Feeding Behaviour as an Indicator of Health and Welfare

PROCEEDINGS

of the

THIRD DAIRYCARE CONFERENCE 2015

Zadar, Croatia, October 5th and 6th 2015

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Proceedings of the Third DairyCare Conference 2015

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This volume comprises the Abstracts of presentations made at the Third DairyCare Conference held in Zadar, Croatia October 5th and 6th 2015. DairyCare is a COST Action (FA1308) and the holding of the Conference was supported by COST under the Horizon 2020 programme. Further information about DairyCare can be found at www.dairycareaction.org and about COST at www.cost.eu

Proceedings

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Third DairyCare Conference 2015

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WELCOME TO DairyCare!

Animal wellbeing is at the start of a chain that links to farmer profitability, product quality, consumer satisfaction and environmental sustainability.

DairyCare is enjoying its second year, and now has more than 450 members representing 32 different COST countries. We have previously published two Conference Proceedings, both available on our website, and will soon publish our eighteen-month progress report. Our Working Groups are actively organising focused scientific Workshops, and by the end of our second year we will have featured a range of topics including general aspects of biomarkers, activity measures, systems level dairy herd management as well as specialised investigation of the lameness/reproduction interface, cortisol and other stress biomarkers, feeding behavior, detection and management of sub-acute ruminal acidosis and lameness detection methodologies. We have a strong focus on Early Career Investigators and their career development, reinforced by dedicated sessions at this Third DairyCare Conference. During August and September this year our website had around 400 pages visits each day, and our networking is now truly global; this Conference will end by considering how we can increase our international impact and hence the global success of European dairy sector industries. Please, enjoy Dairycare, enjoy your visit to Zadar either physically or through the pages of these Proceedings and help us to achieve our objective of improving the health and well-being of dairy animals.

Visit our website www.dairycareaction.org

WELCOME TO ZADAR!

Our Third DairyCare Conference is also our first visit to one of the COST Inclusiveness Countries, but we hope it will not be our last. Croatia joined the EU in 2013, following a period of investment in its agricultural sector. The coastal regions of Istria in the North and Dalmatia further South are amongst the most beautiful in Europe, and it is here that we find the historic city of Zadar. Our Conference is organised by Marcela Speranda, and we are very grateful to Marcela and her colleagues from the Josip Juraj Strossmayer University of Osijek, located in central Croatia close to much of the dairy production. We are also grateful to Ali Mobasheri (University of Surrey) and Tim Shipley (BioMedCentral) for organising our first satellite Workshop, "How to get Published". So, let us take the advice of the Croatian Ministry of Agriculture:
Croatia has a strong food industry with a long tradition, distinguished by highest food quality and safety standards, offering an abundance of top-quality and recognisable agricultural and food products. Visit us and try for yourselves some of the delicacies that Croatian agriculture has to offer.

The Conference has been organised by the DairyCare Action Steering Group:

Chris Knight, Denmark	Gianfranco Gabai, Italy
Marcela Speranda, Croatia	Vivi Thorup, France
Lene Munksgaard, Denmark	Jon Moorby, UK
Ivan Andonovic, UK	Rupert Bruckmaier, Switzerland
Sigrid Agenäs, Sweden	Marta Brscic, Italy
Annelies Van Nuffel, Belgium	Lena Lidfors, Sweden
Local organiser:	Marcela Speranda, Croatia
DairyCare Project coordinator:	Sheena Knight, Denmark

We are grateful to the University of Osijek for generous support, and of course to COST for funding.

Programme for the Third DairyCare Conference, Zadar		
Monday 5th October		
08:00	**Registration**	
08:30	**Welcome** Sonja Maric,*Vice Dean of Faculty of Agriculture, University of Osijek*	
08:40	**Themed Session** **Feeding Behaviour as an Indicator of Health and Welfare** **Chair: Marcela Speranda**	
08:40	1.01	**Invited Plenary: Dairy Cow feeding behavior: Basic concepts and practical Implications** Trevor DeVries, *University of Guelph, Canada*
09:20	1.02	**Invited Plenary: Feeding behaviour and welfare** Daniel M Weary *University of British Columbia, Canada*
10:00	1.03	**Estimation of individual intake of grazing dairy cows with RumiWatch®** Markus Rombach, Andreas Münger, Karl-Heinz Südekum, Fredy Schori *Agroscope, Switzerland*
10:15	1.04	**How does cows' activity change after feeding bin change?** Maria Soonberg, David Arney. *Estonian University of Life Sciences, Estonia*
10:30	1.05	**Automatic monitoring of health and welfare through feeding behaviour: lessons learned in pigs which may also be relevant for dairy** Jarissa Maselyne, Wouter Saeys, Annelies Van Nuffel, *KU Leuven, Belgium*
10:45	**Coffee, put up posters**	
11:20	1.06	**Invited Plenary: Neural Pathways regulating feed intake in ruminants, impacts of disease and relationship to reproduction** James Sartin. *Auburn University, USA*
12:00	1.07	**Silent Herdsman platform** Ivan Andonovic and Craig Michie *University of Strathclyde, UK*
12:20	1.08	**Management of Reticuloruminal pH in Modern Dairy Herds** Sina K Stein, Mario Fallast *smaXtec animal care, Austria*
12:40	1.09	**The reduction of feed intake and gluconeogenesis during kyperketonemia in dairy cows indicates a signal of abundant energy availability** Rupert Bruckmaier. *University of Bern, Switzerland*

Programme for the Third DairyCare Conference, Zadar		
Monday 5th October		
	Themed Session Feeding Behaviour as an Indicator of Health and Welfare Chair: Lena Lidfors	
13:00	**Lunch and posters**	
14:00	1.10	**Invited Plenary: Is spontaneous rumen acidosis related to feeding behaviour in goats?** Sylvie Giger-Reverdin & Christine Duvaux-Ponter *INRA, France*
14:40	1.11	**Lameness affects daily feeding time but not rumination time as characterized from sensors** Vivi M Thorup, Birte L Nielsen, Pierre-Emmanuel Robert, Jakub Konka, Sylvie Giger-Reverdin, Nicolas C Friggens. *INRA, France*
14:55	1.12	**Feeding behavior, milk yield, activity, and insulin sensitivity in lame dairy cows** Janssen Simone, Heppelmann Maike, Meyer Ulrich, Dänicke Sven, Juergen Rehage *University of Veterinary Medicine Hannover, Germany*
15:10	1.13	**Invited Plenary: Current and future prospects for the automatic recording and control of ruminant foraging on farms** S. Mark Rutter. *Harper Adams University, UK*
15:50	**Coffee break and posters**	
16:15	1.14	**High yielding Holstein cows have less lying time available for exchange to more eating time** Peter Løvendahl and Lene Munksgaard *Aarhus University, Denmark*
16:30	1.15	**The effects of dietary energy concentration of dry period diet on the eating and rumination time of cows** Tuomo Kokkonen, Seija Jaakkola, Laura Hänninen, Aila Vanhatalo *University of Helsinki, Finland*
16:45	1.16	**Effects of a separate offer of hay besides TMR on feeding and rumination behaviour** Anet Spengler Neff, Johanna K Probst, Florian Leiber *Research Institute of Organic Agriculture, Switzerland*
17:00	1.17	**Using feed intake behavior and feed bunk attendance to detect dairy cow health issue at an early stage** Paolo Berzaghi, Giulio Cozzi, Flaviana Gottardo and Marta Brscic *University of Padua, Italy*
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20:00	**Conference Dinner, Restaurant Arsenal, Zadar**	

Programme for the Third DairyCare Conference, Zadar		
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08:55	2.01	**Predicting ketosis from milk mid infrared (MIR) spectra using multivariate mixed models** Tesfaye K Belay, Early Career Investigator *Norwegian University of Life Sciences & University of Agriculture in Krakow, Poland*
09:05	2.02	**Development of in vitro rumen model to measure by-pass fat** Mislav Didara, Early Career Investigator *Faculty of Agriculture in Osijek,Croatia & Nutrition Sciences NV, Belgium*
09:15	2.03	**Rumen cannulas vs. wireless bolus sensors for monitoring rumen pH and temperature changes in dairy goats fed control and acidogenic diets in early lactation** Andreia Castro-Costa, Early Career Investigator *Universitat Autònoma de Barcelona, Spain & INRA, France*
09:25		**Prevalence and effect of subclinical ketosis in Holstein cows in environment of Croatia and Slovenia** Vesna Gantner, Early Career Investigator *Faculty of Agriculture Osijek, Croatia & University of Ljubljana, Slovenia*
	WG Development Round-table Discussion Sessions	
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11:30	**WG3 Discussion Session on Future Plans** Jon Moorby, *Aberystwyth University* Ivan Andonovic, *Strathclyde University*	
12:00	**Parallel Scientific Sessions 3 and 4. See Separate Programme on Pages 9 and 10**	

Programme for the Third DairyCare Conference, Zadar		
Tuesday 6th October		
13:00	**Lunch and Posters**	
14:00	**Parallel Scientific Sessions 3 and 4. See Separate Programme on pages 9 and 10**	
15:30	**Coffee and Posters**	
16:00	**DairyCare Internationalisation Session** **Chair: Chris Knight**	
16:00	5.01	**New Zealand dairy industry: A dynamic and changing industry, based on the management of large scale dairy herds and efficient milk production from pasture** Jean Margerison, *University of Nottingham*
16:25	5.02	**Guidelines on use of sensors for animal health and productivity: a new initiative from New Zealand** Claudia Kamphuis, *Wageningen University*
16:40	**General Discussion**	
Evening	**Guided tour of Zadar Old Town**	

Wednesday 7th October	
08:30	**"How to get published" Workshop**

Programme for the Third DairyCare Conference, Zadar		
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12:00	3.01	**Correlation between BHB and NEFA concentration in early lactation period** Marcela Speranda, Mislav Didara, Mirela Pavic, Vesna Gantner *University of J. J. Strossmayer, Croatia*
12:15	3.02	**The association between lipomobilisation syndrome and paraoxonase-1 activity in periparturient dairy cows** I Folnožić, M Samardžija, D Đuričić, S Vince, Z Flegar – Meštrić, T Dobranić, H Valpotić and Romana Turk, *University of Zagreb, Croatia*
12:30	3.03	**Effect of feeding management on thyroid status and energy metabolites in periparturient dairy cows** Irena Celeska, D Kirovski, I Ulchar, I Dzadzovski, M Radeski, V Ilieski *Faculty of Veterinary Medicine Skopje, Macedonia*
12:45	3.04	**Metabolic responses to glucose infusion in Estonian Holstein cows of different body condition** Priit Karis, H Jaakson, K Ling, J Samarütel, A Ilves, M Ots *Estonian University of Life Sciences,Estonia*
13:00	**Lunch and posters**	
14:00	3.05	**Effect of dry period length and dietary energy source on somatic cell count and udder health** Renny J van Hoeij, T J G M Lam, W Steeneveld, B Kemp, A T M van Knegsel *Wageningen University, The Netherlands*
14:15	3.06	**Claw health assessment in dairy cattle herds** Viktor Jurkovich, Endre Bydl, Péter Kovács, László Könyvesr *Szent István University, Budapest, Hungary*
14:30	3.07	**A sequential analysis of body regions and body positions during mechanical brush use by dairy cattle** Daiana de Oliveira, Mikael A. Franko, Linda J Keeling, *SLU, Sweden*
14:45	3.08	**Positive relationships between the use of mechanical rotating brushes, social behaviour and production parameters and in loose-housed dairy cows** Linda J Keeling, Daiana de Oliveira and Bengt-Ove Rustas, *SLU, Sweden*
15:00	3.09	**Stereotypic oral behaviour in ruminants – causes and consequences** George Stilwell *Lisbon University, Portugal*
15:15	3.10	**Welfare Assessment of Sheep During Transport using Hematological and Hormonal Biomarkers** Miroslav Radeski, V Dukoska, K Blagoevska, L Pendovski, V Ilieski *Faculty of Veterinary Medicine – Skopje, Macedonia*
15:30	**Coffee break and posters**	

Programme for the Third DairyCare Conference, Zadar		
Tuesday 6th October Parallel Session 4		
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12:15	4.02	**Measuring feeding time of dairy cows using an indoor positioning system** Lilli Frondelius, Salla Ruuska, Mikko Järvinen, Matti Pastell *Natural Resources Institute Finland (Luke), Finland*
12:30	4.03	**Validation of RumiWatch sensors: a confusion matrix approach** Salla Ruuska, Sara Mämmi, Sari Kajava, Mikaela Mughal & Jaakko Mononen *University of Eastern Finland & Luke, Finland*
12:45	4.04	**Does the increase of feeding frequency by automated systems impact the behavior of dairy cows?** B Mounaix , A Ferarda, G Cabon, PV Protin, JL Menard *Institut de l'Elevage, France*
13:00	**Lunch and posters**	
14:00	4.05	**Measurement of rumen motility using a tri-axil gyroscopic bolus** C Michie, C Davison, A Faure, C Tatchtatzis, I Andonovic, L Somerville, N Jonsson, *University of Strathclyde, UK*
14:15	4.06	**Smart farming in dairy cattle: application of RumiWatch noseband sensors for monitoring of calving events in dairy cows** Nils Zehner, Christina Umstätter & Matthias Schick *Agroscope, Switzerland*
14:30	4.07	**Calving monitorization by remote technology in dairy cattle** Laura Molina, Carlos C Pérez-Marín & Estrella Agüera *University of Cordoba, Spain*
14:45	4.08	**Effects of rearrangement of the cows in production groups on milk cortisol concentrations** S Sgorlon, N Poscic, L Da Dalt, B Stefanon, Gianfranco Gabai *University of Padova, Italy*
15:00	4.09	**Milk beta-hydroxybutyrate and urea as a tool for fast diagnosis of bovine feeding strategies and welfare** Cristina Conceição Pinheiro, A M Geraldo, P Vaz, R Moreira, S Pinto, A Pereira *Universidade de Évora, Portugal*
15:15	4.10	**NMR-Metabolomics Profiles of Two Goat Breeds with Different Level of Tolerance to Seasonal Weight Loss** M Palma, L E H-Castellano, N Castro, A Arguëllo, J Capote, M Matzapetakis, A M de Almeida *Uni Nova de Lisboa. Portugal*
15:30	**Coffee break and posters**	

Programme for the Third DairyCare Conference, Zadar	
Wednesday 7th October	
How to Get Published Workshop **Chairs: Ali Mobasheri and Tim Shipley (BioMedCentral)**	
08:30	**Things to Consider before Submitting your Manuscript (BioMed Central)** Choosing Your Journal Preparing your Manuscript
08:50	**DairyCare Presenter** "Experience as an Editor"
09:00	**How to Survive Peer-Review (BioMed Central)** Communicating with Journals/Editors Dealing with Rejection
09:20	**DairyCare Presenter** "Experience as an Author" My experience of negotiating peer-review
09:30	**The Changing Face of Publishing. How to become a Reviewer. (BioMed Central)** Emerging Issues in Publishing: Open Science and Reproducibility Getting Involved in Peer-Review
09:50	**DairyCare Presenter** Mentoring Young Researchers, practical advice for mentors and junior colleagues
10:00	**Breakout Sessions (30 mins)**
	Topic 1 – I have data, how do I prepare a good manuscript?
	Topic 2 – Peer-review is taking too long, what should I do? A reviewer is making unreasonable requests, what do I do?
	Topic 3 – How do I maximise the impact of my paper?
10:30	**Final Discussion**

