitivity, which may explain the differences observed between the results of the present study. The national commercial kit AGID is the only serological test currently available in Brazil, containing only the p28 antigen of the CAEV prototype. The Eradikit Screening is an imported commercial kit based on a mix of gag and env peptides belonging to the genotypes A and B. These characteristics allow the increase of the antigenic spectrum and better performance when compared to AGID. Although Eradikit Screening showed a higher detection capacity of infected animals when than AGID, It is important to consider that the high import cost and the possible genetic variation of local circulating strains are potential negative factors for their large-scale use in Brazilian herds.

Acknowledgements and funding
Despite several seroepidemiological studies on SRLVs in Brazil, there are still demands for applied research on the characterization of circulating genotypes in different geographic areas of Brazil, in order to develop diagnostic tests at the local level.

doi: 10.1016/j.anscip.2023.01.350

P-073
Polyarthritis in mini goats causes by lentivirus

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Keywords: Lentiviruses; Clinics; Virology; Small ruminants

Clinical history
The objective of this summary is to present the first case of lentivirosis in mini-goats described in Brazil, which was treated at the Clinic of Cattle and Small Ruminants, University of São Paulo (CBPR-USP). A three year old male mini-goat was seen in May 2022.

Investigations
The main complaint was joint alterations, mainly in the pelvic limbs, with an evolution of approximately two months. The animal had difficulty keeping itself in station, and there were moments when it suspended its pelvic limbs and only supported itself on the thoracic limbs. Due to the symptoms, complementary exams such as radiographs and enzyme-linked immunosorbent assay (ELISA) were performed. Radiographs showed exuberant heterogeneous amorphous areas with mineral radiopacity in articular and intra-articular tissues in the thoracic and pelvic limbs, with the bilateral carpal joints and femoro-tibio-patellar joints, respectively, being the most affected. The areas of calcification extended in the tendons of the thoracic limbs, from the region cranial to the humerus to cranial to the metacarpal. The ELISA test (test used: Eradikit Screening indirect ELISA - Eradikit™ SRLV Screening Kit, IN3 Diagnostics, Torino, Italy) was performed with blood serum, and the result was positive.

Differential diagnosis
Micoplasmosis test was negative in this case.

Discussion
In Brazil, the production of mini goats as pets is growing, being an important point regarding the health of these animals, since there are not enough studies on the dissemination of diseases and on the particularities of this species. The goat encephalitis-arteritis virus, previously named CAE (Caprine arthritis encephalitis), is a lentivirus belonging to the Retroviridae family that affects goats and is directly related to the maedi-visna virus (MVV) that affects sheep, being diseases of notification in any confirmed case to the Ministry of Agriculture, Livestock and Supply (MAPA).Given the importance of this virus in goat herds and the increased interest in obtaining mini-breeds as pets, it is important to deepen the studies on the spread of lentivirosis in these animals.

Acknowledgements and funding
I would like to offer my special thanks to HOVET/USP.

doi: 10.1016/j.anscip.2023.01.351

P-074
Study of occurrence Q fever in small ruminants with reproductive problems

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Keywords: Coxiella burnetii; Small ruminants; Infertility; Clinics

Introduction
The Q fever is caused by the bacterial agent *Coxiella burnetii*, is widespread worldwide and endemic in some countries, such as Spain. Since it is a zoonosis, this disease has great importance for public health, since it can cause reproductive problems and even cardiovascular disorders in humans. In Brazil there are few published reports on the presence of this bacterial agent in small ruminants, being a pathogen characterized by its high resistance and for generating reproductive problems such as infertility and abortion. Objective: The present study aimed to investigate the presence of the *C. burnetii* in 34 biological samples from sheep and goats, females, from the Southeast (São Paulo) and Northeast (Pernambuco) regions of Brazil.

Material and methods
Vaginal swab samples were collected from fifteen goats and nineteen sheep with a history of reproductive problems from seven properties located in the municipalities of Vinhedo-SP, Garanhuns-PE, Sertânea-PE, Sanharó-PE and Venturosa-PE. Also, prior to collection, the animals were submitted to a general and specific physical examination of the reproductive system. The pathogen was investigated through the quantitative PCR (qPCR), and was carried out in the Laboratory of Bovine Virus Diseases of the Biological Institute, São Paulo-SP. For DNA extraction, the commercial MagMAX CORE™ Nucleic Acid Purification Kit (Thermo Fisher Scientific) was used in an automated DNA/RNA extraction system (KingFisher™ Flex Purification System). For amplification, the commercial EXOone Coxiella burnetii oneMIX kit (EXOPOL SL, Zaragoza, Spain) was used, following the manufacturer's instructions, and was performed in a QuantStudio™ 12K Flex machine (Applied Biosystems) and the results analyzed with the respective software (software v1.5).

Results and discussion
The results of the processed samples were negative for *C. burnetii*. Although this study did not detect the presence of this bacterium, we do not rule out its existence in Brazilian herds. This disease is cosmopolitan and causes economic losses in several countries, including Spain. In Brazil, there are studies that report the presence of this agent in some Brazilian states, such as Rio de Janeiro and Alagoas, but the research is still incipient and there is no routine diagnosis for producers to identify this problem in their herds. The lack of research and knowledge in the area results in losses for the producer and the production of small ruminants, demonstrating that more information about the occurrence of the causes of abortion and infertility is essential to know the importance of this agent in Brazilian herds.

Conclusion and implications
Researchs on the prevalence of *C. burnetii* is important for improvement in Brazilian goat farming through the implementation of disease control and prophylaxis programs.

Acknowledgements and funding
I would like to offer my special thanks to Exopol SL, Zaragoza.

doi: 10.1016/j.anscip.2023.01.352

P-075
Rhodococcus equi infection in a goat: Case report

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Keywords: Rhodococcus equi; Infection; Goat; Abscesses

Clinical history
A 1.5-year-old female intact crossbreed goat kept in a herd of 51 adult goats from Lodz Voivodeship, Poland, was necropsied following sudden death. For a month before death the goat had presented chronic weight loss and moderate cough. All goats in the herd were regularly dewormed 3 times a year and no vaccinations were used. Caprine arthritis-encephalitis (CAE) had been previously reported in the herd. No other animal species were kept on the farm nor had any horses been grazed on the same pasture for at least previous 3 years.

Investigations
The post-mortem examination revealed multiple well-circumscribed abscesses in the liver ranging from 0.5 to 5 cm in diameter. Similar but markedly smaller lesions (0.5 to 1 cm) were observed in the lungs. Samples of the liver and lungs were submitted for microbiological examination. Standard bacteriological methods were used to isolate and identify bacteria. Material was cultured on a selective medium CAZ-NB and a differentiation medium Columbia Agar supplemented with 5% sheep blood. The plates were incubated in aerobic conditions for 48 hours at 37 °C. The colonies that grew were identified based on their morphological and biochemical characteristics. The biochemical properties of isolated bacteria were evaluated using API Coryne test. In addition, CAMP test with *Staphylococcus aureus* and reference strain

of *Rhodococcus equi* (*R. equi*) was performed on Columbia Agar, and the results were evaluated after a 24-hour incubation (37 °C) in aerobic conditions. Bacteriological examination revealed *R. equi* infection.

Differential diagnosis
Multiple organ abscesses in goats may be caused by the systemic infection with *Corynebacterium pseudotuberculosis*, *Trueperella pyogenes*, and *Mycobacterium* spp.

Discussion
R. equi is a Gram-positive obligatory intracellular bacterium, considered as an important pneumonic pathogen in foals. Infections can also occur in other species including cattle, sheep, goats, buffaloes, pigs, llamas, dogs, cats, and humans. Disseminated organ abscessation with frequent involvement of the liver and lungs is most often described in goats Zychska et al. (2021). The clinical and pathological findings described in our case are in concordance with previous reports on *R. equi* infections in goats. Infection may result from inhalation or ingestion of bacteria but the pathogenesis of rhodococcosis in ruminants is hardly understood. Immunosuppressive factors, such as stress and co-existing immunosuppressive diseases are thought to favor the infection Zychska et al. (2021). We suspect that poor environmental conditions in the herd (e.g. low quality of ventilation) and concurrent respiratory and systemic diseases (such as CAE) may have weakened immunological response, and thus favored the infection.

Reference

Zychska, M. et al., 2021. Rhodococcus equi – Occurrence in Goats and Clinical Case Report. Pathogens 10 (1141), 1–10.

doi: 10.1016/j.anscip.2023.01.353

P-076
A case of intersexuality in a pygmy goat

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Keywords: Sex determination; Intersex; Pseudohermaphrodism; Pygmy goat

Clinical history
A 10-month-old female pygmy goat was presented with a history of having buck-like appearance despite possessing external female genitalia and expressing male behaviour such as compulsive mounting, head butting and flehmen response. Compared to a female pygmy goat, she had a beard, was larger and had bigger horns. However, she had vulva and vagina with an enlarged clitoris. Otherwise, the goat was healthy.