Posters	
P.01	**Use of Photometry in Evaluation of Hoof trimming** R Kasarda, J Tomka, M Vlček, M Ofúkaný *Slovak University of Agriculture in Nitra, Slovakia*
P.02	**Changes in milk composition indicating metabolic disorders in dairy cows** Jožica Ježek, Martina Klinkon, Marija Nemec, Jože Starič *University of Ljubljana, Slovenia*
P.03	**Effect of incremental amounts of camelina oil in concentrate supplements on feed intake, plasma metabolites and milk production in lactating cows fed a mixture of grass and red clover silage** Anni Halmemies-Beauchet-Filleau[1], Kevin J. Shingfield[2,3], Tuomo Kokkonen[1], Seija Jaakkola[1] and Aila Vanhatalo[1] *[1]University of Helsinki, Finland [2]Institute of Biological, Aberystwyth University, United Kingdom [3]Natural Resources Institute Finland (Luke), Finland*
P.04	**Microbiological contamination of raw milk of suspicious cows for mastitis** Vladimír Tančin [1,2], Ivan Holko[3], Miriam Árvayová[3], Ľudovít Černek[3], Štefan Baranovič[2], Zdeněk Havlíček[4] *[1]Research Institute for Animal Production Nitra, Slovak Republic, [2]Slovak University of Agriculture, Slovak Republic, [3]VETSERVIS, Slovak Republic , [4]Mendel University Brno, Czech Republic*
P.05	**Yield of Some Alternative Grazing Species in the 1st Summer Cut at East Croatia** Ranko Gantner, Marcela Šperanda, Zvonimir Steiner, Gordana Bukvić, Domagoj Zimmer *J. J. Strossmayer University of Osijek, Croatia*
P.06	**Differences in behaviour and heart rate variability of lame and non-lame cows during feeding** [1] Viktor Jurkovich, [2] János Tőzsér, [2,3] Luca F. Kézér, [2,3] Levente Kovács *[1] Szent István University, Hungary; [2] Szent István University, Hungary; [3] MTA–SZIE Large Animal Clinical Research Group, Hungary*
P.07	**Effects of litter size on meat quality traits in the Honamlı kid meat raised under semi-intensive conditions in Turkey** Özkan Elmaz, Aykut Asım Akbaş, Mehmet Çolak, Mustafa Saatcı *Mehmet Akif Ersoy University, Turkey*
P.08	**The influence of hop cones (Humulus lupulus L.) supplement on the behaviour of young bulls** Dušanka Jordan, Manja Zupan, Mojca Simčič, Andrej Lavrenčič *University of Ljubljana, Slovenia*
P.09	**Influence of dietary selenium supplementation of ewes and lambs on production performance and exterior characteristic of lambs** Josip Novoselec, Zvonko Antunović, Željka Klir, *Josip Juraj Strossmayer University of Osijek, Croatia*
P.10	**Computer-assisted monitorization of therapeutic drugs consumption in dairy cattle in Southern Spain** Estrella Agüera, Laura Molina & Carlos C. Pérez-Marín, *University of Córdoba, Spain*
P.11	**Influence of feeding regimes on cow milk production at the farm „Planinsko Dobro“ Nevesinje in Bosnia and Herzegovina** Sanel Ridanovic, Lejla Ridanovic' Dzemal Bijedic , University of Mostar, *Bosnia and Herzegovina*
P.12	**Wound treatment using honey, pollen and propolis** Benjamin Čengić, Nazif Varatanović, *University of Sarajevo, Bosnia Herzogovinia*
P.13	**Relationship between body condition of pregnant dairy cows and insulin-dependent glucose metabolism of their offspring** Danijela Kirovski, Snežana Stevanović Đorđević, Ljubomir Jovanović, Željko Sladojević *University of Belgrade, Serbia*
P.14	**Assessing resilience of dairy cattle by studying impact of heat stress on predicted feed intake** Marie-Laure Vanrobays [1], Hedi Hammami [1], Aurélie Lainé [1], Hélène Soyeurt [1], Jérémie Vandenplas [2], Eric Froidmont [3] & Nicolas Gengler [1] *[1] University of Liege, Belgium. [2] Wageningen UR Livestock Research, The Netherlands. [3] Walloon Agricultural Research Centre, Belgium.*

ORAL ABSTRACTS

1.01
Dairy cow feeding behaviour: Basics concepts and practical implications
Trevor J DeVries
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The productivity, efficiency, health, and welfare of dairy cows are largely influenced by nutritional management strategies. Much of that influence is moderated through the consumption behaviour of dairy cows. It is well established that milk production is largely driven by the amount of nutrients consumed, that is, total dry matter intake (DMI). Dry matter intake is largely a function of feeding behavior, impacted by changes in meal size, duration and frequency, as well as feeding time and rate. Changes in DMI require cocomitant changes in different aspects of feeding behaviour. Feeding behaviour is not only important from a total DMI standpoint, but also to keep the rumen healthy and working efficiently. Consuming longer and larger meals, more quickly, has been associated with an increased incidence of sub-acute ruminal acidosis in dairy cows. Recent research has suggested that management strategies that promote frequent consumption of feed in small meals throughout the day are important to optimize production and efficiency. In addition to the time course of eating, the composition of feed consumed may also impact productivity. Sorting of a TMR by dairy cows may result in a ration consumed being greater in highly-fermentable carbohydrates than intended and lesser in effective fibre, thereby increasing the risk of depressed rumen pH, lower milk fat, and lower efficiency of production. In addition to how and what cows consumed, the post-consumption behaviour of rumination is also important in terms of keeping the rumen healthy and functioning efficiently. From a practical standpoint, this all means that we need to be providing diets, and managing the delivery and access to those diets, in such a manner that cows are motivated to consume that feed in a manner that is good for them and consume that feed as it is provided to them.

1.02
Feeding behaviour and welfare
Daniel M Weary, Heather Neave, Marina von Keyserlingk
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This talk will review recent research that illustrates the interrelationship between feeding and animal welfare. We begin with the most obvious cases of underfeeding and how the effects of underfeeding can be assessed in part by changes in feeding behaviours. We go on to summarize research findings on how the comfort of animals can be affected by the design and management of the facilities provided for feedings. We then discuss how measures of feeding behaviour, including measures of feed intake and more highly derived behavioural measures, can be used as early indicators of illness. We end on a more provocative note, arguing that much could be done to improve the lives of animals by changing the way animals are provided with food. For example, we suggest that diet in farm animals should be used as a form of environmental enrichment, rather simply aiming for a single monotonous ration. Cattle, for example, will work hard to 'sort' specific components from mixed rations, indicating that these components are important to the animal, as is, perhaps, the ability to exercise choices in diet. In summary, appropriate feeding is an important element of animal welfare, and measures of feeding behaviour can be valuable is assessing how animals fare.

1.03

Estimation of individual intake of grazing dairy cows with RumiWatch®

Markus Rombach[1,2], Andreas Münger[1], Karl-Heinz Südekum[2], Fredy Schori[1]
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Knowledge of individual intake of dairy cows on pasture is required, for estimating nutrient consumption and adapting forage and concentrate supplementation to meet nutrient requirements of cows. Measuring individual intake on pasture precisely is time-consuming and expensive. A less time-consuming opportunity may be, estimating herbage intake of dairy cows by behavioural characteristics. RumiWatch®, a system based on a pressure sensor and a triaxial accelerometer, allows automatic detection and evaluation of individual feeding behaviour characteristics of cattle. The aim of this study was to determine the mean eating chew size of grazing dairy cows by marker-based intake estimations with n-alkanes. In addition, behaviour-based intake estimations were validated against marker-based intake estimations from an independent dataset. Therefore, 18 lactating Holstein cows were kept on pasture during 18 hours per day; 12 of them were supplemented in the barn with maize silage or maize silage and a protein supplement. All cows were equipped with the RumiWatch® halter over three 7-d periods; simultaneously intake of each cow was estimated by mean of a dosed n-alkane. In order to calculate the eating chew size, marker based intake estimations of nine cows were divided by the number of eating chews, individually recorded by the RumiWatch® system. To validate the estimations by previously calculated eating chew size and recorded eating chews, behaviour- and marker-based intake estimations of the remaining nine cows were compared. In total 27 7-d files were collected for the validation but, due to technical problems, only 18 out of these could be used. The mean absolute error for intake estimation of grazing dairy cows, with no supplementation in the barn was 8.0% (SD 0.7); 9.0% (SD 0.6) when cows were supplemented with maize silage and 6.7% (SD 0.3) when maize silage and a protein supplement were additionally fed. Results indicate the possibility to estimate the intake of dairy cows on pasture using intake behaviour characteristics, but the accuracy depends especially on the animal individual rate of mastication bites while grazing. To increase accuracy of intake estimations for grazing dairy cows, further research should focus on differentiation of mastication and prehension bites during grazing.

1.04

How does cows' activity change after feeding bin change?

Maria Soonberg, David Arney
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Understanding the feeding behaviour of dairy cattle in different indoor housing systems is important to optimize production and welfare. Outdoors, grazing cattle walks about 4 km/day, grazes about 4- 14 hours within 24-hour period and lies down for about 9-12 hours (Broom and Fraser, 2007). Monitoring the locomotion of cows can be used to predict oestrus and lameness. And the same activity monitors can be used to estimate activity and feeding visits by cows. In a system in which cows are grouped and given differential access to feeding bins with different rations, and these groups change over time, it is important to find out how a change in the ration, and a change in the feeding bin, affects the cow's feeding behaviour, and if so, for how long. Ice tag activity monitors were attached to the right hind leg of ten cows. Walking, standing, lying data and health records were used to record changes before and after a change in the feed ration/feeding bin.

1.05

Automatic monitoring of health and welfare through feeding behaviour: lessons learned in pigs which may also be relevant for dairy

Jarissa Maselyne [1,2], Wouter Saeys [1], Annelies Van Nuffel [2]

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The authors are developing an automated warning system for health, welfare and productivity problems in growing-finishing pigs. A High Frequency Radio Frequency Identification (HF RFID) system is being used to measure the individual pigs' feeding behaviour. Abnormal changes in this behaviour are detected through Synergistic Control. During development of the system, lessons were learned that are also important to consider when measuring dairy feeding behaviour, whether for research-purposes or to develop a system for health and welfare monitoring. First of all, feeding is affected by many influencing factors such as diet, housing, feeding and drinking system, breed and environment. Animals tend to be very flexible in their feeding behaviour and large inter- and intra-individual differences exist. The best results for problem detection could thus be obtained when measurements and detection limits are specific for the individual animal, taking into account also the intra-individual variation (e.g. age and lactation stadium). Second, the type of sensor used can also influence the (measured) feeding behaviour. Examples of these influences can be given. The following questions should be considered: 'What are the advantages and limitations of this sensor?', 'Is the system properly validated for the intended purpose and are its settings suitable for my application?'. A third aspect to consider is that feeding behaviour occurs in visits and in meals. Some systems even provide registrations at the feeder or chews. Which unit you use can influence the way you look at the feeding behaviour and the results significantly. In literature, the most relevant unit or variable to use for disease detection has not yet been established. Finally, if meals are constructed, it is important to know that numerous methods exist. Some of these methods are out-dated and proven to be inaccurate, but also new and promising methods exist. There is a need for more validation of these methods, especially from a behavioural point-of-view. To conclude, four important steps need to be taken when measuring animal feeding behaviour: understand feeding and its influencing factors, choose the appropriate sensor, choose the appropriate unit and use a sound method for meal determination.

1.06

Neural pathways regulating feed intake in ruminants, impacts of disease and relationship to reproduction

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Regulation of appetite has its primary control within the central nervous system, primarily the hypothalamus and the brain stem. Within the hypothalamus, the neurotransmitters neuropeptide Y, agouti-related protein, orexin and melanin concentrating hormone represent the major appetite stimulating neurotransmitters while melanocyte-stimulating hormone represents the primary inhibitory molecule regulating appetite. Hormones and metabolites, as well as physicochemical factors in the gastrointestinal tract may modify the activity of these central appetite pathways. In addition to basic appetite control, these neurotransmitters and their receptor are impacted by disease to reduce appetite and increase metabolic rate. Hence these neurotransmitters or their receptors may represent opportunities for intervention in animals with cachexia. Moreover, some of the neural appetite control pathways and reproductive control pathways may have bidirectional effects to integrate reproduction with nutrient availability and metabolism.

1.07
Silent Herdsman Platform
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Silent Herdsman Ltd offers cloud based precision services that bring increased levels of production efficiencies to the dairy and beef farming sectors. The core product is the Silent Herdsman platform which currently provides a fertility and health service to many commercial farms. A neck-mounted smart collar is the data gathering engine at the individual animal level with the advanced software embedded on the collar providing accurate levels of activity, time spent eating and time spent ruminating. These three key windows to animal behaviour gates the provisoning of accurate alerts across the supply chain, indicating the onset of heat and illness. The presentation will decribe the technologies comprising the platform and give examples of the commercial benefits of the product based on the continuous monitoring and mapping of the levels of activity, eating and rumination. The interpretation of one or a combination of these key states provides early indications of the onset of key illnesses such as mastitis and ketosis both of which are known to impair productivity.

1.08
Management of Reticuloruminal pH in Modern Dairy Herds
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Modern dairy farm management focuses on the control, optimization and monitoring of interconnected processes to enable and enhance productivity of the dairy herd. The operations and decisions involved in farm management rely on information about the farm and/or the dairy cows and the expertise of farm management staff in drawing the correct conclusions based on the available data. In recent years, new technologies have emerged enabling the inclusion of new parameters as well as the interpretation of the available data to improve farm management. The important role played by nutrition in dairy cow health and productivity makes optimal feeding management a key factor impacting dairy farm profitability. The timely and precise reaction to irregularities in feeding management, which can lead to diet-related diseases like SARA (sub-acute ruminal acidosis) or off-feed syndrome, is therefore of vital importance. Apart from the widely accepted method of detecting SARA by measuring the duration of periods below a certain pH level, it is clear that the daily patterns of reticuloruminal pH provide very useful information for feeding and health management. Reticuloriminal pH is sensitive to temporary changes in feeding times as well of course in diet composition and health status of the animals. It therefore makes sense to include pH data to drive, optimize, and monitor feeding management in a more effective way. We measure reticuloruminal pH in numerous dairy herds worldwide and show farmers and advisors how to work with this parameter on a day-to-day basis in order to improve feeding management. Particularly in the transition period, and especially due to the significance of SARA at this time, the management of reticuloruminal pH is shown to increase herd health and enhance farm profitability.

1.09

The reduction of feed intake and gluconeogenesis during hyperketonemia in dairy cows indicates a signal of abundant energy availability

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High milk production and simultaneously inadequate feed intake during early lactation causes a negative energy balance and hence the mobilisation of adipose tissue. Because milk production requires huge amounts of glucose for lactose synthesis gluconeogensis runs at a maximum level mainly in the hepatic mitochondria. Gluconeogenesis requires oxaloacetate as a substrate. However, oxaloacetate is also required for fatty acid oxidation in the citric acid cycle. Due to a lack of oxaloacetate acetyl-CoA is increasingly used for the synthesis of ketone bodies in the hepatic mitochondria. Ketone bodies, mainly beta-hydroxybutyrate (BHBA), can be used as an alternative energy source by many organs including the immune system. However, if the plasma concentration of BHBA becomes too high (>1.5 mM) an impairment of the immune system is a consequence, together with an increased susceptibility of infectious diseases and further metabolic disorders. It has been shown that a high concentration of BHBA, also passing through the blood-brain barrier, reduces appetite and feed intake via reduced expression of Agouti-related protein (AGRP), an important inhibitor of anorexigenic signalling in the brain. Peripherally, elevated BHBA (demonstrated by infused BHBA) caused a reduction of glucagon secretion and hence a reduced gluconeogenesis and decreased plasma glucose concentration. It was also shown that an LPS-induced mastitis caused an increased metabolisation of BHBA, obviously used as a fuel for various inflammatory or anti-inflammatory reactions. Simultaneously, the characteristic increase of glucagon as a stimulator of gluconeogenesis during inflammation was reduced in animals with elevated BHBA. It appears that elevated BHBA in parallel with reduced glucose concentrations induce a priority usage of ketone bodies for energetic purposes which may explain the paradox reaction of reduced feed intake. Gluconeogenesis is reduced through elevated ketone body concentration, possibly to save oxaloacetate for the degradation of acetyl-CoA , and to use the ketone bodies as an energy source, also for the immune system. However, the observed reactions do obviously not consider the enormous specific need of glucose by the mammary gland as a consequence of breeding for high milk production in dairy cows.

1.10

Is spontaneous rumen acidosis related to feeding behaviour in goats?

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Subacute rumen acidosis (SARA) is generally associated with off-feed periods and is quite often detected in intensive ruminant production systems. It appears in an unpredictable manner in a herd and only some animals are affected at a given time. It is also quite difficult to study experimentally spontaneous acidosis due to the unpredictability of its occurrence. Nevertheless, it seems that there is a clear relationship between spontaneous rumen acidosis and feeding behavior in goats. This paper aims to better understand the driving force by using different measurements obtained simultaneously in cannulated dairy goats from our experimental unit fed with total mixed rations (TMR) containing different proportions of concentrate. Feeding behavior was characterized by different variates: proportion of dry matter eaten 90 min after the afternoon feeding which corresponded to two thirds of the daily feed allowance (P90), sorting behavior (ratio between cellwall intake and cellwall given) or chewing durations. Rumen pH was measured either with indwelling probes or after direct rumen fluid sampling. Bouts of spontaneous acidosis were generally of short duration (one day) with a clear rebound of several days of relatively high rumen pH (>6.5) before recovery of pre-acidosis values. The pH decrease was followed by a decrease in DMI, reaching a nadir around 2 d after the start of the episode. The pH decrease seemed to be due to the combination of a high intake and a high rate of intake. The intensity of the pH rebound was linked to different animal feeding strategies: a decrease in dry matter intake, a decrease in intake rate (estimated by P90), an increase in the ratio “chewing duration/intake duration” or an increase in sorting behavior. Goats presented different susceptibilities to SARA and different feeding strategies to face it. Some of them never suffered from acidosis and others presented more than one episode of acidosis. This between-animal variability could be due to their feeding behaviour and/or their rumen fermentation profile.
A future challenge is to better understand the between-animal variability and to find the best criteria to phenotype the animals for the risk of SARA when fed a high energy diet.

1.11

Lameness in cows affects daily feeding time but not rumination time as characterized from sensors

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This study is the first to characterize individual cow feeding and rumination behavior simultaneously by the use of automatic sensors to investigate how lameness affects feeding and rumination. Twenty mixed parity, lactating Holstein cows were loose-housed with free access to 24 cubicles and 12 automatic feed stations. Milking was performed 3 times per day and fresh feed delivered once daily. The cows were locomotion scored on four occasions over 22 days. From 18 cows during the same period, 14,977 feed station visits were recorded, and 8,627 rumination events were obtained from 3-dimensional, neck-mounted accelerometers (Silent HerdsmanTM). Eight cows were categorized as not lame and 10 cows as lame. Daily summaries of rumination (time and number of events) and feeding characteristics (intake, duration, feeding rate, and number of visits) were calculated. The effects of lameness and stage of lactation were tested in a mixed model using each of the rumination and feeding characteristics in turn as response variable. Furthermore, using rumination time as response variable, the effects of four feeding characteristics in turn and milk yield and lameness were tested in another mixed model. The first model revealed that lameness decreased daily feeding time and number of feed station visits, but increased feeding rate. Lame cows did not differ from non-lame cows with respect to milk yield, fresh matter intake, rumination time and number of rumination events. The second model showed that rumination time was best described by feeding rate, which decreased rumination time by a small, yet significant amount and by milk yield, which increased rumination time. Neither daily feeding time nor feed intake affected rumination time significantly. In conclusion, cows can be characterized by their feeding behavior, in particular feeding rate. Lame cows eat the same amount and ruminate as long as non-lame cows, but lame cows eat faster and make fewer visits to feed stations. Similar precision livestock farming systems have the potential to detect lameness automatically at an early stage, but more research is needed to quantify rumination efficiency to elucidate why an increased feeding rate causes cows to ruminate less.

1.12

Feeding behavior, milk yield, activity, and insulin sensitivity in lame dairy cows

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Lame dairy cows often show increased plasma levels of non-esterified fatty acids (NEFA) which may be due to pain induced decreased feed intake and hence more fat mobilization from adipose tissues or reduced insulin sensitivity. Thus, aim of the study was to investigate feeding behavior, activity and insulin sensitivity in lame dairy cows. 21 pluriparous lame dairy cows (sole ulcers or white line disease of one hind limb; lameness score ≥ 2 on a scale from 0-5) were detected by bi-weekly lameness scoring. Lame cows were matched with healthy herd mates (controls) according to parity and days in milk. All cows received functional claw trimming and lame cows additionally claw treatment of the affected claw. Feeding behavior (dry matter intake (DMI), number of trough visits, feeding rate), body weight, milk yield and milk constituents were automatically recorded on a daily basis from day -7 to day 7 related to the day of lameness detection (d0). Activity was recorded by pedometers. Blood samples were collected from d0 to d7 and analyzed for glucose, NEFA, insulin (from which RQUICKI was calculated as a surrogate insulin sensitivity index) and cortisol. Compared to controls in average lame cows showed longer lying periods (11 vs. 13 hours/d, resp., $p<0.01$), spent less time feeding (188 vs. 155 min/d, resp., $p<0.01$), had less trough visits (48 vs. 31/d; $p<0.05$), and higher feeding rates (116 vs. 143 g/min, resp., $p<0.05$). However, daily DMI, milk yield and calculated energy balance did not differ between controls and lame cows. Mean plasma concentrations of glucose, insulin, and cortisol did not differ significantly between groups. In lame compared to control cows mean plasma NEFA (340 vs 175 µmol/l, resp., $p< 0.05$) was higher and RQUICKI was significantly lower (0.44 vs. 0.58, resp., $p<0.05$). Since DMI remained almost unchanged in cows with early detected mild lameness elevated NEFA levels may be due to reduced activity and muscular NEFA utilization or may be an expression of increased fat mobilization due to decreased insulin sensitivity. It may be also possible that cows with reduced insulin sensitivity are disposed for claw defects.

1.13

Current and future prospects for the automatic recording and control of ruminant foraging on farms

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Precision technologies are used on many commercial dairy farms to aid cow management. This paper reviews the potential for the on-farm, automatic monitoring and control of feeding-related behaviour. As well as being useful for feed management, changes in feeding-related behaviour can also be used for oestrous and disease detection. On-farm rumination monitoring systems are already in use, based on either acoustic monitoring via neck-mounted sensors or using ear-mounted accelerometers. Research has shown that neck or halter mounted accelerometers can estimate when cows are eating, and this applies whether they are eating a total mixed ration (TMR) or grazing at pasture. Although head- and neck-mounted accelerometers can also estimate herbage intake in grazing cattle, the precision and range of foraging related data collected could be enhanced through the addition of bioacoustic monitoring. This latter approach involves the analysis of the sound generated during grazing and can be used to determine bites, chews and chew-bites. The energy density of the sound of chewing is also proportional to bite mass, and sound analysis also has the potential to estimate herbage quality and plant species consumed. Technology also has the potential to control access to feed, and could be used to optimise grazing management e.g. opening a remote-release gate once a paddock has been grazed to the optimal sward height. Technology could also facilitate diet selection in cattle that are normally fed a TMR. Research has shown that grazing sheep and cattle appear to select a diet that optimises their own efficiency of nutrient capture, albeit in a situation for which they have evolved an appropriate 'nutritional wisdom'. However, cattle given ad lib access to concentrate feed will often eat to excess resulting in acidosis. The current commercial solution to this problem is to ensure the fine mixing of the ration, but this removes the animal's ability to select its own diet, potentially reducing welfare through frustration. The automated control of gates giving access to different feed components could be linked to rumen pH monitoring and intake measurement to provide a technological solution to facilitate diet selection whilst protecting against nutritionally unwise choices.

1.14

High yielding Holstein cows have less lying time available for exchange to more eating time

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High yielding cows need more time to eat; thus they have less time for other activities which may lead to time constraints. Time-budgets (TB) were studied in a herd of 243 high yielding first parity Holstein cows by recording their complete 24 h TB using visual scans at 10 minute intervals. The scans were repeated twice in early and twice again in late lactation. Milk yield was recorded every 2 weeks and expressed as energy corrected milk (ECM). TB traits were analyzed for genetic and phenotypic variation and for covariation with milk yield. The tradeoff aspect was investigated as the change in correlation between TB traits over the range of recorded milk yield. TB traits were found to have low heritability and only moderate repeatability at all lactation stages. Overall, higher yield was correlated to more eating time (rp = 0.25 / 0.29, in early and late lactation, respectively) and less lying time (rp = -0.13 / -0.08). Overall, the tradeoff between eating and lying time was shown by a negative correlation (rp = -0.32 / -0.30). This tradeoff was even more pronounced for time spent in beds (rp = -0.62 / -0.63). The sensitivity of the tradeoff to yield was further investigated by subsampling of data, so that the correlations were estimated on subsets of 40 cows re-sampled from the 243 after sorting them for yield. Then, a regression line was fitted to correlations over the yield trajectory. It was evident at both lactation stages that the correlation was strongest at the low yield, and weakest at high yield, supporting the hypothesis that the tradeoff between lying and eating time is sensitive to yield. We speculate that high yielding cows have already used up most of their "flexible part" of lying time to obtain more eating time. In conclusion, given that the high yielding cows need a large feed intake their option is to increase feed intake rate or remain longer in negative energy balance. Further studies into the genetics and tradeoff in TB traits should include more cows and that would thus be facilitated using automated recordings.

1.15

The effects of dietary energy concentration of dry period diet on the eating and rumination time of cows

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Restricting energy intake during dry period may alleviate metabolic stress of dairy cows after calving. However, restricting energy intake may affect eating and rumination behaviour of cows. Our aim was to study the effects of high and restricted energy allowances during dry period on eating and rumination times. Sixteen multiparous Finnish Ayrshire cows were used in a randomized complete block design. The treatments were ad libitum feeding of grass silage (HIGH) or a mixture of grass silage, wheat straw and rapeseed meal (55%: 40%: 5%) (RESTR). Average neutral detergent fibre (NDF) contents of the diets were 528 and 651 g/kg DM. The cows were kept in tie-stalls and daily forage intake and eating behaviour was recorded using forage intake control system (Insentec BV, Marknesse, The Netherlands). Daily rumination time was recorded using rumination monitoring system (Qwes-HR, Lely Industries, Maassluis, The Netherlands). Weekly averages of measured eating and rumination parameters for each cow were used for statistical analysis. The data were analysed using repeated measures ANOVA. Forage dry matter (13.7 vs. 10.8 kg/d) and metabolizable energy intake (144 vs. 109 MJ/d) of cows in HIGH was higher ($P<0.01$) than cows in RESTR during the dry period. Daily eating time (average 261 min/d) and NDF intake (average 7.4 kg/d) did not differ among groups. Eating rate (56 g DM/min vs. 47 g DM/min) and number of meals/d (13.4 /d vs. 10.7 /d) was higher ($P<0.01$) in HIGH. Time spent ruminating was longer for HIGH than RESTR (520 min/d vs. 429 min/d, $P<0.01$). Similarly, rumination time per kilogram of NDF intake was greater for HIGH than RESTR (72 min/kg NDF vs. 60 min/kg NDF, $P<0.01$), whereas there was no difference in rumination time per kilogram of DM intake. The results suggest that daily rumination time is primarily related to DM intake and not to dietary NDF content in cows fed high-forage diets during dry period, although the potential effect of particle size still have to be considered. Inclusion of straw in the diet decreases rate of eating but it may not prevent the decrease of rumination time caused by restriction of energy intake.

1.16

Effects of a separate offer of hay besides TMR on feeding and rumination behaviour in dairy cows

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In a dairy herd (Swiss Fleckvieh) with moderate performance (7000 kg milk/cow/year) 23 cows were investigated for their behavioural response to a change in roughage offer. They were kept in a stanchion barn with separated feeding places. During the first measurement week, cows received forages as a total mixed ration (TMR), based mainly on grass silage (32%), maize silage (30%) and hay (21%), ad libitum 24h/d. This was the diet they had been used to prior to the experiment. In the second measurement week, TMR contained a lower proportion of hay (6%); hay (2nd cut) was separately offered ad libitum to each individual cow in the morning between 6.00 a.m. and 8.00 a.m. Animals had been adapted to this feeding system 14 days before measurement week 2 started. During both measurement weeks, cows were equipped with chewing sensors (noseband collars with pressure tubes) to record jaw movements and identify eating and rumination parameters. Roughage intake was weighed individually for each cow during the measurement weeks. Data were processed with SPSS in a mixed linear model with measurement week as fixed and cow as random factor. The comparison of the two measurements showed that separate offer of hay in the morning led to significantly longer intake time (min/h) between 6.00 a.m. and 8.00 a.m. ($P<0.01$), but also between 4.00 p.m. and 6.00 p.m. ($P<0.05$). However, intake amounts were not affected. Rumination time (min/h) was increased between 9.00 a.m. and 3.00 p.m. ($P<0.01$). Further, when hay was offered separately in the morning, the number of activity changes per hour was decreased. These data show a clear effect of sequential roughage feeding on intake and rumination. Separately fed hay might have caused a necessity to increase intake and rumination time to maintain intake amounts and digestion. However, the decreased activity changes per hour indicate a calmer behaviour, which might be a health and welfare issue.

1.17

Using feed intake behavior and feed bunk attendance to detect dairy cow health issue at an early stage

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Dairy cows eating habits are fairly constant and changes in normal behavior may reflect changes in their hormonal (heat) or health status. Twelve cows were fed a total mixed ration (TMR) once a day and feed intake and feed bunk attendance were monitored by an automatic system, with mangers placed on electronic scales (Biocontrol System A/S, Grimstad Gred, Norway). The number of mangers was equal to the number of cows and animals had free choice to visit any manger. Feed bunk attendance was recorded by an antenna placed in front of the mangers detecting the collar neck tag. During the trial, one cow developed displaced abomasum that was detected by the farm personnel only two days after its onset when milk production had dramatically dropped. The cow was then removed from the trial and properly treated. Data recorded for this cow for 9 days of trial were used in the current study. Normal daily intake and attendance pattern were observed on days 1, 2, 3, 4, 6, and 7 and these data were compared to those on days 5, 8, and 9 when the cow had an intake lowered of about 25%. Cumulative time of manger attendance and as fed TMR intake (TMRI) at each hour after feeding were modelled using an asymptotic first order exponential model ($y=a+b(kt*t)$; y= attendance time or TMRI; t= time in hours). The model explained 86% and 92% of variability of intake and attendance, with a tendency to underestimate both intake and attendance during the first 6-7 hours after feeding, but fitted correctly for the remaining time of the day. By predicting the cow behavior based on the normal day it was possible to identify that attendance was below 95% confidential limits (C.L.) after 9 and 8 hours from feeding on day 8, and 9, but it was still classified as normal or within the limits on day 5. Cow TMRI was below confidential limits after 3, 4, and 1 hour after feeding on day 5, 8, and 9, respectively. Compared to mangers attendance, measurement of intake was more sensitive in detecting the problem at an early stage on all three days. However, a simple and cheaper system measuring the attendance at the manger could help farmers to better detect and manage health issues of individual cows at a much earlier stage than the farm personnel, reducing animal distress and costs related to late diagnosis

2.01

Predicting ketosis from milk mid infrared (MIR) spectra using multivariate mixed models (work in progress)

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This study was conducted to verify whether multivariate modeling of milk spectra (direct approach) gives better prediction of β-hydroxybutyrate (BHB) than the common uni-variate (indirect) approach. BHB is an indicator for ketosis. Data-sets were from Polish Federation of Cattle Breeders and Dairy Farmers in Poland. Part of one data-set (small) established a link (regression) between blood BHB and milk spectra. Calibration model developed was unstable, as 10-fold random segment cross-validation suggested different numbers of optimal factors. Spectra from large data-set were reduced to fewer latent variables (PC). Eight principal components explained >99% of the variation in the spectral variables. Estimated variance components and the corresponding variance ratios for the PC were low to medium. In the direct approach, REML estimates of (co)variance components (additive genetic, permanent environment, herd test day and residual variance) for large data-set and BLUP solutions for the PC scores form spectra of small data-set not used in model calibration were computed. Predicted PC scores were back-transformed into spectral scale loading matrix obtained from large data-set and to BHB through regression coefficient. In the indirect approach, the large spectral data-set was converted to single trait (BHB) and variance components estimated by fitting same effects as in the direct approach, but with uni-variate variance structure for the random effects. These BLUP solutions used to calculate predicted BHB. The two sets of predicted BHB values (from direct and indirect approaches) were compared by correlation coefficients with blood BHB for data not used in model calibration. Unexpectedly, correlation between BHB predicted by the indirect approach and blood BHB was higher than correlation predicted from direct approach. That means better prediction of BHB was found when uni-variate variance structure used than when multivariate co-variance structures were used. However, this is not a final conclusion since work is still in progress.