Investigations
Transabdominal ultrasound followed by a computed tomography (CT) scan under general anaesthesia (GA) were performed. Although the presence of a uterus and gonad-like structures were confirmed, a ventral midline exploratory laparotomy under GA was performed to characterize these structures. Two small, tubular, bicornuated, filled-fluid structures were exteriorized and examined, which anatomically appeared as underdeveloped uterine horns. A thick-walled white tubular structure that was attached to the end of both horns led to a small rounded soft tissue masses. The tube had the gross appearance of ductus deferens and the masses appeared to be testicles. The reproductive tract was removed by ovariohysterectomy. Histopathology confirmed that the round masses had testicular features such as epididymis, seminiferous tubules and presumptive Sertoli cells but with complete absence of spermatogenesis. The paired tubular urogenital organs had features consistent with both normal ductus deferens and uterine horns. Blood testosterone levels were measured before and two weeks after the surgery showing a decrease in testosterone production (2.10 nmol/l vs <0.03 nmol/l). Blood samples were also sent for sex genotyping.

Differential diagnosis
Due to its ambiguous sex phenotype, the differential diagnosis included any type of intersex. Intersex animals are subdivided in two categories according to their gonads. If an animal has gonads of one sex and the external characteristics of the opposite, it is called a pseudohermaphrodite. If it possesses gonads of both sexes (either combined or as separate structures), it is referred as true hermaphrodite. Pseudohermaphrodism is the most common type of intersex, and affected individuals can be male or female pseudohermaphrodites based on their gonadal sex. Therefore, a male pseudohermaphrodite carries testis while having mixed or female phenotype, and a female pseudohermaphrodite has ovaries but a male appearance.

Discussion
According to the description and the results of the diagnostic tests, this pygmy goat was presumptively diagnosed as male pseudohermaphrodite. This condition is generally a consequence of a deficient or decreased secretion of testosterone and paramesonephric inhibitory hormone by the foetal testes or of a lack of androgen receptors (testicular feminization syndrome). A final diagnosis will be established when chromosomal sex is known. Recovery from surgery was uneventful, and the male behaviour ceased after four months after the surgery.

doi: 10.1016/j.anscip.2023.01.354

P-077
Comparison of behavioural observation and quantitative sensory testing of pain in lambs following two different methods of tail docking

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Keywords: Pain; Welfare; Tail Docking; Quantitative Sensory Testing

Introduction
Growing global scrutiny towards animal welfare is driving research in animal production to progress practice. Painful procedures can negatively impact welfare but are often necessary for optimum health and productivity. To validate improved pain mitigation strategies, accurate and reliable quantification of pain is needed. Here we utilised repeated behavioural observation and quantitative sensory testing (QST) in lambs to measure pain after tail docking.

Material and methods
At marking (tagging, vaccination), 139 Merino lambs (4–6 weeks) were randomised to control, hot-knife docking, rubber ring docking, or ring castration with either ring or knife docking. Tail dermatome mechanical nociceptive threshold (MNT) was measured (n = 7–10/group/-sex) pre-marking, and 4h, 4wk, 10mth, and 12mth post-marking. Pain-related behaviours were recorded (n = 15–18/group/sex) for 30-minutes immediately, 4 h, 4 wk, and 10 mth post-marking. Mixed effects models tested group differences in MNT, abnormal posture, and total pain event behaviours. Group classification performance of these measures at each timepoint were assessed by logistic regression area under the receiver operating characteristic curve (AUROC). Correlations (Spearman) between pain measures were also examined.

Results and discussion
Significant group * time interactions were identified in males and females for MNT ($p = 0.0001$ and 0.02, respectively), abnormal posture ($p < 3 \times 10^{-16}$) and pain event behaviours ($p < 3 \times 10^{-16}$). Compared to control males, knife docked males (+/- castration) had greater decreases in MNT from baseline to 4h ($p < 0.01$), but not within females (post-hoc $p = 0.2$). Baseline-adjusted 4h MNT differentiated knife docked from control with AUROC 0.87–0.92 in males and 0.74 in females. Immediately post-marking, ring docked (median [IQR] uncastrated = 66% [29–80]; castrated = 69% [54–94]) and knife docked castrated (28% [21–64]) males had longer ($p < 0.0001$) time-in-view in abnormal posture than control males (1.5% [0.6–3]); ring docked females (47% [31–81]) were also longer than female controls (1.5% [0.4–4]). The same group differences were observed for events (both sexes $p < 0.0001$), with no significant differences between control and knife docked (uncastrated) lambs for either behavioural measure (both sexes $p > 0.1$). Both behaviour measures completely separated female control from ring docked lambs immediately post-marking, with AUROC 0.9–1 for male controls versus ring docked (+/- castration) and knife docked castrated. Pain behaviours immediately post-marking did not correlate with 4h baseline-adjusted MNT ($p > 0.05$). Together, MNT and behavioural results indicated acute pain following tail docking +/- castration, with divergent findings likely reflecting different dimensions of nociception and pain being measured, which are differentially affected by alternative procedures (e.g. ring vs knife).

Conclusion and implications
QST and behavioural measures need to be considered in combination to cover multiple dimensions of pain. Further research is required to understand the biological mechanisms underlying the differential responses to husbandry procedures and guide development and implementation of effective positive welfare initiatives.

Acknowledgements and funding
Meat and Livestock Australian Donor Company
South Australian Sheep Industry
ARC Future Fellowship

doi: 10.1016/j.anscip.2023.01.355

P-078
Occurrence of toxoplasmosis in goats and sheep

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Keywords: Reproductive disorders; Small ruminants; Public health; Toxoplasmosis

Introduction
Toxoplasmosis is a disease caused by *Toxoplasma gondii*, a coccyde protozoan, affecting a wide variety of domestic animals, including cattle, goats and sheep. This disease has a worldwide distribution, with variable prevalence among countries, being considered an important zoonotic disease, responsible for economic damage and significant impacts on animal health. In goats and sheep, *T. gondii* infection is related to abortions, fetal mummification, stillbirths, birth of weak goats and lambs, and neonatal mortality. In humans, it is estimated that approximately one third of the world population has antibodies against the protozoan. In this species, in healthy men and non-pregnant women toxoplasmosis is commonly asymptomatic or presents symptoms similar to the state of influenza. However, this disease is more relevant in women who were infected during pregnancy, where, due to the risk of congenital transmission, it may compromise the neurological and ophthalmological system of the fetus

Material and methods
In this context, the objective of this study was to determine the presence of *T. gondii* in goats and sheep associated with herd history with abortion conditions in the states of Pernambuco and São Paulo. Vaginal swab samples were collected from fifteen goats and nineteen sheep with a history of low reproductive efficiency, abortion and/or stillbirth, from seven properties located in the municipalities of Vinhedo-SP, Garanhuns-PE, Sertânea-PE, Sanharó. Prior to collection, the animals were submitted to a general and specific physical examination of the reproductive system. The pathogen research was carried out using the real time PCR (qPCR) technique, being carried out at the Bovine Virus Laboratory, at the Biological Institute, São Paulo-SP. For DNA extraction, the commercial MagMAX CORE™ Nucleic Acid Purification Kit (Thermo Fisher Scientific) was used in an automated DNA/RNA extraction system (KingFisher™ Flex Purification System). For amplification, the commercial kit EXOone Toxoplasma gondii oneMIX (EXOPOL SL, Zaragoza, Spain) was used, following the manufacturer's instructions.

Results and discussion
According to the results, it can be observed that one of the thirty-four samples collected had the presence of the protozoan detected, representing 3%. In Brazil, the occurrence of the disease in small ruminants is widely described, emphasizing that toxoplasmosis is widespread in goat and sheep farming, being closely related to climatic, socioeconomic and cultural conditions.

Conclusion and implications
In view of this, it appears that there is a need to prepare animal health planning, as well as the implementation of control and prophylaxis programs aimed at reducing the occurrence of this disease, as well as raising the awareness of producers about the risks that this infection can cause to public health.

doi: 10.1016/j.anscip.2023.01.356

P-079
The effect of oral colostrum supplementation on bodyweight and health during the pre-weaning period in dairy lambs

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Keywords: Colostrum; Lambs; Health; Bodyweight

Introduction
The owner of a dairy sheep flock in Greece complained initially of a high incidence of diarrhea (apprx. 20%) in lambs 10–20 days old. An evaluation of 50 colostrum samples using Brix refractometers revealed that 50% of the samples were <18% BRIX score.

Material and methods
The experiment was conducted from middle October to late November 2021, in a medium-size (350 ewes) purebred and crossbred Lacaune dairy farm. 150 lambs were born, from which 66 were enrolled in the study. All lambs were weighed following birth and were randomly assigned to two experimental groups, designated as Test (T group: tube-fed with reconstituted dried colostrum powder containing 14%IgG and 23% fat, SCCL®, $n = 33$) and Control (C group: tube-fed with dam's colostrum, $n = 33$). Lambs were stratified by birth's weight, gender and litter size. All C lambs were hand fed 200ml of colostrum from their dams and T lambs were tube-fed 200 ml solution of colostrum powder (67 gr powder colostrum SCCL/133 ml of water, 38–39 °C). In both groups, lambs received colostrum within 2–4 h of birth. All lambs were ear tagged and remained with their dams for the first day of age. On the 2nd day after parturition lambs were moved to the artificial rearing designated area until weaning (at 35 days). During the pre-weaning period, lambs had ad libitum access to milk replacer (CP 23%, Fat 20%) and from the 3rd day of age, lambs had ad-libitum access to solid concentrated feed (50% maize, 25% wheat bran and 25% soymeal), straw hay and water.
Lambs' body weight (BW) was measured with a digital portable livestock scale, with an accuracy of ±0.5 kg, at birth (1st day) and at weaning (week 5). Average daily gain (ADG) was calculated from birth to weaning (ADG). Clinical condition of lambs was recorded twice a week by a veterinarian.
Comparisons among groups were performed using ANOVA. Analyses were performed with IBM SPSS v.25.