2.02

Development of in vitro rumen model to measure by-pass fat

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The goal of this research was to build a model for in vitro assessment of rumen by-pass fat coated/encapsulated products digestibility. Our model is based on 3 steps: 1. Rumen fluid simulation, 2. Gastric fluid simulation and 3. Intestinal fluid simulation. Small amount (0.5 g) of bypass fat product (Ca soap, bypass palm oil, fat coated bypass selenium, fat coated bypass choline chloride) was placed inside nylon bags. Bags were sealed, weighted and incubated. After incubation bags were freeze-dried and weighted again, the difference in weight was used to calculate digestibility. Soxhlet analyses were done to confirm freeze-dry weight from pure fat products.

For the first step rumen fluid from the three cannulated sheep was used. Rumen fluid was diluted with the sheep artificial saliva acting as buffer. Minifors benchtop bioreactor (Infors HT, Switzerland) was used to simulate anaerobic rumen conditions of 39˚C and constant pH. Second step lasted for 1 h, and included incubation in 1 g/L pepsin and 0.0125 M HCl at pH 1.9. In third step commercial substitute for bile, which contained some of the bile acids necessary for fat digestion, and dried complete bovine bile (Sigma-Aldrich, Germany) were used in the trial. Higher in vitro intestinal digestion was determined using bovine bile so model was build up using bovine bile. Optimal digestibility was determined when using bovine bile at 10 g/L concentration in comparison to 5 or 15 g/L of bovine bile. Optimal concentration of pancreatin was set to 3.0 g/L, concentrations of 1.5 g/L and 4.5 g/L showed no significant difference. Although better digestibility was determined at pH 7.8 compared to the pH 5, pH was gradually increased from 5.0 to 7.8 to simulate in vivo conditions in ruminants.

Three step in vitro fat digestion method was compared with the in vivo dairy cow trials with rumen bypass products. Good correlation was find both after rumen digestion step and intestine digestion step. In that matter we can conclude that three step in vitro model for digestion of fat works with rumen bypass fat products.

2.03

Rumen cannulas vs. wireless bolus sensors for monitoring rumen pH and temperature changes in dairy goats fed control and acidogenic diets in early lactation

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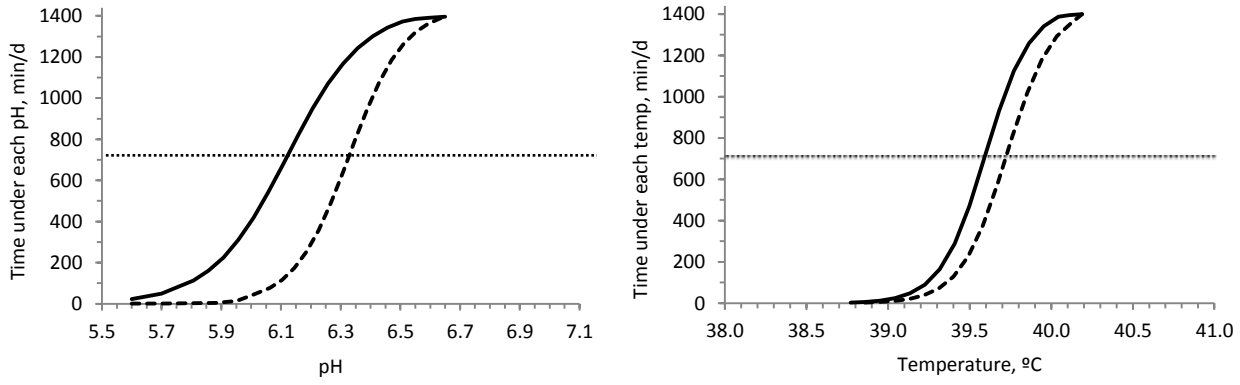
Rumen cannulated dairy goats (4 Alpine and 4 Saanen, 66.4 ± 3.08 kg BW and 93 ± 2.4 DIM), in individual pens with automatic feed and water intake recording, were provided with rumen sensors (27 × 145 mm, 70 g) for pH and temperature and used to investigate the effects of switching from control (CO, 20% concentrate) to acidogenic (AC, 50% concentrate) diets. Diets were offered as TMR and fed ad libitum ×2 daily (a.m. 1/3, p.m. 2/3). Sensors collected data every 15 min for 34 d and diets were switched from CO to AC on d 12 after p.m. milking. Cannulas were used for measuring rumen pH (0, 1, 2, 4 and 6 h after feeding) by pH-meter before (d −4 and −1) and after (d 8 and 14) diet change. Values of pH-meter and sensors correlated (R2 = 0.86; P < 0.001) and were used for recalibration. Obtained pH and temperature values were modeled by logistic regression (Castro-Costa et al. 2015; 2nd DairyCare Conference). Results showed daily variations in rumen traits, with lower rumen pH after p.m. than a.m. feeding. Comparing CO and AC diets before (d −4 and −1) and after change (d 8 and 14), mean rumen pH was greater in CO vs. AC goats (6.32 ± 0.023 vs. 6.12 ± 0.031; P < 0.01). The pH values recorded by sensors fit the logistic model (R2 = 0.97 to 0.99). On average, no pH <5.5 were observed for AC diet, although 2 goats showed values under the threshold. With regard to adaptation to the AC diet, differences among goats, but not between breeds, were observed. Time spent under pH 6.0 and pattern of logistic models allowed classifying goats as sensitive (3/7, 43%) or tolerant (4/7, 57%) to AC diets, showing the consequences of feeding and watering behaviors. Rumen temperature correlated with pH (R2 = 0.66; P < 0.01) although, on average, did not differ by diet (39.7 ± 0.03°C; P > 0.05). In conclusion, wireless sensors and logistic models proved to be useful for monitoring rumen function and to discriminate between sensitive and tolerant goats to rumen acidosis. Recalibration of sensors by using actual pH values is still an issue.

Figure 1. Logistic models of rumen pH and temperature daily changes in lactating goats (A = 1,440; *P* < 0.001): pH and temperature of goats fed CO (; $y = A/[1+e^{48.0 - 7.84x}]$, $R^2 = 0.98$; and, $y = A/[1+e^{289.8 - 7.32x}]$, $R^2 = 0.98$) or AC (; $y = A/[1+e^{68.3 - 10.79x}]$, $R^2 = 0.99$; and, $y = A/[1+e^{281.7 - 7.09x}]$, $R^2 = 0.99$) diets, respectively.



3.01

Correlation between BHB and NEFA concentration in early lactation period

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Early post-partum cows suffer from negative energy balance because of sudden huge demand of mammary gland for high milk production. Especially high-yielding cows suffer from NEB during the first week of lactation due to discrepancy of feed intake and real energy need. NEFA and BHB concentration, with many other metabolites and substrates have been used as a markers to diagnose metabolic disorders. The objective of this study was to find out is the correlation of the most common used energy parameters, NEFA and BHB, useful tool as a predictor of risk for metabolic diseases.

Blood concentration data for a package of biochemical parameters collected from 32 multiparous Holstein cows first 14 days after calving (Group 1) and after 28 days in lactation (Group 2) were used in this study. Cows were fed by TMR with 6.75 MJ/kg NEL. Glucose concentration was significantly (P<0.05) lower, urea higher and NEFA lower in Group 1. BHB concentration did not differ between groups (Table 1). The correlation coefficient between NEFA and BHB was strong and high significant in Group 1, according to BCS and milk yield. Contrary, after four weeks in lactation, relationship is week and not significant, according to milk yield even negative (P>0.05). In the Group 1 higher level of NEFA (>0.7 mEq/L) was determined in 62.5% and BHB (>1.2 mmol/L) in 8.3% of cows, while in Group 2 values were not higher. It is important to notice that there was difference in the average body condition score (Group 1: Group 2 =3.25: 2.75).

Conclusion: The correlation between the commonly used markers of NEB is strong and significant in the first two weeks after parturition. After 1 month this is not relevant tool for monitoring and evaluation risk for metabolic disturbances and their consequences. In that case, it is necessary to take other parameters into consideration.

Table1. Biochemical parameters in cows' blood

	Glucose $\bar{X}$ ± SEM	Urea $\bar{X}$ ± SEM	TP $\bar{X}$ ± SEM	ALB $\bar{X}$ ± SEM	NEFA $\bar{X}$ ± SEM	BHB $\bar{X}$ ± SEM
Group 1	3.28±0.07	2.39±0.09	74.35±1.44	28.75±0.66	0.94±0.11	0.65±0.07
Group 2	2.92±0.1*	4.37±0.25**	68.45± 1.97	29.07±1.35	0.14±0.04**	0.40±0.02

TP-total protein, ALB-albumin, NEFA-non-esterified fatty acid, BHB-beta- hydroxybutyrate; **P<0.01; *P<0.05; SEM-standard error of mean

Table 2. Correlation between NEFA and BHB according to BCS and milk production

	BCS	r	Milk yield	r
Group 1	< 3	0.85**	< 30 L	0.99*
	> 3	0.77**	> 30 L	0.79*
Group 2	< 3	0.15	< 30 L	-0.38
	> 3	-0.23	> 30 L	-0.48

BCS-body condition score

3.02

The association between lipomobilisation syndrome and paraoxonase-1 activity in periparturient dairy cows

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Late pregnancy and early lactation is a critical period for health and productivity of dairy cows due to the energy deficit with a high incidence of metabolic diseases and reduced fertility. The objective of this study was to investigate the relationship between parameters of lipid mobilisation and paraoxonase-1 (PON1) activity during the transition period. The study was conducted on 24 Holstein-Friesian dairy cows aged 2-7 years. Blood samples were taken on days -30, -10, -2, 0, 5, 12, 19, 26 and 60 relative to parturition. Serum triglycerides (TG), total cholesterol (TC), HDL-cholesterol (HDL-C), nonesterified fatty acids (NEFA) and β-hydroxybutirate (BHB) concentrations were assayed by the standard commercial kits. The PON1 activity was measured spectrometrically by the method of hydrolysis of paraoxon. Serum NEFA concentration was significantly elevated at calving and stayed at the highest values up to day 19 after calving ($P<0.05$). As a consequence, BHB concentration increased significantly ($P<0.05$) on days 12 and 19 after calving. In addition, significant correlation between BHB and NEFA has been found ($r=0.38$; $P<0.0001$). Serum TG concentration significantly declined at calving and stayed at the lower values until day 60 of lactation ($P<0.05$). Both TC and HDL-C significantly decreased at calving with an increase during lactation. Significant positive correlation between TC and HDL-C concentrations ($r=0.95$; $P<0.0001$) was observed. Serum PON1 activity was decreased at calving and increased significantly on days 26 and 60 postpartum, suggesting a lower antioxidant status in the postpartal period. Additionally, PON1 significantly positively correlated with TC and HDL-C ($r=0.42$; $P<0.001$ and $r=0.49$; $P<0.0001$, respectively) and inversely correlated with NEFA ($r= -0.33$; $P<0.0001$) indicating the relationship of PON1 with lipid metabolism and lipomobilisation syndrome. These results indicated a lipomobilisation syndrome and lower antioxidant activity in periparturient dairy cows and also suggested that PON1 is related to lipomobilisation syndrome being influenced by negative energy balance during the transition period.

3.03

Effect of feeding management on thyroid status and energy metabolites in periparturient dairy cows

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The study revealed the effect of feeding management on basal metabolism rate. Examination included 64 multiparous high yielding Holstein cows from two dairy farms (A and B) with different feeding strategy. Combination of semi-intensive and pasture feeding management was applied on farm A, while intensive feeding management with concentrate prepared on the farm was applied on farm B. Concentrate composition was prepared in accordance with stage of productive cycle. Blood samples were taken from v. jugularis at days 30 and 7 before expected time of calving, as well as at days 14 and 60 after calving. Thyroid status (tT3, tT4, fT3 and fT4) and energy metabolites (glucose, BHBA and NEFA) were determined in blood serum samples. Obtained results showed significantly higher serum concentration of fT4 in cows from farm A compared to cows from farm B, during all examined period, except day 60 after calving. This result may be explained by influence of any possible existing alimentary thyroid-stimulating factor in the pasture. Those cows were probably exposed to stressful alimentary recourse. Additionally, high serum concentrations of fT4 could modified energy metabolic pathways, especially those related to glucose utilization in peripheral tissue and inappropriate oxidation of NEFA in the liver tissue. Those might be explanations why cows on farm A have significantly lower glucose and significantly higher BHBA concentrations, compared to cows from farm B. Serum concentration of NEFA did not show statistically significant difference between cows from different farms. In conclusion, physiological bioactivity of fT4 may play important role in metabolic rate of dairy cows during transition period, by increasing oxidation of glucose and enhancing hepatic ketogenesis. Due to importance of adequate transition of dairy cows from late pregnancy to early lactation period, this inappropriate adaptation provoked by inadequate feeding strategy may be significant risk factor that could result with metabolism disturbance and consequently decreased milk production and increased incidence of metabolic diseases in periparturient dairy cows.

3.04

Metabolic responses to glucose infusion in Estonian Holstein cows of different body condition

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Breeding for milk production has led to a higher frequency of metabolic diseases, which mostly appear during the transition period and are associated with insulin resistance. The objective of this study was to evaluate the response of metabolites to glucose infusion in cows with different amounts of fat reserves.
Holstein dairy cows (n=44) were divided according to body condition score (BCS) four weeks before parturition into three groups: BCS≤3.0; BCS=3.25-3.5; BCS≥3.75. A glucose tolerance test (GTT) was carried out three weeks before and after parturition. Glucose, insulin, non-esterified fatty acids (NEFA) and β-hydroxybutyrate (BHB) concentrations were analyzed from the blood samples collected during GTT.
Glucose infusion led to transient changes in the analyzed blood metabolite concentrations. Although the shapes of the response curves were similar, basal concentrations of NEFA and BHB were lower, and maximum concentrations of glucose and insulin were higher before parturition compared to the values after parturition ($P<0.001$) in all BCS groups. Before parturition BCS≥3.75 cows had higher insulin basal concentrations ($P<0.01$) and during the GTT a more pronounced insulin response ($P<0.01$ 40 to 60 min.) along with higher NEFA concentrations ($P<0.05$ 5 to 40 min.) compared to the BCS≤3.0 cows, and a more extensive glucose response compared to other groups ($P<0.05$). After parturition, glucose and insulin basal concentrations and dynamics from the GTT were not different between the BCS groups. Both the BHB and the NEFA basal concentrations in the BCS≥3.75 cows were almost double the concentrations in the BCS≤3.0 cows ($P=0.05$ and $P=0.12$ respectively). During the GTT concentrations were higher at 20 to 40 min. for NEFA ($P<0.05$) and within the first 40 min. for BHB ($P<0.05$) in the BCS≥3.75 cows compared to BCS≤3.0 cows. This indicates that the BCS≥3.75 cows were in a more extensive lipolytic state compared to the BCS≤3.0 cows.
The results indicate that BCS influences glucose and lipid metabolism before parturition; however, BCS may not play such a relevant role on glucose metabolism after parturition but may have more profound effect on lipid metabolism.