Results and discussion
The initial BW (mean ± SD) was 4.21 ± 1.03 kg and 4.48 ± 0.72 kg for T and C lambs, respectively ($P = 0.223$). Average daily gain for the total pre-weaning period was significantly higher in T lambs (0.316 kg ± 0.04) compared to lambs in the C group (0.29 kg ± 0.03) ($P = 0.015$). In C group, 9% of lambs were treated for diarrhea, while in the T group only 3%.

Conclusion and implications
Overall, lambs fed with SCCL® colostrum powder solution performed better and received fewer antibiotic treatments for diarrhea during the pre-weaning period, compared to those fed colostrum from their dam. The use of a high-quality commercial colostrum product could be a useful alternative when ewe colostrum quality is low.

doi: 10.1016/j.anscip.2023.01.357

P-080
Absence of adverse effects after a double intravaginal administration of *Lactobacillus* spp. in dairy sheep: A preliminary study

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Keywords: Ewes; Vaginitis; Probiotics; Intravaginal

Introduction
The use of antibiotics is common to prevent or treat vaginitis produced by estrus-synchronizing protocols using intravaginal sponges in ewes. This poses a risk of antimicrobial residues reaching the consumer through milk and the generation of resistance to antimicrobial agents, a growing public health concern. From this important issue surges the necessity of finding therapeutic alternatives. For this reason, the aim of this preliminary study was to evaluate the possible effects of intravaginal inoculations of a probiotic in two flocks of dairy ewes.

Material and methods
A total of 120 dairy ewes from two commercial farms in Spain were involved. In each farm, healthy animals were randomly divided in two groups of 30 animals: a probiotic group and a control group. Both groups underwent an estrus synchronization protocol with progestogen impregnated intravaginal sponges. The probiotic groups received two doses of a *Lactobacillus* spp. inoculum (L2), one before inserting the intravaginal sponges (T0) and one on the day of sponges' removal (T1). The pregnancy diagnosis (T2) was established 50 to 60 days after T1 by ultrasound. The general health status of the animals was evaluated by a physical inspection and by checking rectal temperature before and after each inoculation. The conception rate was calculated based on the gestation diagnosis.

Results and discussion
Externally, no adverse effects on the animals' health were detected. Rectal temperatures did not reveal any sign of alterations 24 hours after inoculating the probiotic doses. At T2, the conception rate was similar in one farm in both experimental groups but in the second farm it

was 5.7% higher in the probiotic group compared to the control group. These results are in accordance with our previous study that showed an increase in reproductive success with a single administration of this probiotic and the absence of adverse effects on the health of the animals in a small experimental population of sheep (Quereda et al., 2020).

Conclusion and implications
It appears that the use of our intravaginal probiotics' inoculation protocol has no negative effects on the health status of ewes. The outcome of the pregnancy diagnosis also suggests another evidence of a possible positive effect on the ovine fecundity. Further *in vivo* studies with a larger number of herds and animals need to be pursued to confirm the results observed in this preliminary study.

Acknowledgements and funding
Marion Toquet is the recipient of a FPI contract by the CEU-UCH. This work was funded by the grant GVA/2020/026 and the grant 20190020007437 (REPROVI).

Reference

Quereda, J.J., García-Roselló, E., Barba, M., Mocé, M.L., Gomis, J., Jiménez-Trigos, E., Bataller, E., Martínez-Boví, R., García-Muñoz, Á., Gómez-Martín, Á., 2020. Use of Probiotics in Intravaginal Sponges in Sheep: A Pilot Study. Animals 10, 719.

doi: 10.1016/j.anscip.2023.01.358

P-081
More insight into passive transfer in dairy kid goats

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Keywords: Colostrum; Passive transfer; Goats; Dairy

Introduction
Assessment of the serum total proteins (STP) with a Brix refractometer is a practical and useful way to understand the success of passive transfer. There is limited information on reference values for the Brix use in dairy goats. Therefore, the aim of this study was to describe the Brix values obtained from 3 well-managed dairy goat farms, with good colostrum management.

Material and methods
A total of 112 dams, kidded between 21 October - 21 November, were used. Data were recorded included ID, breed, kidding date, parity, and number of kids (singlet, twins, triplets). Colostrum was collected immediately post-partum and its quality assessed with a Brix refractometer - Suboptimal (<22%); Good (>22%). Kids were blood sampled within 2h, at 24h, at 48%, and 72% after birth to assess SPT. Descriptive statistics of the Brix values were carried out by parity and number of kids. Study approved by the AW & Ethics Committee of FMV-ULusófona.

Results and discussion
Mean (∓ SD) colostrum Brix values in dams in Parity 1 (P1; n = 8) was 27.8%, P2 (n = 38) was 20.7, P3 (n = 37) was 22.8%, P4 (n = 19) was 27.0, and in Parity 5 (n = 10) was 23.3%. Primiparous showed high-quality colostrum, and dams in parity 2 and 3 showed lower quality; likely associated with higher colostrum volume and dilution effect.
Mean serum Brix values at birth was 6.2% (P1), 4.5% (P2), 4.4% (P3), 5.3% (P4), and 3.9% (P5); at 24h was 8.2% (P1), 6.5% (P2), 5.4% (P3), 5.9% (P4), and 6.9% (P5); at 48h was 7.7% (P1), 6.3% (P2), 5.6% (P3), 5.8% (P4), and 6.8% (P5); and at 72h was 7.3% (P1), 5.8% (P2), 5.3% (P3), 5.9% (P4), and 6.5% (P5).
Mean serum Brix values for kids born singlets (n = 25), at birth (B) was 5.0%, at 24h was 7.0%, at 48h was 6.7, and at 72h was 6.1%; for kids born twins (n = 72), at birth was 4.7%, at 24h was 6.1%, at 48h was 6.0, and at 72h was 5.8%; for kids born triplets (n = 15), at birth was 3.5%, at 24h was 5.2%, at 48h was 5.5, and at 72h was 5.8%.
This shows that STP seem to correlate with the quality of the colostrum ingestion, as the kids born from primiparous had higher Brix levels in blood. Kids born from dams in parity 3 showed the lowest Brix levels. Kids born singlets also showed higher STP at all times, compared to twins and triplets; likely associated with a higher frequency of singlets in parity 1.

Conclusion and implications
Good colostrum management leads to successful passive transfer. Kids born from primiparous and as singlets have a better passive transfer.

Acknowledgments and funding
Funded by the FMV-Lusófona Scholarship for Final Year Projects.

doi: 10.1016/j.anscip.2023.01.359

P-082
Facial paralysis in a sheep associated with Caseous lymphadenitis. A case report

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Keywords: Mass; Pseudotuberculosis; Vestibular; Nervous

Clinical history
An Assaf dairy sheep was referred to the Ruminant Clinical Service (SCRUM) due to an evident disturbance of the face. Although the animal presented an adequate body condition, the sheep showed lack of mobility of the left ear, accumulation of food in the left cheek and the tongue remained hanging out of the mouth on the left side most of the time as well, although the ewe could move it.

Investigations
Initially, a comprehensive clinical examination was performed. Only the commented disturbance of the face was appreciated. Upon palpation of the area, the presence of a mass was detected below the left ear. When the food accumulated inside the mouth and next to the mass was removed, it presented a rounded and well- encapsulated appearance.
After that, a neurological examination was carried out. The absence of threat and palpebral response was observed in the left eye, while the right showed a normal response. Ventro-lateral strabismus in the left eye was also observed when the ewe raised its head. Postural reactions were correct, except for the hemistation of the left side. All of this findings could make us think of a vestibular syndrome and facial paralysis.
A computed tomography (CT) scan was performed to appreciate the location and extension of the mass. A rounded, 2 cm diameter well-encapsulated mass was observed next to the inner ear that explained the vestibular syndrome signs. In addition, another mass with a lamellated pattern was also found in the palate.
Finally, the animal was humanely sacrificed, and a *post-mortem* study was performed. Some caseated necrotic material pyogranulomas were found in the liver. Likewise, the masses located in the CT scan showed the same aspect at necropsy. All the lesions were sampled to perform a microbiological test. Massive and pure isolation of *Corynebacterium pseudotuberculosis* was obtained in all sampled lesions.

Differential diagnosis
A wide number of causes are associated with facial paralysis. In sheep, this face paralysis is commonly associated with listeriosis. Although it is relatively frequent to find this disease in sheep flocks, the animals get worse quickly due to nervous affection and die in a few days. Some trauma, tumours or even medium-inner otitis can also affect the facial nerve, causing the observed paralysis. Moreover, bacterial infections caused by *Staphylococcus aureus*, *Trueperella pyogenes* or even *C. pseudotuberculosis* can develop an abscess or a caseous pyogranulomas that compresses the nerve, causing the same clinical signs that the tumour or the trauma in the nerve.

Discussion
Based in the results, the ewe was affected by caseous lymphadenitis in an atypical location. The mass was pressing the left facial nerve, which runs next to this pyogranuloma, causing the clinical signs.

doi: 10.1016/j.anscip.2023.01.360

P-083
Vagus indigestion resulting from a calcified cysticercus in an adult ram

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Keywords: Cysticercus; Digestive disorders; Sheep; Vagus indigestion

Clinical history
A six-year-old Rasa Aragonesa ram was referred to the Ruminant Clinical Service (SCRUM) of the Veterinary Faculty of Zaragoza on November 2018. Initially, the ram was affected by mandibular osteomyelitis and chronic weight loss. The animal was maintained in the facilities until November 2020 to follow the evolution. At this moment, the ram developed several digestive and respiratory disturbances.

Investigations
A clinical examination was performed when the animal got worse. The ram showed normal temperature (39.2°C) and normal heart and respiratory rates (104 bpm and 26 rpm, respectively). Dry diffuse dyspnea was also detected, although the animal developed productive sounds in the cranial lobes of the lung. The main clinical sign detected was an intermittent abdominal pear-shaped distension, although faeces and ruminal movements were normal.
Haematological analysis showed moderate anaemia with leukocytosis caused by neutrophilia and monocytosis. After that, a computed tomography (CT) scan was performed. This test was essential to discover a calcified cysticercus (*Cysticercus tenuicolis*) in the peritoneal cavity next to the vagus nerve tract. In addition, the CT scan showed a reticulum enlargement and an omasum reduction.
Finally, the animal was humanely sacrificed, and a complete post-mortem study was performed. The most relevant finding was the presence of a calcified cysticercus in the peritoneal cavity, located near the caudal lobe lung and next to the vagus nerve tract.

Differential diagnosis
In cattle, some of the possible causes of vagus nerve syndrome include traumatic reticulopericarditis, liver abscesses, abomasum displacement or volvulus, as well as tumours like a liver hemangiosarcoma and fibropapilloma. However, causes associated with vagus nerve syndrome in sheep are not well-described.

Discussion
Various causes of vagus indigestion have been described, including mechanical obstruction to a neurogenic cause. In this case, the presence of the calcified cysticercus pressed or damaged the functionality of the vagus nerve, resulting in a disturbance in the digestive content circulation. Previous studies in sheep confirmed that the modulation of the vagal nerves was related to the contractions of the reticulum-omasum orifice, making it lose activity and tone after being overly stimulated. Due to imaging diagnosis and the post-mortem findings, it was confirmed that the ventral branch of the vagus nerve was injured by the cysticercus, causing vagal indigestion.

doi: 10.1016/j.anscip.2023.01.361

P-084
Suspected mycotoxicosis in sheep causing high mortality

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Keywords: Immunosuppression; Mycotoxicosis; Sheep; Septicemia

Clinical history
An acute process of high mortality (up to 10%) affected a herd under semi-intensive production conditions. Necropsies performed on the farm did not provide information, so it was decided to send 12 animals and 15 samples of whole blood to the Ruminant Clinical Service (SCRUM) of the Veterinary Faculty of Zaragoza. The affected animals exhibited a depressed mental state, weakness and dark-bloody diarrhoea. After that, the animals rapidly died. No other severe pathologies had affected the farm.

Investigations
All animals that arrived alive at the SCRUM facilities were subjected to the same protocol. Different clinical signs, including hypersalivation, diarrhoea, halitosis, mouth wounds and decreased rumen motility, were detected. Haematological analysis showed mild anaemia, lymphopenia, and severe thrombocytopenia. Finally, a complete histopathological exam was performed. The necropsy revealed wounds and erosions in the oral cavity, oesophagus and abomasal mucous membrane. In addition, haemorrhagic lesions and petechiae were observed mainly in the lungs, heart and kidneys. Histopathological examination and molecular and microbiological tests were carried out without relevant results. Severe bone marrow atrophy was observed in the last animals studied, indicating severe immunosuppression. Due to abrasive lesions on the digestive tract and immunosuppression, intoxication was suspected.

Differential diagnosis
Initially, due to the presence of wounds in the oral cavity, orf virus, peste des petits ruminants (PPR), sheep and goat pox, foot and mouth disease and blue tongue disease were suspected. Soon, orf virus and blue tongue disease were tested and ruled out. After necropsies, the lesions causing death were compatible with enterotoxemia or a peracute ovine respiratory complex. However, it was considered that these lesions were secondary. Finally, accidental or induced intoxication was considered the most probable cause since the conservation of the feed was not adequate, being blackish and mouldy. For this reason, food and water samples were tested to find abiotic toxins or mycotoxins.

Discussion
Although Spain is currently free of FMD and PPR, both must be discarded initially. Orf virus does not usually cause severe disturbances in adult sheep. However, it was tested and discarded. Microbiological culture revealed massive growth of *Mannheimia haemolytica* and *Bibersstenia trehalosi*, both cause of the ovine respiratory complex as a final cause of death. Unfortunately, food and water exams did not show any abiotic toxins or mycotoxins. However, many of them could not be tested.
Based on the abrasive digestive lesions found and severe immunosuppression and according to literature, T-2, HT-2 (produced by *Fusarium* spp.) and toxins produced by *Stachybotris chartarum* were suspected as the most probable cause of this outbreak, although unfortunately, it could not be confirmed.

doi: 10.1016/j.anscip.2023.01.362

P-085
Evaluation of humoral and hematological stimulus in goats submitted to ozone therapy under hyperimmune serum production

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Keywords: Antibodies; Caprine; Erythropoiesis; Ozone gas

Introduction
Hyperimmune serum is essential in stages in the vaccine quality control, diagnostic tests, in addition to serving as an immediate immunizer in acute cases of many diseases. Goats have been used as model for antibody production. Ozone therapy has been reported to be effective in stimulate blood cells and immunoglobulin contents. Therefore, this study aimed to characterize the protocol for the production of hyperimmune serum in goats, in addition to evaluating whether O3-MAHT and ozonized saline solution could be applied to increase antibody titers and stimulate goats' erythropoiesis, respectively.

Material and methods
A 2x2 crossover design was adopted in which 10 female goats inoculated with attenuated antigen for mumps (n = 5) and measles (n = 5) were used. In study 1, 12 h after booster inoculation, 240 mL of whole blood were collected in bags, which received 240 mL of mix O2/O3 gas (20 μg/mL; Gozone; n = 5) or not (Gcontrol; n = 5) to be reinjected 12 h after. Bleeding (15 mL/kg) for hyperimmune serum production was performed 21 days later. In study 2, after bleeding, the Gozone was treated with ozonized saline (500 mL of saline IV plus 240 mL of homogenized O2/O3 gas) to assess its effect on erythropoiesis. Throughout both studies, whole blood samples were collected for complete blood count, reticulocyte count and anti-measles and mumps antibody analysis at predetermined times. TBARS and MDA values were also evaluated from each blood bag during its 12 h refrigerated storage.

Results and discussion
In study 1, there was time effect to the HCT, TPP, WBC, lymphocyte, segmented and monocyte indices ($P < 0.001$), as well as there was a time effect for TBARS and MDA ($P < 0.01$). There was a phase effect on antibody titers and inactivation of viral particles ($P < 0.05$). There was a tendency ($p = 0.114$) for Gozone to have greater inactivation of viral particles in T21 when compared to Gcontrol. In study 2, there was a time effect for the RBC, HCT, HGB, TPP, RDW, MCV, MCH, RC, WBC and segmented indices ($P < 0.001$). This is the first study to feature hematological and antibody changes that occur throughout a hyperimmune serum production in goat species, highlighting the stages of booster stimulation, bleeding, antibody production and blood recovery time. Other studies also showed that ozone therapy can effectively improve blood immunoglobulin contents (IgG, IgA and IgM) and immune function in humans with prostatic adenoma and rats with pelvic inflammatory disease, respectively.

Conclusion and implications
All goats responded effectively to the production of hyperimmune serum against measles and mumps and a second booster, within the adopted protocol, did not improve humoral values. AHTM-O3 tends to improve the inactivation of viral particles. Finally, all goats recovered hematological indices 30 days after bleeding, regardless of ozonized saline solution treatment.

doi: 10.1016/j.anscip.2023.01.363

P-086
Oestrus ovis: A survey on its presence and relative disease awareness in human medicine in Italy

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Keywords: Oestrus ovis; Ophthalmo-myiasis; Sheep; Zoonosis

Introduction
Oestrus ovis is the most common cause of ophthalmo-myiasis in humans, and its infection is often misdiagnosed by medical doctor (MD). Although it typically affects farmers, it has also been reported in urban areas. Herein, the results of a survey on *O. ovis* zoonosis in Italy are reported.