3.05

Effect of dry period length and dietary energy source on somatic cell count and udder health

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Shortening or omitting the dry period (DP) improved energy balance but decreased milk production in the subsequent lactation. Feeding a glucogenic ration improved energy balance in early lactation, compared with a more lipogenic ration. An improved energy balance may improve udder health in lactation. The aim of this study was to analyze the effect of DP length, and dietary energy source on SCC, incidence of SCC elevations, and clinical mastitis in the subsequent lactation. Holstein-Friesian dairy cows (n=168) were randomly assigned to three DP lengths (0, 30 or 60 days), and early lactation ration (glucogenic or lipogenic). The glucogenic concentrate mainly consisted of corn. The lipogenic concentrate mainly consisted of sugar beet pulp and palm oil. Forage mainly consisted of grass silage and corn silage, and was not different among rations. Postpartum daily milk production, and weekly milk composition (fat, protein, lactose, and SCC) was available. SCC elevation was defined as at least one SCC >200.000 cells/mL after two previous weeks with SCC<200.000 cells/mL. Data were analyzed using a mixed linear model. Prepartum, milk yield, milk composition, and SCC in milk did not differ between DP lengths or rations. Somatic cell count was higher for cows with 0-d DP (232± 512 *103 cells/mL) compared with cows with a 30-d DP (178 ± 317 *103 cells/mL) or 60-d DP (141,4± 248 *103 cells/mL) ($P<0.01$). Somatic cell count was not different between rations. The constant high level of SCC is probably due to restrained regenerative involution during a 0-d DP, and a greater apoptosis rate in early lactation in cows with a 0-d DP, compared with cows with a 30-d or 60-d DP. Incidence of SCC elevations (n=275), and occurrence of clinical mastitis (n=59) did not differ ($P>0.01$)between DP lengths or rations. Studies are ongoing to detect predictors for SCC, incidence of SCC elevations, and clinical mastitis in dairy cows after different DP lengths. Predictors for udder health in subsequent lactation can be used in a decision support model to optimize individual cow DP length strategies.

3.06

Claw health assessment in dairy cattle herds

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Lameness is the number one welfare issue in dairy cattle herds. In most of the dairy cattle herds, over 10% of the animals are affected by some form of claw disorder so we must consider lameness as a herd health concern.
Herd level assessments of claw health status were performed in 8 Hungarian dairy cattle herds. Locomotion and body condition were scored in 2663 animals. Data on claw trimmings, lameness treatments, preventive foot bathing and any predisposing technology- or management related factors were also collected. The overall hygiene conditions and the quality of walking and resting areas were assessed. The behaviour of animals during resting was also observed as a sign of cow comfort. 29.7% of the animals were not lame (locomotion score 1, Sprecher et al.; 1997). The rest of the studied animals showed some form of abnormal gait. 41.2% of the cows were considered as clinically lame (locomotion scores 3-5). There was a negative correlation between body condition score and locomotion score. Digital dermatitis was the number one hoof problem in the assessed herds. The prevalence and severity of lameness varied among herds. The incidence of lameness was significantly lower in freestall barns than in straw-bedded yards, possibly due to the cleanliness of the resting areas in freestalls. On farms with regular hoofcare and/or preventive foot bathing - compared to only two occasions of claw trimming per year or a not systematic foot bathing protocol – the rate of lameness was relatively low.
On the basis of our results, the most important factors associated with poor claw health are the lack of early detection of lame animals, improper foot bathing protocol, delay in the treatment of lame animals, poor environmental hygiene and poor cow comfort. A better focus on these areas is vital in improving the lameness situation.

3.07

A sequential analysis of body regions and body positions during mechanical brush use by dairy cattle

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The aim of this study was to evaluate cow's body postures associated with brushing the different body regions with a view to investigating how they might experience grooming by mechanical brushes. A mixed group of 72 Holstein and Swedish Red cows in a loose housing system with access to two brushes were observed during 20 days, comprising 10 different scan periods of 30 min each of continuous detailed observations. Every 15 seconds we observed which part of the body was brushed (head, neck & withers, belly, hind quarters) and which ear position (axial, forward, back up, back down, asymmetric) neck position (horizontal, above horizontal, below horizontal, down) and tail position (no wagging, small wagging, directed wagging, vigorous wagging and bent side) they showed. A sequential analysis of the body region and position was applied followed by Pearson residuals of four-way cross tabulation. Cows spent most time brushing their hindquarters (head 11%, neck 18%, belly 15% and hind 55%). When switching from brushing one region to another, the following region was most likely to be the region towards the hindquarters supporting that cows brush from head to tail. The most frequent ear positions while brushing were 'back up' (44%) and 'axial' (31%), the most frequent neck position was 'horizontal' (47%) and the tail was most like to be 'not wagging' (52%). There were also specific combinations of ear, neck and tail positions that occurred significantly more often than others, or only occurred when brushing specific regions. Tail bent to the side was only associated with the cow brushing the hind quarters and the 'axial' ear position, which has been associated with relaxed positive situations. Vigorous tail wagging was correlated with brushing the neck/withers/belly regions and the ears were in positions associated with alertness e.g. ears forward. In summary these results show a clear order of brushing the body with a preference for the brushing the hind quarters and we speculate that specific posture combinations might reflect different levels of arousal while experiencing a positive emotional state.

3.08

Positive relationships between the use of mechanical rotating brushes, social behaviour and production parameters and in loose-housed dairy cows

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This study investigated the relationship between the use of mechanical rotating brushes, social behaviour and production parameters in a mixed group of Holstein (32%) and Swedish Red (68%), second and third lactation dairy cattle. The average group size was 55 cows and information was gathered on a total of 72 cows over a 9-week period. The loose housing cubicle system was equipped with an individual automatic milking system and two mechanical rotating brushes in the alley opposite the roughage bins. Milk yield, feed consumption and performance parameters were monitored individually and merged with data from behaviour observations of brush use by individual cows. From observations of social behaviour (giver and receiver) we determined the dominance rank (based on butting, threats, pushing and fighting) and the affiliative rank (based on social licking and sniffing) for each individual. Both dominance and affiliation rank affected brush visits. Middle dominance ranked cows and high receivers of affiliative social behaviour visited the brush most often. There was a positive relationship between the frequency of brush use, milk yield and intake of roughage. A closer look at the estimates showed that each additional brush use was associated with a higher milk yield of 0.75kg and a higher roughage intake of 0.32 kg dry matter per day. The statistical analysis with mixed models using brush use as a covariate allows us to say that these relationships were independent of the breed, lactation number, stage of lactation, dominance or affiliative rank of the cows. Unfortunately, it is not possible from this study to identify the 'driver' in this triad, although it would be interesting to test the hypothesis that the tactile stimulation for the cow while using the brush is a trigger for the oxytocin release chain. This might explain the increase in milk yield and consequently feed consumption. The relationship between received positive social interactions, which includes licking, and the frequency of brush use implies that tactile stimulation is more important for some cows than for others.

3.09

Stereotypic oral behaviour in ruminants – causes and consequences

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Stereotypic behaviours (SB) are described as repetitive, topographically invariant response sequences that appear to lack any ultimate or proximal function. The most frequent examples of SB in ruminants are "tongue-playing" observed mostly in heifers and cows, and biting at fences, walls or troughs, which are common in sheep, goats and calves. These behaviours are almost exclusive of intensive systems and are very seldom observed in grazing animals. Although it seems clear that oral SB in ruminants are associated with diet/feeding, the exact causes and mechanisms are not known. Its value as a welfare indicator and its health and economical impact are also under discussion.

Another abnormal oral behaviour is cross-sucking and inter-sucking in dairy farms.

We have been studying tongue-playing, object biting and cross-sucking in intensive dairy farms for the past 10 years. The prevalence varies tremendously across farms, suggesting husbandry plays a crucial role. We suggest that in some intensively kept and fed ruminants this stress is related to a reduced need for oral movements – no foraging, no need for chewing and less time ruminating. For example, our studies show that pens where animals are eating a total mixed ration with shorter fibre or higher concentrate will show more oral SB and restricting feeding will increase oral SB prevalence.

We have also studied the social behaviour of dairy calves and its correlation with the establishment of cross-sucking, through the use of Social network analysis. In one farm only 18 % of the calves did not perform cross-sucking, although not all continued to perform intersucking. In this study, we found that there are "popular" calves that are sucked by many in the group and that there are calves that only suck on each other. In conclusion, we suggest that oral stereotypic behaviour occurs because some quality or quantity feeding needs are not fulfilled. This subject deserves further multidisciplinary research as the welfare and health significance seem to be important.

3.10

Welfare Assessment of Sheep During Transport using Hematological and Hormonal Biomarkers

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The transport could be a stressful procedure for farm animals. This is especially significant in traditional sheep management where seasonal transport is common for providing mountain pasture fieldsin summer periods. The objective of this study was to determine the changes in plasma cortisol, glucose and hematological parameters in sheep before and after short transport by walk and train, as indicators for stress and animal welfare disturbance. Three groups with 10 – 20 animals/group were used in the study: control group – not transported animals, group translocated by walking and group transported by train. Blood samples were taken twice in the control group (10 days between blood sampling) and five times before and after transport (7days before, immediately before and after, and first and the second week after the transport) in the walking and train group.Statistical identification of the transport effect within the group was performed using RM-ANOVA and unpaired two sample Student t - test. The plasma cortisol levels and blood glucose level in the control group were 66.13±43.08 ng/ml and 3.2±0.57 mmol/l, respectively, without significant difference between two measurements. Within the walking group significant difference ($p<0.05$) was detected in the glucose level immediately before and after the transport, 3.0±0.19mmol/l and 3.8±0.44mmol/l, respectively. Considering the hematological parameters, significant differences were found in HGB, MCV and PLT before and after translocation by walking. The group of animals transported by train showed differences in the glucose levels immediately 4.0±0.40 mmol/l and 3 days after transport 3.7±0.49 mmol/l ($p<0.05$). Additional hematological changes were found in PLT before and after transport, 116.18±52.65 and 199.00±67.86 x 10^9/l, respectively. Cortisol levels were found to be significantly different only in the train group immediately after the transport 51,30±56,40 ng/ml in comparison with the higher values before the transport.Increased glucose levels in the blood are indicating that the transport by walking and train transport are stressful procedures for the animals and have serious impact on their welfare. While the lower values of plasma cortisol levels could suggests that the transport by train is more strenuous procedure for the animals followed by additional stress from loading and unloading of the animals.

4.01

Predicting daily eating activity of dairy cows from 3D accelerometer data and RFID signals by use of a random forests model

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Feed intake is very important for dairy cows and deviation from normal eating behaviour may predict a cow that needs treatment. Therefore we investigated whether a device from Lyngsoe Systems (Aars, Denmark) could be used to estimate eating behaviour.

Data were collected from 23 cow/logger combinations and synchronised with video recordings at the Danish Cattle Research Centre (DKC). The sensor recorded 3D accelerometer data and radio frequency identification (RFID) signals for positioning of the cow at the feed bunk. Video observations from 21 to 48 hours per cow/logger combination were classified per second by a trained technician into the states: ears behind feed bunk, ears above feed bunk, eating, other, or view blocked. Logger data was reduced to per second level by averaging the original 12-14 hertz signals.

In the current stage of the study we are developing a prediction model to be used for monitoring eating behaviour of dairy cows. Our results show that daily eating time is predicted reasonably well by a random forests algorithm using sensor observations at present time and a number of seconds back in time (lag window). Performance was measured by "leave one cow/logger out" cross-validation, i.e. in turns preserving data from one cow/logger combination as test set and using data from the other 22 for training of a random forests model.

Results were only slightly affected by the number of trees and 50 trees seemed to suffice. Larger size of the lag window reduced the bias and increased the accuracy, see Figure 1. We varied the window size from 8 to 128 seconds and while accuracy stabilises from around 80 seconds the bias decreases through the whole range.

The results suggest that the device can be used to estimate eating behaviour of dairy cows with large accuracy. However, the equipment needs to be validated on commercial farms.

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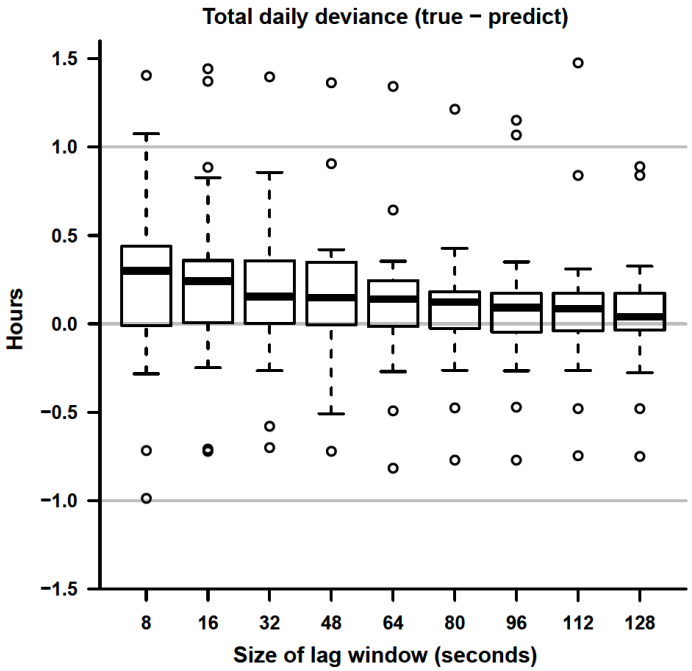

4.02

Measuring feeding time of dairy cows using an indoor positioning system

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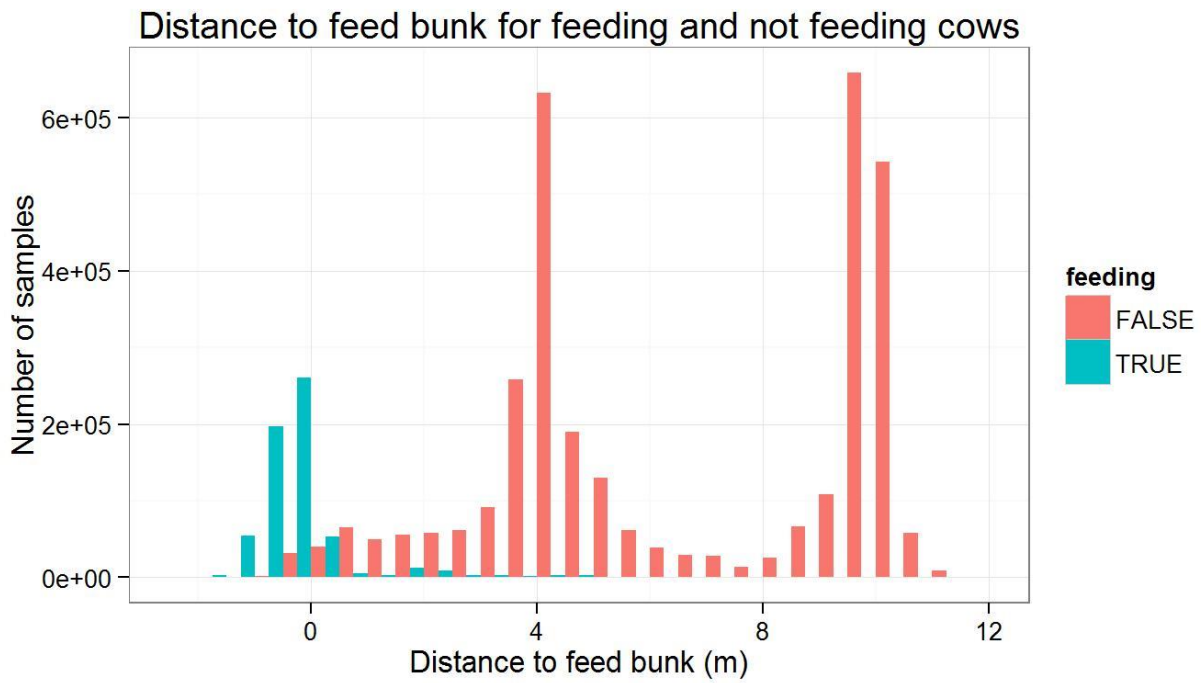
Automated measurement of feeding behaviour can be used for surveillance of production, health and welfare of dairy cattle. Feeding behaviour can be measured with stationary feeding systems, however, these systems often require high investments and structural changes in a barn. Thus, new low-cost, automatic measurement methods could be useful when measuring feeding behaviour. The aim of this study was to investigate how accurately we can measure the feeding time of dairy cows using an indoor positioning system.

We collected feeding time data of 39 dairy cows for 48 hours in a freestall barn using Insentec RIC feed intake measurement system. The position of the cows in the barn was simultaneously recorded using Ubisense UWB-based indoor positioning system at 1.2Hz. We filtered the positioning data to remove large jumps returning to original position with a custom algorithm and interpolated missing samples using piecewise interpolation.

We calculated the distance of each location sample to the feed bunk. Samples on the side of the feed bunk were defined as negative and on the side of the cows positive. We fitted a linear discriminant model (LDA) using the distance to feed bunk in order to classify feeding from position data to the first 24 hours of the sample and evaluated the classification performance of the model on the second 24 hour period.

The model predicted that data points closer than 97cm (0.5 cut-off for LDA) to feeding troughs come from feeding cows. The classification accuracy of the model (mean ± sd) was 94.6 ± 6.2% with sensitivity 94.1 ± 6.8% and specifity 95.0 ± 7.2%. The area under the ROC curve with model cut-offs from 0 to 1 for the LDA model was 0.98. High AUC indicates that the model is not very sensitive to used cut-off.

The results indicate that the used positioning system provides very accurate estimates of feeding time for dairy cows, and thus it may provide an inexpensive tool for feeding behaviour measurements at the feed bunk.



4.03

Validation of RumiWatch sensors: a confusion matrix approach

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RumiWatch (RWS; ITIN+HOCH GmBH, Switzerland) is a pressure sensor based system measuring eating, ruminating and drinking time of cattle. In the present study we use confusion matrix approach for validation and calculate sensitivity and precision of the RWS measurements. The method also reveals what kind of erroneous classifications RWS makes. Five non-lactating dairy cows kept in tie-stalls were equipped with RWS halters for 48 hours. The cows were offered 7 DM kg silage per day and water was provided ad libitum from water bowls. Two trained observers recorded eating (ET), ruminating (RT) and drinking (DT) bouts by continuous recording from video-recordings and these measures were compared to RWS ET, RT and DT classifications second by second. There was three to nine hours (i.e., 10800 - 32400 seconds) of data per animal. For each of the three behaviour patterns, we calculated sensitivity (true positives / [true positives + false negatives]) and precision (true positives / [true positives + false positives]). The results are presented as lowest value - highest value of all the five halters separately, as well as for the pooled data from all the five halters.

RWS measured ET little more reliably than RT: sensitivity for ET was 81.8 - 99.3 % (calculated from pooled data 90.3 %) vs. RT 62.5 - 97.0 % (82.7 %). On the other hand, RWS misclassified other four behaviours more to eating than to rumination: precision of ET 33.5 - 75.9 % (48.6 %) and RT 61.1 - 96.6 % (87.3 %). The major reason for the overestimation of ET were behaviour categories that included “behaviour resembling eating” (jaw movements without feed in the mouth) and “other behaviours” (behaviours other than eating, rumination, drinking or “behaviour resembling eating”) being classified as ET (Table 1). The RWS system did not measure DT reliably: sensitivity was 0.0 – 7.6 % (3.4 %) and precision 0.0 – 4.4 % (2.4 %).

RWS classified eating and rumination, but not drinking, reasonably well although there was a lot of variation between the individual halters. The detailed information of RWS misclassifications can be used in the further development of the system.

Table 1. A confusion matrix for eating, ruminating, drinking, “other behaviours” and “behaviour resembling eating” RumiWatch (RWS) measurements. Continuous behaviour recording is regarded as gold standard.

		Gold standard				
		Eating	Ruminating	Drinking	Other	Resembling eating
RWS	Eating	20716	3002	862	6972	11043
	Ruminating	2044	21248	3	860	190
	Drinking	43	0	43	1316	368
	Other	143	1453	354	49226	2514

4.04

Does the increase of feeding frequency by automated systems impact the behavior of dairy cows?

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With increasing automation of dairy farm, new questions arise about the possible impacts on the health and the welfare of cows. Automated feeding systems lead to increase significantly the rate of mixed ration distributions, up to 7/day on average in a recent review around European countries (Grothmann, 2009). Because cows' behavior is strongly sequenced by feeding and rumination, the increase of feed distribution may impact this behavior and impede animal welfare. The behavior of a group of 17 cows fed once a day (1D) was compared with a paired group of 17 cows fed 8 times a day with an automated system (8D), both wintering in the same experimental farm. Both groups were observed during daytime by the same person using scanning visual observations. Feeding sequences of 8D differed, with a peak of ingestion after each ration distribution, but the whole daytime budgets were not significantly affected. Although, 8D cows spent more time ruminating when standing in the feeding area than when standing or lying in the cubicles. More competition was observed in 1D group, but this behavior was very rare in both groups. It was concluded that in good housing and feeding conditions, where feeding is ad libitum and feeding competition is minimized, the increase of the distribution of mixed ration wouldn't impact significantly the welfare of animals. Yet, this issue should be investigated also in more competitive farm conditions and taking into account nighttime behavior also.

4.05

Measurement of rumen motility using a tri-axil gyroscopic bolus

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Rumination monitoring in dairy cattle is becoming increasingly important as a means to identify welfare events such as the onset of calving or the early onset of illness such that appropriate interventions can be made. Several approaches have been adopted including the use of accelerometer based collars where the neck motions experienced by the accelerometer are interpreted to identify eating and rumination events. This study reports initial trials of a rumen motility bolus containing a tri-axial accelerometer and a tri-axial gyroscope to determine the feasibility of measuring the frequency and amplitude of rumen contractions in ruminants. The bolus recording were made over a 5 day period. Motility sensor boluses were placed in the cranial ventral sac of the rumen in 4 Jersey cows with ruminal canulae. The cattle were house housed indoors in a straw yard and fed hay ad libitum, with 300 g lightly roller-milled barley grain fed to each cow at 08:00 h and 15:00 h each day.

Data from the rumination boluses were processed to identify the duration and time between rumen contractions. During rumination periods the time interval between contractions was generally longer, around 60 seconds with typical contraction durations of 10-11 seconds. The contraction events were observed to clearly align with points in the collar measured signatures where the mastication process stops and a fresh bolus is regurgitated (see Figure 1 below). The rumen motion frequency increased during eating periods with a typical contraction rate being 1 every 40 seconds.

The study has identified that the rumen motility bolus is clearly measureable using accelerometer and/or gyroscopic sensors. The information derived from the sensor correlates well with collar based measurements and provides an additional sensor modality that can provide an insight into animal welfare.

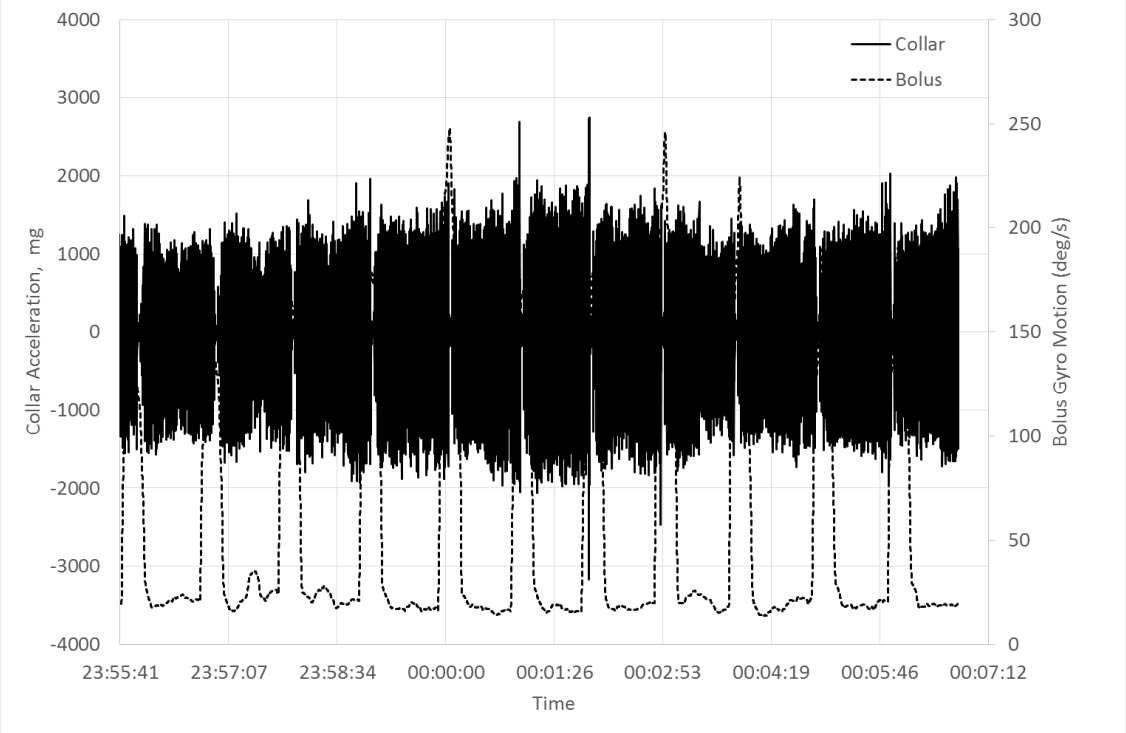

Figure 1: Collar Acceleration Measurement and Bolus Contraction over 10 minute period.

4.06

Smart farming in dairy cattle: application of RumiWatch noseband sensors for monitoring of calving events in dairy cows

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Particular interest of large-scale dairy farming is to benefit from automated detection of occurrences requiring assistance or treatment by the farmer, such as calving, disease, or heat. Therefore, technical monitoring tools for animal behavior are a major focus in the development and marketing of dairy technology. RumiWatch noseband sensors (Agroscope, Ettenhausen, Switzerland) represent a potential predictive tool for calving and disease events, as it allows to monitor both ruminating and eating activity via an animal-attached measuring device with real time on-line analysis and wireless data transmission. This study aimed to identify relevant parameters for calving detection measurable by RumiWatch noseband sensors and to investigate inter- and intra-individual differences in ruminating and eating behavior during the transition period. For data acquisition, 24 dairy cows (Fleckvieh, 6 primiparous, 18 multiparous) were equipped with RumiWatch noseband sensors 7 days before the calculated calving date and monitored for 21 days consecutive to parturition, in order to conduct continuous measurement of behavioral changes in ruminating and eating parameters during the peripartum period. Daily rumination time showed a consecutive decrease, starting from a baseline of 488.8 min/24h (day -3) by -12.1 min/24h (day -2) and -29.4 min/24h (day -1), respectively. Daily rumination time was found to be lowest on the day of parturition (day 0), marked by a decrease of -159.8 min/24h compared to the baseline. Daily eating time showed a decrease, starting from a baseline of 361.1 min/24h (day -3) by -7.6 min/24h (day -2) and -14.1 min/24h (day -1), respectively. On the contrary, daily eating time increased by 21.0 min/24h at the day of parturition (day 0) compared to the baseline. Significant differences in ruminating time were found between lactation days ($p < .0001$) and parity of cows ($p = 0.0059$), whereas eating time significantly differed between lactation days ($p < .0001$). These results reveal significant changes in ruminating and eating activity in the peripartum period that are measurable by RumiWatch noseband sensors, and hence might allow the prediction of approaching calving events. Future research aims for development and validation of reliable detection algorithms for calving and further management-relevant occurrences, e.g. disease and heat.

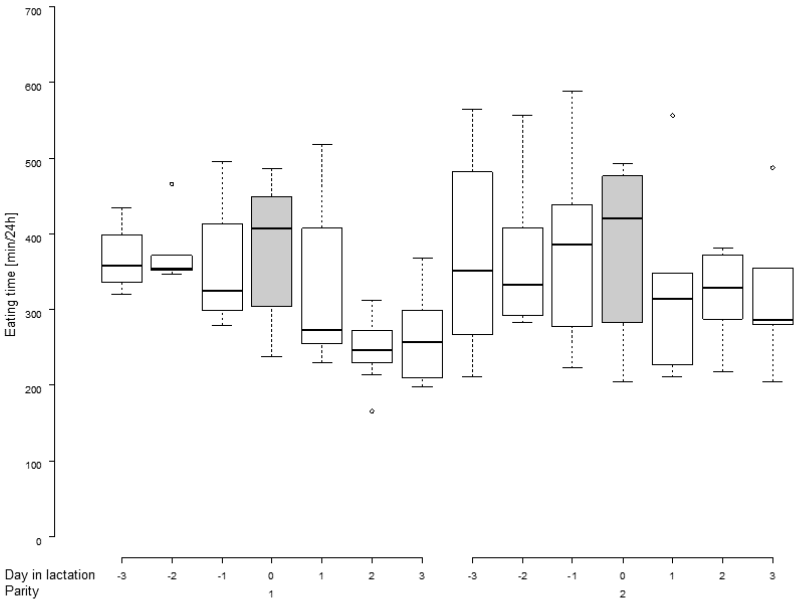

Figure 1: Changes in eating time in the peripartum period (gray: day 0 = day of parturition; n=13 cows)

4.07

Calving monitorization by remote technology in dairy cattle

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Implementation of Smart Farming (SF) technologies is helping to collect plenty of data regarding animal health, weather and machinery, among others, to improve productivity. One of these technologies are the precision livestock farming (PLF) sensors, which could be used to detect early reproductive events. An example of these PLF is the calving detection sensor, that may reduce the incidence of dystocia and genital infections, improving the reproductive performance and animal welfare. In this experience, Vel´Phone sensor (Medria, France) was inserted into the vagina of pregnant cows around 7-10 days before the expected date of parturition and it measured the vaginal temperature. This gadget sends a first SMS message (F) to the farmer´s phone indicating which is the normal vaginal temperature; the second notification (S) indicates that temperature drops suddenly and parturition is impending; and the third (T) informs that the sensor has been expelled. When the second notification was received, cows were moved to a calving barn. There, animals were better monitored by videocamera, observing the expulsion of fetus (E) and writting down the elapsed time. The objective was to determine intervals between S and T, and between T and E, and also to analyse the variation in cows suffering retained placenta (RT). A total of 51 dairy cows were monitored. It was observed that a 14.9% of sensors did not send the second notification, while 5% failed in T. When data were reviewed, it was confirmed that all these animals calved before the expected date, and that sensors were inserted at the wrong (too late) time. In cows suffering RT, the elapsed time between S-T was 17.0±1.7h, while when placenta was correctly expelled the interval was longer (26.9±4.0h), although no significant differences (p=0,305) was detected. T-E intervals were 176.7±63.3 and 94.1±12.8 min in RP and normal-calving cows, respectively, and significant differences ($p<0.05$) were observed. To conclude, the determination of S-T interval at the parturition could help farmers to make a decision to move animals at relaxing barns for a better monitorization, and longer T-E intervals could give information on when the probability to retain placenta is higher and preventive treatments should be implemented. Further research in this field is necessary because the use of these technologies can prevent a lot of problems associated with postpartum diseases.

4.08

Effects of rearrangement of the cows in production groups on milk cortisol concentrations

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Under challenging situations, several systems mainly the hypothalamic-pituitary-adrenal axis (HPA), the autonomic nervous system, and the immune system are recruited to reestablish homeostasis. Whether the measurement of cortisol in dairy cows can be used as a biomarker of adverse environmental or pathophysiological conditions is still under of scientific debate. Cortisol and its metabolites can be measured in integuments and fluids, as hair, urine, feces, and milk, each site of sampling presenting advantages and limitations. For lactating cows, milk can be viewed as the sampling site of first choice, since it could be measured without manipulation of animals; hence, it is completely compatible with animal welfare recommendations. A first aim of the present study was to evaluate physiological variations of milk cortisol and its pulsatility in dairy cows, whilst a second study investigated the effects of rearrangement of the cows in production groups, on milk cortisol concentrations. For the first study, 10 Norwegian Red (NR) cows and 10 Holstein Friesian (HR) cows, lactating and pregnant, were used. Milk was sampled at the morning (6:00 am) and at the afternoon (6:00 pm) milking for 3 consecutive days. In the second study, a total of 35 animals were used: 5 NR and 13 HF cows which were moved from “post partum” group to “high production” group and 10 NR and 7 HF cows which were moved from “high production” group to “low production” group. Milk was sampled at the evening milking (6:00 pm) for 5 consecutive days starting from 2 days before the relocation (day 3). No significant effects in milk cortisol concentrations were observed in trial 1 for time of sampling, day of sampling and breed. In trial 2, for NR cows, the estimated marginal means of milk cortisol were significantly higher in comparison to HF cows ($P<0.001$). Moreover, milk cortisol concentration increased at days 3, 4 and 5 ($P < 0.05$), showing estimated marginal means significantly higher after the reallocation of the cows. These results, although promising, deserve further investigations to pinpoint that milk can be used in dairy cows to point out short-term stimulation of the HPA axis.