Material and methods
Between January 2021 and September 2022, a survey to MDs working in Italy was carried out.

Results and discussion
A total of 100 completed questionnaires were returned. The main feedback was obtained in South Italy (Sardinia and Sicily included), where this parasite is ubiquitous, and small ruminant husbandry is prominent. The average number of patients for each MD was 1,686.25 (range 1,000-12,000), in a mean period of 11.7 years (range 1-45 years) of activity. 35% of the MDs had already knowledge of the myiasis, 18% had heard about it only, and 31%had no knowledge of it whatsoever. The cases observed from each MD per year were 1 (14%), 2 (9%), 3 (2%), 4 (4%), or more than 10 (3%). Infections were registered from spring to autumn. 18% of the patients had worked outdoors and were in contact with animal, 6% had worked outdoors without being in contact with animal, 3% worked indoors with some outdoor activities (i.e. trekking), and 1% worked indoors without any outdoor activities. Presumably, the infection was contracted in rural areas in 23% of the cases (only in 6% of the cases the patient reported contact with ovine), whilst in 7% infestation was presumed to have been contracted at the beach. The diagnosis was confirmed based on either the symptoms and/or the anamnesis only (16%), or after parasite identification (14%). 25% of MDs did not request any further diagnosis, whilst 7% and 2% asked for morphological identification, and molecular biology/serological tests, respectively. In these occasions, nematodes or other *Diptera*, in 4% and 1% of the cases, respectively, were identified. The myasis were ocular (26%), otherwise oral-pharyngeal (1%), nasal (1%), ocular and oral/nasal-pharyngeal (3%); surprisingly, also auricular (2%). 12% of MDs prescribed ophthalmic topic antibiotic and corticosteroid cream, alone or associated with povidone-iodine (7%), 6% reported the efficacy of a mercuric oxide ointment, 9% performed larval removal only. The duration of symptoms ranged 1 (3%), 2-7 (18%), 7-10 (3%), 10-20 days (3%), or ended after larval removal (2%); 5% of the interviewees were not able to collect patient follow-up. 9% of the physicians reported repeated infestations in the same patients.

Conclusion and implications
Recent global warming together with increasing rural tourism predispose an increase of *O. ovis* infection in humans. This should raise the DVMs and DMs' awareness level and the need for an active surveillance of the disease.

doi: 10.1016/j.anscip.2023.01.364

P-087
Excessive copper accumulation in dairy goat kid

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Keywords: Copper accumulation; Goat kids; Intoxication; Liver

Introduction
Copper (Cu) is an essential trace element in small ruminant nutrition, playing an important role in many physiologic pathways. However, the narrow margin between the amount of absorbed Cu needed to meet physiological needs, and the amount at which toxic effects can occur, makes small ruminant feeding challenging. Although goats are less susceptible compared to sheep, Cu intoxications are regularly diagnosed at dairy goat farms in the Netherlands, and nutrition of young goat kids is thought to play an important role.

Materials and methods
Liver Cu values were established in dairy goat kids submitted for post mortem investigation or in pooled liver samples submitted for routine investigation. In case elevated liver Cu levels were found, nutrition until weaning was assessed regarding Cu intake.

Results and discussion
Elevated liver Cu values of up to 1500 mg/kg dry matter (ppm DM) were found in dairy goat kids around weaning age, whereas concentrations exceeding 500 ppm DM are indicative of potential hepatocyte damage, and at concentrations exceeding 800 ppm DM, a release of Cu into the bloodstream results in a haemolytic crisis. In none of these cases, jaundice, discoloured kidneys and haemoglobinuria, indicative of a haemolytic crisis, were present. Together with elevated liver Cu values, deformities of bone structure, such as osteochondrosis or osteomyelitis, were often observed. Given their young age of around 7 weeks, milk replacers, and in some cases concentrates, were considered to be the source of excessive dietary Cu intake. During the milk-phase, absorption rates of dietary Cu can be up to 90%, whereas in mature ruminants this is typically limited to 3- 5%. In the Netherlands, milk replacers are distributed with varying Cu levels, ranging from 0 to 10 ppm DM. Although the high end of this range is within the EU Feed Industry recommendations of 5-15 ppm DM for goat feed, levels above 4 ppm DM are thought to be too high for caprine milk replacers.

Conclusion and implications
Identification of animals in the silent phase of chronic Cu accumulation is important to prevent losses due to severe disease or death, but also to avoid the subclinical disease, and to optimize Cu supplementation. More research is needed on the relationship between feeding and Cu accumulation in young kids. To what extent the current way of feeding young stock is appropriate should also be examined.

doi: 10.1016/j.anscip.2023.01.365

P-088
Caprine neutrophils display a strong innate response against Mycobacterium avium subspecies paratuberculosis in vitro

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Keywords: Neutrophils; Mycobacterium; Paratuberculosis; NETosis

Introduction
Neutrophils constitute an essential component of the innate immune response due to their ability to eliminate pathogens emplpoying different mechanisms such as phagocytosis, degranulation -a process in which they release the contents of their granules into the extracellular space-, or the release of extracellular traps (NETs), networks of DNA associated with proteins capable of immobilizing and kill pathogens. Moreover, an immunoregulatory role, through the production of different cytokines is being unveiled. Regarding mycobacterial infections, the role of these cells has been scarcely studied. Some *in vivo* and *in vitro* experiments have yielded contradictory results. Paratuberculosis is an important mycobacterial disease of ruminants, where the information on the role of neutrophils on its pathogenesis, has been poorly and recently investigated, and not in small ruminants. Thus, the objective of this study is to assess the response of caprine neutrophils after *in vitro* infection with *Mycobacterium avium* subspecies *paratuberculosis* (*Map*), the etiological agent of paratuberculosis.

Material and methods
An optimized protocol to isolate caprine neutrophils from peripheral blood was performed for studying its response against Map. For this purpose, caprine neutrophils, obtained from three healthy goats were exposed to different stimuli (Zymosan and PMA) and Map concentrations (1:1 and 1:10), both live and inactivated. Afterwards, neutrophil mechanisms were assessed using a wide panel of laboratory techniques such as fluorescence microscopy, scanning electron microscopy, fluorometry, flow cytometry and qPCR.

Results and discussion
The results obtained reflect that neutrophils accumulate around the clumps formed by this bacterium, phagocyte it and that *Map* triggers the release of neutrophil granules and NETs, and induces an increase in the RNA expression of proinflammatory cytokines (IL- 1β and TNF). These results indicate that caprine neutrophils are highly responsive against *Map*, and this response is dependent on bacterial concentration and significantly stronger against live bacteria.

Conclusion and implications
These results show that, *in vitro*, caprine neutrophils manifest an marked innate immune response against *Map*, and set the basis for future studies on the early response of these cells against this infection, or the effect that vaccination could have on it. These findings should be confirmed *in vivo*, on intestinal and lymphoid tissues, a much more complex environment, where this response would be modulated by other immune cells and its mediators. Additionally, these techniques could aid in the research of mycobacteria-neutrophil interaction and be applied to the study of ruminant responses against other pathogens.

Acknowledgements and funding
This work was funded by RTI2018-099496-B-I00 and PID2021-125807OB-C21 from the "Agencia Estatal de Investigación". Miguel Criado acknowledges the receipt of a pre-doctoral grant (PRE2019-087309) from the Ministerio de Ciencia e Innovación. We would like to thank the technical help of the staff of the Instituto de Ganadería de Montaña (CSIC–ULE).

doi: 10.1016/j.anscip.2023.01.366

P-089
A comparative study of hematological parameters in intensively reared Chios and Lacaune milking ewes

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Keywords: Hematological parameters; Dairy sheep; Chios; Lacaune

Introduction
Breed-specific reference values of hematological parameters in dairy sheep are scarce. The objective was to comparatively study the variation of hematological parameters in intensively reared Chios and Lacaune milking ewes.

Material and methods
A total of 343 clinically healthy Chios and Lacaune ewes (146 and 197 sheep, respectively), from four intensive farms, at the last stage of lactation were used for the study. For each individual animal, age and body condition score (BCS) were recorded, and a whole blood sample was collected and analyzed using a Mindray BC-30Vet hematological analyzer for the following parameters: white blood cell count (WBC), granulocyte count (GC), lymphocyte count (LC), monocyte count (MC), percentages of granulocytes (GP), lymphocytes (LP), and monocytes (MP), red blood cell count (RBC), hemoglobin concentration (HGB), hematocrit (HCT), mean values of corpuscular volume (MCV), corpuscular hemoglobin (MCH), and corpuscular hemoglobin concentration (MCHC), red cell distribution width coefficient of variation (RDW-CV) and standard deviation (RDW-SD), platelet count (PLT), mean platelet volume (MPV), platelet distribution width (PDW), plateletcrit (PCT), platelet large cell count (P-LCC), and platelet large cell ratio (P-LCR).
SPPS v23 was used for the data analyses which included descriptive statistics (mean ± SD) and analysis of covariance as follows:

$$Y_{ijk} = \mu + F_i + P_j + B_k + a_1 \times BCS + e_{ijk},$$

where, Y_{ijk} = dependent variables (hematological parameters), μ = overall mean, F_i = random effect of the farm (i = 4 levels), P_j = fixed effect of age (j = 4 levels, 1st year to $\geq$4th year), B_k = fixed effect of the breed (k = 2 levels, 1 = Chios 2 = Lacaune breed), a_1 = regression coefficient of BCS, and e_{ijk} = residual error.

Results and discussion
Mean ± SD of leukocytes for WBC, GC, LC, MC, GP, LP and MP were 8.0 ± 2.57 × 10^3/uL, 3.8 ± 1.76 × 10^3/uL, 3.7 ± 1.30 × 10^3/uL, 0.5 ± 0.2 × 10^3/uL, 46.6 ± 9.81%, 47.0 ± 9.60%, and 6.4 ± 1.41% and 9.3 ± 2.40 × 10^3/uL, 4.1 ± 1.46 × 10^3/uL, 4.5 ± 1.35 × 10^3/uL, 0.6 ± 0.21 × 10^3/uL, 44.3 ± 8.87%, 49.0 ± 8.77%, and 6.7 ± 1.15% for Chios and Lacaune ewes, respectively. The respective values for red blood cells (RBC) and the HGB, HCT, MCV, MCH, MCHC, RDW-CV and SD were 8.7 ± 1.25 × 10^6/uL, 10.0 ± 1.33g/dL, 31.4 ± 4.23%, 36.3 ± 3.45fL, 11.5 ± 1.01pg, 31.8 ± 1.63g/dL, 16.8 ± 2.07%, and 24.0 ± 4.35fL for Chios, and 8.6 ± 1.25 × 10^6/uL, 9.5 ± 1.28g/dL, 29.0 ± 4.29%, 34.0 ± 2.53fL, 11.2 ± 1.05pg, 32.9 ± 2.37g/dL, 16.9 ± 1.54%, and 22.6 ± 3.25fL for Lacaune sheep. Regarding the thrombocyte-associated traits, mean values of PLT, MPV, PDW, PCT, P-LCC, and P-LCR were 305.1 ± 193.62 × 10^9/L, 6.2 ± 0.49fL, 15.0 ± 0.35, 1.9 ± 1.17mL/L, 150.1 ± 91.19 × 10^9/L, 50.6 ± 7.46% in Chios, and 270.5 ± 150.48 × 10^9/L, 5.8 ± 0.36fL, 15.1 ± 0.36, 1.5 ± 0.83mL/L, 114.5 ± 59.09 × 10^9/L, 43.6 ± 5.99% in Lacaune sheep, respectively.
Chios ewes had significantly higher MP (1.28%, 95% CI, 0.50-2.07, P = 0.001), P-LCR (4.6%, 95% CI, 0.36-8.87, P < 0.05) and MPV (0.3fL, 95% CI, 0.08-0.61, P < 0.05) and lower RDW-CV (1.5%, 95% CI, 0.25-2.66, P < 0.05), compared to Lacaune ewes.

Conclusion and implications
Breed-specific differences and thresholds of hematological parameters in intensively reared dairy ewes need to be further elucidated to enhance the diagnostic value of hematological analyses in clinical practice.

doi: 10.1016/j.anscip.2023.01.367

P-090
Fatal haemorrhage due to rupture of the internal carotid artery in 3 sheep

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Keywords: Blood vessel; Haemorrhage; Pathology; Sheep

Clinical history
Post-mortem examination of two 2-4-year-old meat ewes (E1 and E2), and a 7-year-old dairy ewe (E3) were performed. E1 and E2, originated from the same flock, were both dull for 1-2 weeks approximatively and were drenched 10 and 21 days previously, respectively. E3 was found dead after a few weeks of dyspnoea and dysphagia. Histological evaluation for E1, and bacteriological examination for E1 and E2 were also performed.

Investigations
On gross examination, the ewes showed generalized moderate to severe pallor, blood staining of nostrils and mouth. In the ventral neck region of both E1 and E2, a poorly defined swelling (about 11 x 6 x 5 cm) involving the surrounding lymph-nodes, salivary glands, muscles and subcutis was present. Unilateral perforation of the internal carotid arteries was found, and the swellings consisted of large blood clots and fibrin, whilst the surrounding soft tissues showed diffuse severe oedema, bruising and laceration. The swellings were communicating with the oropharynx, and in E2 there was a fistula between the swelling and the lateral surface of the base of the tongue with an opening 2cm in diameter. In E3 the lesions were similar to those observed above, but less extensive. In all ewes, large blood clots in the trachea, main bronchi, oral cavity, oesophagus, reticulum and rumen, together with melena, were also observed. Histologically, severe necrotising, neutrophilic and bacterial arteritis resulting in arterial rupture was observed. Severe necrotising and bacterial sialadenitis was also seen. *Streptococcus ovis* was cultured from the lesion of E1, whilst *Streptococcus lutetiensis* was isolated from the lung of E2. E1's lesion also tested PCR positive for *Bibersteinia trehalose*.

Discussion
Herein the authors described three cases of fatal cervical haemorrhage due to rupture of the internal carotid artery in 3 adult ewes. Fatal haemorrhage due to bacterial infection and resultant perforation of the main cervical blood vessels are considered rare. In this case, the inflammatory process was chronic, bacterial in nature and extended to a wall of a surrounding large blood vessel, which could have lead to its weakening and rupture and a consequent haemorrhage and hypovolemic shock, together with abundant blood ingestion and aspiration.
The history of 2 ewes from the same flock (E1 and E2) stated that both were drenched within 3 weeks of the death. It is possible that they may have sustained oropharyngeal injury during drenching which may have resulted in bacterial infection of the adjacent salivary gland and internal carotid artery.

doi: 10.1016/j.anscip.2023.01.368

P-091
A comparative study of milk quantity, quality traits between a maedi-visna infected, a maedi-visna free dairy sheep farm

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Keywords: Maedi-visna; Dairy sheep; Milk yield; Milk quality traits

Introduction
The effects of maedi-visna (MV) seropositivity on milk quantity and quality traits in dairy ewes have not yet been fully documented. The objective of our study was to compare the forementioned traits between a maedi-visna infected and a maedi-visna free dairy sheep farm.

Material and methods
Eighty-three and fifty-two milking ewes at post-weaning from one MV-free (Farm A) and one MV-positive (Farm B) intensive dairy sheep farm with similar management schemes, were randomly selected and enrolled in this prospective study. Daily milk yield (DMY), milk quality traits [MQT, daily fat- (DFY), protein- (DPY), lactose- (DLY), and solids non-fat- (DSNFY) yield, log of somatic cell counts (logSCC), pH and electrical conductivity (EC)], age and body condition score (BCS) were recorded for each individual ewe, bimonthly for 4 months. At the beginning of the study, blood samples were collected and assayed for the detection of antibodies against SRLVs using a commercial indirect

ELISA (IDEXX, CAEV/MVV Total Ab Test). Descriptive statistics were calculated, and the following mixed linear regression model was used in SPSS v23 to estimate the effect of MV on MY and MQT:

$$Y_{ijklm} = \mu + F_i + G_j + P_k + S_l + a_1 \times BCS + G_j \times P_k + F_i \times P_k + F_i \times P_k \times G_j + E_m + \delta_{ml} + e_{ijklm}$$

where, Y_{ijklm} = dependent variables of MY and MQT, μ = intercept, F_i = fixed effect of the farm, G_j = fixed effect of MV serological status (j = 2 levels), P_k = fixed effect of age (k = 4 levels), S_l = fixed effect of the sampling occasion (l = 3 levels), a_1 = fixed effect of the regression coefficient of BCS, E_m = random variation of the m^{th} ewe, δ_{ml} = repeated variation of the m^{th} ewe in the l^{th} sampling occasion, and e_{ijklm} = residual error.

Results and discussion

Seronegative ewes had significantly higher DMY and DLY, and lower DFY ($P < 0.05$ in all cases) compared to seropositive ewes. Ewes in Farm B had significantly higher DFY ($P < 0.05$), and lower DLY ($P < 0.05$), EC ($P < 0.001$) and pH ($P < 0.01$) compared to ewes in Farm A. Moreover, sampling occasion ($P < 0.001$) and BCS ($P < 0.05$) were negatively associated with DMY and the rest MQT, while age only with DPY and DLY (both $P < 0.05$). The interaction of MV serological status and age was significantly associated with DFY and DLY ($P < 0.05$), while the interaction of farm, MV serological status, and age with DFY ($P < 0.01$) and pH ($P < 0.05$).

Conclusion and implications

The MV-free farm had higher DMY and DLY compared to the MV-infected one. In any case, large-scale studies, with the involvement of several farms, under various farming systems, are necessary to validate the results of the study.

Acknowledgements and funding

This research was funded by "Farma Lamias IKE' within the Regional Operational Program "Central Greece 2014-2020 RIS3", Project code: STER1-0024719, Project name: "Development of ovine progressive pneumonia-free sheep breeding stocks in the region of Sterea Ellada."

doi: 10.1016/j.anscip.2023.01.369

P-092
Homeopathic approach in small ruminants: Sharing clinical experiences

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Keywords: Homeopathy; Integrative medicine; Sheep; Treatment

Introduction

Homeopathy is based on highly diluted succussed preparations which become popular in organic livestock as it promotes health and well-being in treated animals without leaving residues in milk or meat. It was aimed to describe the group's experience in the use of homeopathic formulations to sheep medicine.