4. 09

Milk beta-hydroxybutyrate and urea as a tool for fast diagnosis of bovine feeding strategies and welfare

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Dairy cows in early lactation and mainly animals with high-yielding production have a lower dry matter intake, have weight loss and lower body condition, and consequently negative energy balance. The equilibrium between protein and energy, precisely rumen degradable protein and highly fermentable carbohydrate, enhances the optimization of dietary protein in dairy cows. This leads to a suitable reproductive performance, higher milk production, low costs in food and lower environmental impact owing less loss of nitrogen by feces and urine. Beta-hydroxybutyrate (BHB) and urea are metabolites that can be evaluated in blood, urine and milk in dairy cows, which are related to sub-clinic and clinical ketosis and energy –protein balance.
Based on milk samples collected by the Portuguese Official Milk Control (ANABLE and EABL) , the records of milk beta-hydroxybutyrate and urea from dairy farms of Southern Portugal, are analysed, with the purpose to show that this metabolites evaluated in a non-invasive fluid, are an easy and efficient tool for the dairy farmers to monitoring the eating patterns and cows' welfare, what may help in decision making.

4.10

NMR-Metabolomics Profiles of Two Goat Breeds with Different Level of Tolerance to Seasonal Weight Loss

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The goat has economic and nutritional importance in the Mediterranean basin and tropical regions, specially due to its milk production and varied dairy products. However, the yearly production of milk is affected by the scarcity of pastures during the dry season, which leads to seasonal weight loss (SWL) in ruminants. The aim of this work was to study the effect of feed-restriction in two dairy goat breeds, with different tolerance levels. The results will help to define breed selection strategies in drought prone regions.

Nuclear Magnetic Resonance (NMR) was used to compare the metabolome of aqueous fraction of mammary gland and milk serum from two dairy goat breeds: one tolerant to dry environment (Majorera) and other susceptible (Palmera). Goats in mild lactation were divided by breed, and then by two feed-regime groups: a control groups and a restricted fed group (to achieve 15-20 % reduction of body weight in the end of the experience). Milk samples were collected daily and it was studied the sample from the last day of experience (23 days). Mammary gland biopsies were collected in the end of the study. Aqueous fractions were obtained by tissue aqueous/organic extraction and milk serum was obtained by ultra-centrifugation and filtration. 1H NMR spectra were collected from the aqueous extract of the mammary gland and the milk serum.

Profiling analysis has led to the identification of 47 metabolites in aqueous extract of mammary gland. Lactose, glutamate, glycine and lactate were found to be the most abundant. Analysis of milk serum allowed the identification of 50 metabolites, being the most abundant: lactose, citrate and creatine. Significant differences were observed, in mammary gland and milk serum, between control and restricted-feed groups in both breeds, however without differences between breeds. Variations are coherent between breeds and seem to be related to metabolism adaptation to the low-energy diet and indicative of breed-specific microflora. Milk serum shown more metabolites varying between control and restricted groups, than the mammary gland. Majorera breed shown also more variations than Palmera in this sample, which could be an indication of a slower adaptation to SWL by Palmera breed.

5.01

New Zealand dairy industry: A dynamic and changing industry, based on the management of large scale dairy herds and efficient milk production from pasture

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In 2013 to 2014 New Zealand's over 4 million dairy cows reached a new record of 1,063 kg of milk solids/ha, which equivalent to 4,196 L/cow, comprising 5% milkfat and 3.8% protein, equivalent to 5,250 energy corrected to 40.g/kg produced during approx. 244 days in milk. There was a small increase in the number of dairy herds to 11,927 and herd size to 413 cows/herd. Just over fifty percent of herds had 100 to 349 cows, 28% had over 500, 12% had over 750 and 5% had over 1,000 cows. Dairying is traditionally dominated by the North Island, but the greatest expansion continues to take place in the South Island, which is characterised by larger herds and more seasonally inclement climate. This, along with more frequent drought in the North Island and higher milk prices in the last few years has resulted in an ever increasing diversity of production systems in terms of; feed types, equipment, housing, management and supplements being applied in addition to pasture. This has taken New Zealand beyond their typical marketing paradigms. Legislation around nitrogen leaching and management of water resources has dramatically increased the number of farmers building cattle housing, retaining dry cows on-farm and housing cows fully or for some proportion of each day to reduce nitrogen losses, pasture damage and improve cow welfare by reducing heat stress and providing better housing condition for cows. These are typically used during critical parts of the year, when soil conditions are excessively wet and/or dry and nutrient leaching from actively grazed pastures are greater. Investment in; housing, feeding equipment and genetics have increased the cost of production and business risk. In the current season, there has been an early forecast of lower milk price and close to the cost of production for many dairy farmers, resulting in less feeds being purchased. This along with a cold, late start to the pasture growing season may well have detrimental effects on dairy cow feeding, fertility and dairy heifer management, which have tended to be some of the more inefficient areas of this production system.

5.02

Guidelines on use of sensors for animal health and productivity; a New Zealand initiative

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The continuous increase in dairy herd sizes is driving a need for sensor technologies that support daily management decisions to improve animal health and productivity. Scientific research on sensor technologies has focused on assessing their ability to detect events of interest (e.g., mastitis or oestrus events) using epidemiological terms like sensitivity and specificity. However, these performance indicators are meaningless for farmers, who are end-users of these sensor technologies. Moreover, comparing performance indicators between studies, and thus between sensor technologies, is extremely difficult since studies have used (1) a variety of gold standards, (2) different in- and exclusion criteria to create data sets for model development and validation, and (3) different time windows in which alerts for events of interest are considered true positive or false positive. Lastly, studies often used a limited number of (research) farms to collect data, and thus, there is little to no evidence of field performance. To overcome the difficulties of interpreting performance indicators and the lack of uniform performance information, DairyNZ developed protocols to field-evaluate performance of in-line mastitis detection systems. The protocols are aimed at providing: (1) robust and uniform information on performance of in-line mastitis detection systems against criteria of importance to farmers to support more informed investment decisions, and (2) an evaluation framework to help sensor technology providers develop or improve their products. However, protocols require support from both sensor technology providers and the wider industry in order for them to be accepted and regularly used. Although New Zealand sensor technology providers have expressed general support for the proposed protocols for in-line mastitis detection systems, an international approach would be beneficial to refine and gain agreement on the proposed protocols. Furthermore, protocols for sensor technologies targeting other events of interest (e.g., estrus detection) would benefit technology development and adoption. The DairyNZ approach can be used as a starting point to gain agreement on guidelines, definitions, and approaches for sensor evaluation in general. By doing so, it is expected that improved sensor technologies will be developed that offer improved management support. IDF established a working group to progress the development of these guidelines.

POSTER ABSTRACTS

P.01

Use of Photometry in Evaluation of Hoof trimming

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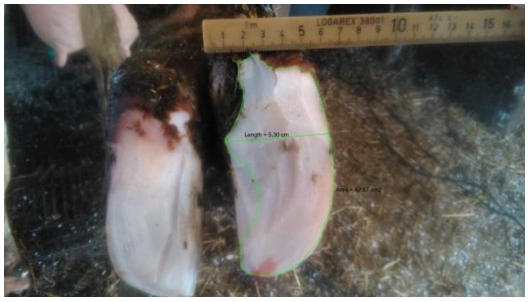
The Aim of the study was computer image analysis of dairy cows claws digital photos made during claw trimming. High performance group of Holstein cows (n=71) bred at university (SUA Nitra) farm (n=292) belonging to TOP10 in Slovakia was selected for the trial. Digital images of the claw from the bottom site with ruler were made using conventional 5 MPix camera. NIS elements software was used for computer image analysis. Total size of claw area, size of functional area and width of claw were observed from the images. Cows were born between years 2006 to 2012, with min. 1 and max. 6 lactations. Majority of analysed cows was purebred (n=34) or with less than 6.25% of other origin (n=34), rest of the cows were crossbred (n=3). Cows were progeny of 27 sires (min. 1, max. 7 daughters).
Observed size of total area was in average 41.76±8.37 cm2 (min. 28.76, max. 69.18). Size of functional claw area was in average 28.98±6.72 cm2 (min. 11.81, max. 44.27). Observed width of claw was 4.91±0.51 (min. 3.19, max. 6.10). Birth year and number of lactations were observed to most influence the total size of claw with R2 = 16.36% resp. 10.38% with threshold probability. Size of functional area of claw was most influenced by sire line (R2 = 15.96%), followed by number of lactation (R2 = 11.29%), but not statistically significant. Effect of breed type was marginal, non¬-significant. Observed health status of cows was as follows, 21 cows was diagnosed with sole ulcer, 34 with interdigital dermatitis and heel erosion, 45 with digital dermatitis. Size of functional area of claw was affected by digital dermatitis ((R2 = 10.38%). Width of thee claw was significantly affected by interdigital dermatitis and heel erosion (R2 = 20.84%).
Further development of methodology to be used on-farm as part of daily herd management is on demand. Project APVV 14-0054 Is acknowledged for the support of activities.



P.02

Changes in milk composition indicating metabolic disorders in dairy cows

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Results of variation in milk composition may be useful for early detection of health problems in a herd. The results of Slovenian official milk recording scheme from 19 farms with fertility problems (delayed cyclicity, ovarian cysts) were analysed with regard to the stage of lactation. The mean number of dairy cows in herds investigated in our study was 41.5±28.9. The cows in the early lactation (0-100 days in lactation) produced in average more milk with lower fat, protein and urea content in comparison to the cows in mid lactation (101-200 days). In one third of cows fat content in milk deviated from normal values in the 1st stage of lactation. In 50.8% of early lactation cows in our study milk protein level was below 3.2%. Milk fat to protein ratio decreased from the 1st to the 2nd stage of lactation. Low values of milk fat and protein in many cows especially in the 1st stage of lactation indicating that subclinical rumen acidosis can be present in these herds. Deviations like high content of milk fat or high fat to protein ratio were not so often found. Deviations in milk composition indicate metabolic problems in some cows due to inadequate supply what could contribute to fertility problems reported in these herds.

P.03

Effect of incremental amounts of camelina oil in concentrate supplements on feed intake, plasma metabolites and milk production in lactating cows fed a mixture of grass and red clover silage

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Camelina (Camelina sativa) is an ancient oilseed crop rich in essential polyunsaturated fatty acids [30-40 % and 15 % of fatty acids in camelina oil (CO) as 18:3n-3 and 18:2n-6, respectively]. The present study investigated the effects of incremental amounts of CO in concentrate supplements on feed intake, plasma metabolites and milk production in lactating cows. Eight multiparous Finnish Ayrshire cows averaging 91 (SD 5.5) d in milk were used in replicated 4x4 Latin squares with 21 d periods. Treatments comprised 4 concentrates (12 kg/d) based on cereals and camelina expeller containing 0 (control), 20, 40 or 60 g/kg of CO on an air-dry basis. Cows were offered a mixture of grass and red clover silage (1:1 on a dry matter basis) ad libitum. Data were analysed by analysis of variance (ANOVA). Incremental CO supplementation linearly lowered (P<0.01) silage and total dry matter intakes, whereas 18:2n-6, 18:3n-3 and total fatty acid intakes were linearly increased (P<0.01; Table 1). CO treatment had no effect (P>0.10) on whole tract apparent dry matter, organic matter or neutral detergent fibre digestibility. Supplements of CO linearly increased (P<0.01) plasma NEFA concentration and tended to cubically lower (P=0.08) plasma glucose and linearly lower (P=0.11) plasma insulin concentration. Incremental CO supplementation quadratically decreased (P<0.03) daily milk yield and linearly decreased (P<0.01) daily protein and lactose yields, but had no effect (P>0.10) on fat secretion. In conclusion, incremental amounts of CO in the diet lowered silage and total diet intake that together with a decrease in plasma glucose and insulin concentrations, and lower yields of milk protein and lactose suggests that high levels of CO may result in an inadequacy of energy to meet the requirements of high yielding dairy cows. Data suggest that inclusion of high amounts of supplemental polyunsaturated lipid may have adverse effects on glucose status and animal performance as a consequence of decrease in dry matter intake.

Table 1. Effect of incremental inclusion of camelina oil in concentrate supplements fed at a fixed rate on intake, whole tract apparent digestibility, milk production and plasma metabolite concentrations in cows fed a grass and red clover silage based diet

	Camelina oil in concentrate (g/kg)				SEM	*P*[1]		
Item	0	20	40	60		LIN	QUAD	CUB
Intake								
Silage, kg dry matter/d	10.9	9.78	9.68	7.98	0.797	0.002	0.477	0.197
Total diet, kg dry matter/d	21.5	20.3	20.0	17.7	0.89	0.001	0.321	0.248
18:2n-6, g/d	191	210	229	236	6.6	<0.001	0.304	0.718
18:3n-3, g/d	205	249	292	309	11.4	<0.001	0.174	0.587
Total fatty acids, g/d	703	838	965	1066	30.5	<0.001	0.533	0.878
Apparent digestibility, %								
Dry matter	72.9	73.5	73.8	73.4	0.58	0.381	0.257	0.783
Organic matter	74.2	74.7	75.1	74.8	0.57	0.212	0.350	0.764
Neutral detergent fibre	62.1	61.5	62.4	60.6	7.22	0.249	0.355	0.171
Plasma								
NEFA[2], mmol/l	0.130	0.163	0.176	0.206	0.0143	<0.001	0.864	0.366
Glucose, mmol/l	3.96	3.99	3.68	3.82	0.124	0.102	0.508	0.074
Insulin, µIU /ml	11.8	13.0	9.66	8.94	2.31	0.105	0.513	0.286
BHBA[3], mmol/l	1.13	1.00	1.42	0.96	0.201	0.923	0.322	0.066
Yield								
Milk, kg/d	33.5	32.5	32.3	28.0	1.38	<0.001	0.022	0.108
Energy corrected milk, kg/d	35.8	34.8	34.8	30.8	2.06	0.002	0.087	0.172
Fat, g/d	1117	1123	1148	1055	99.5	0.438	0.261	0.479
Protein, g/d	1027	962	946	815	48.6	<0.001	0.140	0.107
Lactose, g/d	1554	1507	1499	1287	71.9	<0.001	0.014	0.081

[1]Significance of linear (LIN), quadratic (QUAB) and cubic (CUB) components of the response to incremental amounts of camelina oil in the diet [2]Non-esterified fatty acids [3]Beta-hydroxybutyrate

P.04

Microbiological contamination of raw milk of suspicious cows for mastitis

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Inflammation of the udder is generally considered as the most costly and complex diseases in dairy practice and also as possible sources of pathogens influencing the milk safety. The aim of study was to find out the presence of mastitis pathogens in milk samples from cows with problematic udder health from 42 dairy farms in Slovakia during the period 2013 and 2014 (project MLIEKO No 26220220196, Kega 006SPU-4/2014). In total 633 milk samples were cultivated and identified. Only 7.74 % of samples were bacteriologically negative indicating well established diagnostic approaches in dairy practice. From the samples 42 different microorganisms were identified. The predominant bacterial isolates were Coagulase negative staphylococci (32.54 %), followed by Escherichia coli (12.48 %), Staphylococcus aureus (11.06 %), Streptococcus uberis (9 %), Streptococcus agalactiae (4.73 %) and yeasts (3.63 %). The effect of year was slightly observed and in both years the above mentioned microorganisms were frequently detected. There were observed presence of Enterococcus faecalis in 2014 (6.64 %) and Enterococcus faecium in 2013 (2.46 %). The presence of other detected microorganisms was below 2 %. In conclusion, high percentage of positive samples and clearly high occurrence of environmental microorganisms were identified in milk samples of suspicious cows for mastitis from dairy practice indicating the problem with the hygiene of the milking process especially udder and housing environment. However the presence of contagious pathogens should be also considered in management of dairy farms in mastitis control program.