Material and methods

From December 2021 to November 2022, the homeopathic approach was used in three distinct clinical cases diagnosed in the meat sheep flock raised under semi-intensive system at the Veterinary Farm School of the Universidade Federal Fluminense in Rio de Janeiro, Brazil. All animals received intranasal spray application containing a distinct homeopathic complex for each case. The first case involved two adult ewes diagnosed with seasonal allergic dermatitis (skin biopsy and histopathology) that received a complex containing: Nat-m and Led, at 30CH twice a week. One ewe responded well to this application interval and the other one had to reduce the interval to every 48 hours to reach the same outcome. The second case occurred in a senile ewe diagnosed with chronic bilateral carpal osteoarthritis (radiographic diagnosis and negative for lentiviruses by PCR) and shortening of flexor tendons. This ewe showed no improvement after conventional anti-inflammatories and intra-articular corticoids, in addition to bilateral tenotomy. After the failure of such conventional therapies, homeopathic intervention was started using a complex containing: Guaj, Rhus-t, Ruta, Ol-j, Calc-c and Calc-p at 12CH, Bry 30CH, Form and Act-sp 6CH, administered once a day. The third case occurred in two young rams with chronic history of rhinitis, weight loss, pasty feces with streaks of blood and mucus and dull coat. After clinical examination and differential diagnosis, a presumptive diagnosis of idiopathic ulcerative colitis was reached (unconfirmed suspicion of allergy to corn or soy used in the feed). Both were treated with a homeopathic complex containing: Graph, Sil and Petr 30CH, Usn and Echi 6CH, Podophyllum peltatum and Calc-c 12CH and Carc 200CH, twice a day.

Results and discussion

In the first case, the treatment was effective in reducing periocular and auricular skin lesions. In the second case, the animal showed improvement in locomotion, weight gain and stabilization of the osteoarthritis radiographic image (11-month follow-up). In the third case, both animals showed progressive improvement in fecal consistency, weight gain and coat appearance. There was also a decrease in signs of

rhinitis, but no total resolution. It is important to emphasize that all cited clinical cases were not self-limiting or acute diseases and therefore would continue to progress without therapeutic intervention.

Conclusion and implications
Homeopathic medicines can be integrated in sheep medicine, providing quality of life and well-being to patients with chronic and difficult-to-manage diseases, which makes it important to encourage further studies in this field of knowledge.

doi: 10.1016/j.anscip.2023.01.370

SEOC (Sociedad Española de Ovinotecnia y Caprinotecnia)

P-093
Multivariate analysis of meat from non-pregnant ewes, light lambs of Merino breed

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Keywords: Age; Sex; Nutritional value; Quality

Introduction
The traditional product in Spanish ovine' production systems are the light lambs but near the 2% of the herd are non-pregnant ewes, which represent great losses for the farmer. To value non-pregnant ewes' meat would be a viable market strategy but considering that the typical product is a light lamb and that the age and sex of the animal influence the quality of its meat, we aim to evaluate the meat quality of non-pregnant ewes and light lambs (males and females) of the Merino breed.

Material and methods
We used 10 ewes (in average, 26.7 Kg of Hot Carcass Weight), in and 20 lambs (half females, half, males; 10.9 Kg Hot Carcass Weight). After carcasses cooling (24h/4°C), 50 variables concerning pH, color, fatty acid profile, proximal composition, vitamins, minerals, and texture profile were recorded. We performed an ANOVA with the type of animal (thereafter, group) as fixed effect and a Discriminant Analysis (DA) with a stepwise procedure. The same statistics were repeated considering only light lambs but no ewes data.

Results and discussion
We found differences between groups in 22 of the 50 variables. Nevertheless, the DA selected only 7 variables: hot carcass weight, total MUFA, α- and δ-tocopherol, lutein content, collagen content and C* of muscle *Longissimus lumborum*. Factor 1 explained for the 98.9% of the variability. Centroid for males and females lambs are near between them (7.58 and 7.96, respectively) and far from ewes centroid (-15.54). The 100% of ewes and males are correctly classified whereas only the 80% of the females did. When repeated the statistics considering only the lambs, we found differences between males and females only in 8 of the 50 variables. The DA selected only 3 variables: MUFA, δ-tocopherol and b* of muscle *Longissimus lumborum*. All the animals were correctly classified. The usefulness of multivariant analysis to study the lamb meat quality was yet demonstrated by other authors Caneque et al. (2004).

Conclusion and implications
The sex and/or age of the animals can be discriminate based on few variables. Differences between meat quality from non-pregnant ewes and light lambs are feeble enough to consider the selling of the meat from non-pregnant ewes' as a viable marketing strategy.

Acknowledgements and funding
To Merino Farmers Association for the animals. To Service of Analysis of University of Zaragoza and to Juan Ramón Bertolín for its technical assistance.

Reference

Caneque, V., Perez, C., Velasco, S., Di, X.A.M.T., Lauzurica, S., Alvarez, I., Ruiz de Huidobro, F., Onega, E., De la Fuente, J., 2004. Carcass and meat quality of light lambs using principal component analysis. Meat Sci. 67, 595–605. https://doi.org/10.1016/j.meatsci.2004.01.002.

doi: 10.1016/j.anscip.2023.01.371

P-094
Color, fatty acids and lipid oxidation of meat from male and female light lambs, and non-pregnant ewes

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Keywords: Ewe; Sex; Light lamb; Quality

Introduction
Most of the meat of Spain comes from suckling or light lamb but consumption has decreased in recent years. So, it is essential increase the incomes of farmers. Keeping non-pregnant ewes in herds leads to economic losses. It is estimated that near the 2% of the herd are non-pregnant ewes and their value are low. It is necessary to define the characteristics of the meat from these non-pregnant ewes before finding feasible market strategies to increase the value of their meat. The objective of this study was to evaluate the quality of the meat of non-pregnant ewes compared to male and female light lambs of the Merino breed.

Material and methods
We used 10 non-pregnant ewes (NPE, 26.7 of Hot Carcass Weight), 10 male lambs (ML, 13.2 kg) and 10 female lambs (FL, 12 kg). Animals were slaughtered and after carcasses cooling (24h/4°C), the muscle *triceps brachial* was sampled to determine fatty acids (FA) profile by HPLC (expressed as percentage of fatty acid metyl esthers), meat color after blooming (spectrophotometer) and lipid oxidation at 1 d and 7 d after slaughtering (TBARS method, expressed as mg/kg of fresh meat). An ANOVA with the group of animals as a fixed effect and a Tukey test for differences between means ($p < 0.05$) were performed.

Results and discussion
There were no differences ($P > 0.05$) between groups on pH (5.7 ± 0.03), yellowness index (8.3 ± 0.60), chroma (11.3 ± 0.72), saturated FA (42.3% ± 0.23), monounsaturated FA (47.4% ± 0.20) and polyunsaturated FA (10.3% ± 0.31). However, there were differences ($P < 0.05$) in lightness, redness index and hue angle. NPE had lowest lightness (37.15) and hue angle (35.94) while FL and ML had greatest lightness (41.39 and 44.04, respectively) and hue angle (53.35 and 52.47, respectively). Conversely, NPE had highest values of redness (10.33) while FL and ML had lowest values (5.82 and 6.20, respectively). The three groups had no differences ($P > 0.05$) in lipid oxidation at 24 h between them with values ranging from 0.006 to 0.011 mg/kg of fresh meat. NPE had values of lipid oxidation at 7 d similar ($P > 0.05$) to those at 24 h (0.084 mg/kg of fresh meat). However, FL and ML increased ($P < 0.05$) its values at 7 d until 0.155 mg/kg of fresh meat and 0.169, mg/kg of fresh meat respectively but without differences ($P > 0.05$) between them.

Conclusion and implications
Therefore, ML and FL were similar according to the studied meat quality traits, but NPW had meat redder and slightly darker. Meat from NPE keep the lipid oxidation steady for a week showing longer shelf life than that from light lambs.

Acknowledgements and funding
Asociacion de Criadores de Ganado Merino y Matadero frigorífico de Agudo.

doi: 10.1016/j.anscip.2023.01.372

P-095
Preweaning growth curve in crossbred Dorper, Katahdin, Romanov lambs

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Keywords: Comecial; Production; Intensive; System

Introduction
A growth curve synthesizes the information of a life span into a small set of mathematical parameters and allows the heaviest animals to be identified at early ages in large groups of animals. The objective was to evaluate the behavior of the predestined growth curve of crossbred lambs.

Material and methods
Dorper (DPr; n = 46), Katahdin (KTn; n = 204) and Romanov (RMv; n = 40) was used for the experiment, the sample size of the groups was not uniform due to the characteristics of the herd and where it is sought to characterize the behavior only of the different genotypes present in the herd. To fit the growth curve, Bertalanffy's non-linear mixed model was modified: y (t) = a(1-be-cx) + ε, where y: live weight at age "t", a: asymptotic weight, interpreted as the adult weight, b: is an integration parameter related to the initial body weight, which is defined by the initial values of both "y" and "t", c: maturation rate, interpreted as the change in weight in relation to mature weight, indicating how quickly the animal reaches its adult weight, ε: occasional error, normally distributed with zero means and constant variance. The parameters were estimated using the NLMixed procedure of the SAS v.9.3 statistical package. To determine the goodness of fit of the model, the CME (mean square error) criteria were used; CIB (Bayesian information criterion) and R2 (coefficient of determination).

Results and discussion
Parameters a, b and c indicate that DPr lambs show better development compared to KTn and RMv specimens (Table 1), since they show the highest values in parameters a and b. However, the highest precision was found for the KTn genotype, given by a higher value of R2, which is attributed to a greater amount of productive information due to a greater number of specimens under evaluation, which strengthens the criterion of use of the greatest amount of productive information possible, since this entails a greater precision of the indicators that are calculated.

Conclusion and implications
It is concluded that the growth curve is a very important tool to evaluate the productive behavior of various genotypes in various environments with satisfactory precision, in this study DPr lambs showed better growth.

doi: 10.1016/j.anscip.2023.01.373

P-096
Impact of dam characteristics on vitality lambs at birth

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Keywords: Apgar; Neonatal; Gestation; Sheep

Introduction
Neonatal death in flocks is high during the first three days of life and represent economic loss and welfare concern. Lamb vitality score have been used to indicate existence of abnormal condition at birth and to prevent neonatal mortality, identifying lambs with low vigor and implementing corrective measures. At large flocks, there is difficult to assess all lambs at birth, and some dams need more attention to labor than others to reduce neonatal mortality. The aim of this study is to verify the effect of dam characteristic on lamb vitality at birth.

Material and methods
There were evaluated 98 beef breed lambs from 72 dams. The contrasting groups were: the length of gestation (77 normal ≥145 days; 21 premature <145 days), category (27 yearlings; 45 ewes), age (54 young, <3 yo; 44 adults, ≥3 yo), weight (31 light, £ 75 kg; 67 heavy, >75 kg), prolificacy (42 singletons; 56 multiple), body condition (58 ideal, between 2.5 to 3; 40 fat ≥3.5)and Famacha score (81 ideal, =1; 17 good, between 3 to 2) of dams. Lamb's vitality was evaluated immediately after birth using the Apgar system and low-vitality lambs were considered with a score below 7. To assess differences between the median to each characteristic and vitality score, the Mann-Whitney test was performed. The significance level was 5% and all analyzes were performed in GraphPad Version 9.

Results and discussion
There were 53 normal vitality lambs and 45 low-vitality lambs (Apgar < 7). The dam category ($P = 0.0022$), dam weight ($P = 0.0212$), and days of gestation ($P < 0.0001$) affected the median vitality score of lambs; on the other hand, daḿs prolificity, body condition and Famacha scores did not influence it. Lambs from ewes have better vitality (Apgar = 7) than from yearlings (Apgar = 5). Lambs from a normal-length gestation have better vitality (Apgar = 7) than premature (Apgar = 5), and lambs from light dams (Apgar = 5) have worse vitality than from heavy dams (Apgar = 7). However, singletons need more attention in peripartum than multiples because median vitality of singletons is below the normal vitality cut-off, and the same occurs with the light, young and ideal body condition dams. Results show that the main influence on low vitality of neonate lamb was the low duration of gestation yearling category and low body weight dam.

Conclusion and implications
We conclude that yearlings need more assistance than ewes to reduce neonatal mortalityof lambs at birth and that is important to observe the aspects that may influence the weight of dams at parturition as maternal nutrition during pregnancy.

doi: 10.1016/j.anscip.2023.01.374

P-097
Productive evaluation pre-weaning of Romanov and Romanov x East Friesian lambs

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Keywords: Romanov; East Friesian; Lambs; Sheep production

Introduction
The breed of Romanov (R) sheep is among the prolific and as a dairy breed is the East Friesian (EF), for both genotypes, in Mexico there are few works to evaluate their productive and reproductive potential, even less, of the animals result of the crossing between both. It is known, but not documented, that F1 with the use of EF rams (black variety) with R sheep, are excellent recipients of embryos.The objective was to study the racial influence, birth type and sex on the productive performance and mortality from birth to weaning in R lambs and EF ram with R sheep (EFxR).

Material and methods
Data from 40 R lambs and 89 EFxR from a sheep production unit in confinement were evaluated. At birth, the lambs were sexed, weighed, and identified with a metallic earring, within a week potassium selenate was applied. The lactation period was 84 days on average. Preventive measures were applied to avoid health problems. To know the differences between the groups and variables studied, the results were statistically processed by analysis of variance with the SAS program.

Results and discussion
Of 20 R births studied, six were single, eight with twins and six with triplets. The 89 EFxR were the result of 44 births, mostly twins (24), nine singles, eight with triates and two quadruples. Prolificacy was 2.0 for both genetic groups ($p > 0.05$). The average birth weight of R and EFxR lambs was 2.5 and 2.1 kg, respectively ($p < 0.5$). There were more R males (24) than females (16), the proportion in EFxR was similar, 47 (51.7%) and 43 (48.3%). At weaning, R lambs weighed more (20.0 kg) than EFxR (18.7 kg). The simple lambs weighed more and as litter size increased, the average individual weaning weight decreased. There were notable arithmetic differences in mortality percentages, not statistically significant ($p > 0.05$), of 89 EFxR lambs born, 11 (24.7%) died. In the R lambs, there were three deaths out of 40 births (7.5%). Mortality in EFxR increased depending on litter size, 14.6% in doubles and 45.8% in triplets, and 50% in quadruples.

Conclusion and implications
In conclusion, the predominance of multiple births over single births is notorious, the prolific character of the R breed is confirmed, this attribute was maintained when crossed with EF. Weaning mortality was very low in R and high in EFxR, which is related to the increase in litter size, so it is recommended to pay special attention to multiple births.

doi: 10.1016/j.anscip.2023.01.375

P-098
Respiratory tropism of Coxiella burnetii in goats during a Q fever outbreak: A case report

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Keywords: Q fever; Coxiella burnetii; Goats; Respiratory

Clinical history
During the October kidding of 300 second-parity females in a goat farm of 2000 animals, the farmer reported the death of 30 adult goats, 35 abortions, and the birth of 75 weak kids. Keratitis and a reduction in milk production were observed in the dairy herd. Oxytetracyclines

were injected into all the pregnant goats. Four months earlier, during a Q fever outbreak in the farm with an abortion rate of 60%, all animals were vaccinated with Coxevac®. The females from the October kidding were vaccinated when they were 1.5 months pregnant.

Investigations
A total of 21 samples were taken from the necropsy of two pregnant goats against *Coxiella (C.) burnetii* and *Chlamydia (C.) abortus*: three lung lobe samples in both lungs, vaginal swabs, nasal swabs, and individual milk samples. The following samples were taken for q-PCR against the same etiological agents only from animal 2: placental tissue, rectal swab and bronchial swab. To search for *Mycoplasma (M.) agalactiae* by q-PCR, the following samples were taken from both goats: external auditory canal swabs, ocular conjunctiva swabs and individual milk samples. For the bulk-tank milk (BTM) samples, q-PCR was performed against *M. agalactiae*, *M. mycoides* susbp. *capri*, *M. putrefaciens*, and *M. capricolum*. The blood sample from goat 2 was tested by ELISA against *M. agalactiae*.

Differential diagnosis
The main differential diagnoses proposed in this case were: *C. burnetii* infection, *C. abortus* infection, or contagious agalactia (*Mycoplasma* spp.)

Discussion
The q-PCR samples positive for *C. burnetii* from animal 1 were the right cranial lung lobe and nasal swab. In animal 2, only the nasal swab sample was positive. There were no positive results of mycoplasmas or *C. abortus*. This is the first reported case of the joint presence of *C. burnetii* in lung and nasal swab samples in goats during a Q fever outbreak. In infected pregnant goats, the vaccine has no effect to control *C. burnetii*, with similar results to Astobiza et al. (2011) in sheep. This work suggests a possible underestimated respiratory tropism of the pathogen in goats. The nasal sample is a potentially effective tool to increase the sensitivity of the caprine Q fever diagnosis.

Acknowledgements and funding
Á. Gómez-Martín and J.J. Quereda are supported by a "Ramón y Cajal" contract of the Spanish Ministry of Science, Innovation and Universities (RYC2021-032245-I; RYC-2018-024985-I). A research grant from the Generalitat Valenciana supports R. Toledo.

Reference

Astobiza, I., Barandika, J.F., Ruiz-Fons, F., Hurtado, A., Povedano, I., Juste, R.A., García-Pérez, A.L., 2011. Four-year evaluation of the effect of vaccination against Coxiella burnetii on reduction of animal infection and environmental contamination in a naturally infected dairy sheep flock. Appl. Environ. Microbiol. 77 (20), 7405–7407. https://doi.org/10.1128/AEM.05530-11.

doi: 10.1016/j.anscip.2023.01.376

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