P.05

Yield of Some Alternative Grazing Species in the 1st Summer Cut at East Croatia

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Croatian consumers' interest in the milk from grazing animals has recently come to follow the EU and USA trends, and few Croatian producers started an evident shift to grazing practices in dairy herds. Shift in some larger extent has a certain constraints which mainly arise from the adverse climatic conditions for grazing. Namely, great share of Croatian agricultural land lies either in the semiarid continental climate or mediterranean climate, which both are characterized by summer drought and consequent poor grass growth with the lack of pasture during summer. Election of appropriate alternative grazing species to substitute perennial grasses in terms of pasture yield and quality is crucial for the improvement of grazing herds productivity. Therefore appeared idea to test the performance of grazing-type lucerne and grazing-type forage chicory (Cichorium intybus L.) in the continental climate of east Croatia, in a field trial.

The field trial comprised hay-type lucerne "Mirna", grazing-type lucerne "Verbena", perennial forage chicory "Puna II" and several other combinations, which were seeded on the 24th March 2015 near Osijek on a deep fertile soil, in 3 replicates, with basic parcels 5m×1m. The yield was harvested by cutting at height of 4 cm aboveground. The 1st cut was taken on 10th Jun 2015 without any measurements because of excessive wideness. The 2nd cut was taken on 17th July 2015, when majority of perennial grasses and semi-natural grasslands start to exhibit their summer slump. Average herbage yields of the hay-type lucerne, grazing-type lucerne and chicory were 5.26 t/ha, 4.43 t/ha and 23.9 t/ha, respective. Dry matter (DM) concentrations in herbages were 20% in both lucernes and 7.5% in chicory. Dry matter yields were 1.06 t/ha, 0.89 t/ha and 1.8 t/ha. Considerable weed yields were brought along with targeted species: 2.29 t/ha of DM along with hay-type lucerne, 2.06 with grazing-type lucerne and 1.32 t/ha with chicory. If further investigations confirm the chicory's superiority this may give a significant lever to farmers' shift to the grazing dairy operations.

P.06

Differences in behaviour and heart rate variability of lame and non-lame cows during feeding

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The effect of lameness on the behaviour at the feed bunk and on the level of stress was examined in Holstein cows (DIM: 150±23.6) on a commercial dairy farm. Based on their locomotion score two groups of cows (non-lame: scores 1-2, N=28; lame: scores 3-5, N=24) were formed. The number of aggressive interactions exhibited as performer or receiver was determined for each cow over a 30 min period at the feed bunk. Dominance score (DS) was calculated for each animal based on aggression rate (AR; aggressive interactions as performer/total aggressive interactions).

Heart rate variability (HRV) parameters were calculated in frequency (LF, HF and LF/HF ratio), time (rMSSD) and non-linear domains (Lmax, REC%) for four 5-min bouts for each animal.

Lame cows were less dominant (DS: 1.44±0.69 vs. 2.24±0.79; $P<0.001$) compared to the sound ones, and there was a higher level of aggression against the lame cows by their group mates at the feed bunk.

Higher rMSSD ($P<0.001$), HF ($P<0.05$) and Lmax ($P<0.01$) were found in lame cows reflecting a higher parasympathetic tone, while lower LF and LF/HF ratio ($P<0.05$) showed lower sympathetic activity in lame cows during feeding. Daily milk yield of the sound cows was higher compared to lame ones (35.27±7.58 vs. 29.84±7.56; $P<0.001$). Results suggest that the effect of lameness can be manifested in HRV as confirmed by the observed differences in aggression levels in lame and non-lame cows.

P.07

Effects of litter size on meat quality traits in the Honamlı kid meat raised under semi-intensive conditions in Turkey

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Honamlı goat breed are breeding by Turkish nomads in Antalya, Burdur, Isparta and Konya cities, located on the hillside of the Taurus Mountains in the Mediterranean region of Turkey. In Turkey, 97% of the goats are the Hair goat (Kıl goats). Honamlı goat has been existing as a variety in the Hair goat population. Different morphological and production characteristics have been determined. It has a big body and long legs. Nose is clearly convex. Honamlı goat as a new goat breed have been registered by the Turkey Ministry of Agriculture. Honamlı goat breed have high fertility and faster growth rate.

In this study, the influence of litter size on meat quality traits was investigated using 20 Honamlı kids (10 single, 10 twin) slaughtered at 146 days of age. Single and twin male kids weaned at 75 days of age. Following a 15 day adaptation period, kids were fed ad libitum concentrate (12 % CP and 2750 kcal/kg) in pellet form and ad libitum dry alfalfa hay diet during 56 days. This study was investigated kept at the Training and Research Farm of the Faculty of Veterinary Medicine Mehmet Akif Ersoy University in Burdur province in Turkey. On the day of slaughter, pre-slaughter liveweights were recorded after deprived of food (for 12 h) but free access to water. Non-carcass components (head, skin, feet, lungs and trachea, liver, heart, spleen) were recorded and then hot carcass weight of each kid was determined. The gastro-intestinal tract was weight when it is full and empty. Thus empty body weight (EBW) was also calculated. The carcasses were then chilled at 4°C for 24 h. At the end of this period, the cold carcass weights were detected. Dressing percentage was detected based on EBW. Fat thickness over the leg, loin, rack, and shoulder) 12th rib was detected using digital plot. The results of the fattening trial were analyzed by a 2- Sample t test (Independent Samples t-test) procedure. While statistically significant difference between the groups in terms of the beginning of fattening was found to be statistically insignificant difference between the groups at the end of fattening. Twin kids in fattening period and provided more weight gain compared to singletons. While twin 231 g goat daily live weight gain, daily weight gain was 203 grams in singleton kid. There were not significant differences between single and twin kids for slaughter and carcass characteristics.

Table 1. Growth performance, slaughter and carcass characteristics according to litter size in Honamlı kids (Mean ± SE)

	Litter size		**P**
	Single	**Twin**	
No. of observations	**10**	**10**	
Birth weight (kg	4.8 ± 0.23	4.1± 0.21	0.05
Initial Age (days)	89.2 ± 2.4	90.9 ± 1.2	0.53
Initial live weight (kg)	23.0 ± 5.22	17.53 ± 4.14	0.01
Final live weight (kg)	34.4 ± 2.0	30.4 ± 1.5	0.13
Daily gain (g/day)	203 ± 0.12	231 ± 0.08	0.07
Slaughter weight (kg)	33.19 ± 2.0	28.92 ± 1.50	0.103
Empty body weight (EBW) (kg)	27.36 ± 1.80	24.00 ± 1.30	0.153
Cold carcass weight (kg)	14.07 ± 1.00	10.93 ± 1.20	0.062
Dressing percentage based on EBW (%)	51.30 ± 0.54	49.33 ± 0.84	0.066
Chilling loss (%)	2.12 ± 0.16	2.03 ± 0.12	0.641
Carcass length (cm)	73.95 ± 1.60	70.20 ± 1.20	0.075
Leg length (cm)	29.25 ± 0.49	29.10 ± 0.63	0.854
Back fat thickness (mm)	0.73 ± 0.06	0.69 ± 0.07	0.717
Shoulder percentages (%) relative to EBW	5.65 ± 0.07	5.43 ± 0.11	0.106
Ribs percentages (%) relative to EBW	8.26 ± 0.20	7.68 ± 0.25	0.090
Long Leg percentages (%) relative to EBW	8.29 ± 0.096	8.15 ± 0.20	0.542

P.08

The influence of hop cones (Humulus lupulus L.) supplement on the behaviour of young bulls

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Hop cones (Humulus lupulus L.) with their preservative and bitter ingredients represent an essential raw material in the brewing industry. Due to their sedative, estrogenic, antimicrobial, stomachic and cancer-related effects they are also applied in herbal medicine. In the last years large surpluses of hop cones in the world market increased the need to find additional ways of their use. Antimicrobial and antioxidative hope cones' properties proved in vitro and/or in vivo increased interest in their use in farm animal nutrition. Hope cones could also be used to decrease e.g. aggression and mounting in fattening males due to their sedative and anaphrodisiac effect shown in laboratory rats and mice. However, according to our knowledge this has not yet been studied. The aim of our study was therefore to evaluate the influence of pelleted hope cones (variety Aurora) supplement on the behaviour of 42 Slovenian Cika young bulls housed in six pens with fully slatted floors. According to the amount of pelleted hope cones supplement to daily total mixed ration, animals were allotted to three treatments: control received no hop cones, treatment H50 received 50 g and H100 received 100 g of hop cones/animal/day. Feed and water were available ad libitum. The behaviour of animals (resting, feeding, agonistic behaviour, mounting, drinking) was recorded by direct observation for eight weeks during three observational days, eight hours per day starting at 10:00 h, immediately after feed delivery. The hop cones supplement did not affect any of the observed behaviours ($P > 0.05$), except drinking ($P = 0.0397$). Animals in H50 drank more often (mean ± SE = 0.34 ± 0.06) compared to the control (0.18 ± 0.04) and H100 treatment (0.29 ± 0.05). In this study we could not confirm hope cones' sedative and anaphrodisiac effect on bulls' behaviour. This may be as the microbial feed digestion in ruminants might change the mechanism of hop cones action compared to laboratory animals, or the offered quantity of hop cones to the young bulls was inadequate. Further studies, especially regarding the amount of hope cones supplement, would be recommended.

P.09

Influence of dietary selenium supplementation of ewes and lambs on production performance and exterior characteristic of lambs

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The aim of this study was to determine the effect of selenium supplementation (organic, inorganic) in the feed mixture of high pregnant ewes on the production properties and exterior characteristic of lambs. The research included 30 pregnant Merinolandsaf ewes and their lambs. Ewes and lambs were divided into three groups of 10 animals. The research lasted 4 months respectively, 2 months with ewes during high pregnancy, 2 months with eves during lactation and their lambs during suckling period. Control group of ewes and lambs (group I) was given a meal which consisted of 300 g/day/animal feed mixtures without selenium supplement and 150 g/day/animal of barley and alfalfa hay, which, like water, they had ad libitum. The second group´s ration was enriched with the addition of 0.3 mg/kg organic form of selenium (Selplex®, Alltech), and the third´s group by the same amount of inorganic form of selenium (sodium selenite). In lambs body measures were determined by the Lydthin's stick or stock tape, while the body weight was measured by balance and indexes of body development were calculated. The average body weight of lambs at the age of 23 days was significantly ($P<0.05$) greater in the group with addition of the inorganic selenium in comparison to the control group. Addition of inorganic ($P<0.01$) or organic ($P<0.05$) selenium led to a significantly better exterior characteristics in older lambs comparing them with a control group of lambs. A significant ($P<0.05$) better indices of body proportions and body mass are evident in younger lambs whose mothers, and they fed the addition of inorganic selenium. Indexes of anamorphosis, body condition and massiveness were better ($P<0.05$) in older lambs who has had the addition of organic form of selenium in feeds. Results of current study suggest that form of Se source used in this research, has limited potential for improving the production performance especially if there was no a great lack of selenium only shortage.
Key words: ewes, lambs, selenium, production performance, exterior characteristic

P.10

Computer-assisted monitorization of therapeutic drugs consumption in dairy cattle in Southern Spain

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It is necessary to establish a drugs consumption monitorization in animals in order to avoid the mistaken use of different substances, to reduce the illegal administration of some active principles, and to promote the rational use of drugs by farmers. Chronic treatment with antibiotics in animal husbandry could lead to changes in human intestinal flora, hypersensitivity reactions, development of bacterial strains resistant to a particular antibiotic and so on. Usually, the indiscriminate use of drugs in dairy cows is due to poor management and/or specific stress situations. In Southern Spain, temperatures may reach 40-43ºC during summer, what induces severe stress in cows and may increase the use of therapeutic drugs. The aim of this study was to evaluate the consumption of drugs during the summer 2015 (June, July and August) in 51 farms in Southern Spain (7752 cows), in order to know what drugs are the most used, how many animals are treated and which farms are using drugs over the average. Data were gathered using an specific software to register the type of drugs and the animal identification. Therapeutic drugs prescribed during the period of study were: antibacterials, nonsteroidal anti-inflammatory drugs (NSAID), dry therapy, haemostatic, antiparasitic, choleretic, vitamine and mineral supplements, corticosteroids, digestive regulators, hormones and inmunomodulators. The percentage of drugs is showed in figure 1. It can be observed that vitamine and mineral supplements were the most used, perhaps because during summer cows need to be helped to maintain vital functions and to produce milk. The second most used type were hormones, what can be explained because of the interest of these farms to maintain good reproductive performance (very negatively affected during summer). In the third position were antibiotics, among which beta-lactam (cephalosporins, penicillins), tetracyclines and fluoroquinolones were the most commonly prescribed. An average of 50.7 animals were treated per month per farm, as represented in figure 2. This graph could detect farms that deviated from the average, recommending their analysis to determine why this consumption is so high. In conclusion, drugs utilization data should be correctly registered throughout easy-use computer tools, to reduce the negative impact of their inadequate use on human health, to avoid their illegal administration and to improve the farm profitability, in order to achieve sustainable livestock.

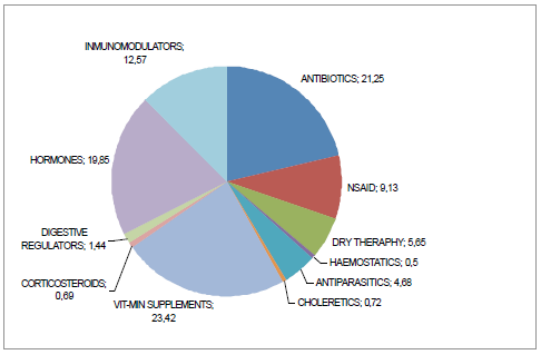

Figure 1. Consumption of drugs during summer in dairy cattle farms from Southern Spain.

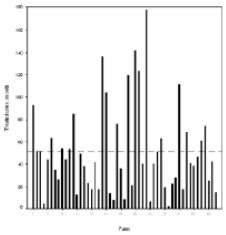

Figure 2. Number of cows monthly treated in the studied farms during the summer period.

P.11

Influence of feeding regimes on cow milk production at the farm „Planinsko Dobro“ Nevesinje in Bosnia and Herzegovina

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The main aim of the study was to evaluate the influence of the cattle feeding regimes on milk production and to establish correlation between feeding regimes and quantity of milk produced from 2009 to 2014 at the farm „Planinsko Dobro“ Nevesinje, Bosnia and Herzegovina. Although the quality and quantity of the produced milk depends primarily on the breed of milk cattle, a feeding regime is a crucial factor in the production of milk. The main criteria of cattle feeding are based on the type of food they feed on. The diet of cattle investigated within this study mainly consisted of: hay, silage and voluminous forage with the addition of vitamins and minerals. Voluminous forage is quite important for the milk cattle because digestion of fresh and voluminous forage positively influences production of milk and its quality. Voluminous forage contributed to 60-80% of the total meal, at this farm. Results show that the quality and quantity of milk during 2009-2014 has been significantly influenced by feeding regimes. However, some additional factors such as: cattle breed, hygienic and health conditions as well as climatic conditions have to be taken into consideration.

P.12

Wound treatment using honey, pollen and propolis

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Honey, pollen and propolis had been used as ancient remedy in the treatment of infected wounds. These substances express antimicrobial activity even against microorganisms resistant to conventional antibiotics and antiseptics. The goal of the research is to answer the question of whether these substances could help in healing of the udder wounds under the real field conditions. Substances subject to research were mixed in a remedy, which was applied directly into the udder wounds once daily.
The wounds were treated during May and June, after second milking and left uncovered. Application of a remedy in the udder wounds gave good results in elimination of infection, prevention of reinfection and faster tissue healing. Prepared remedy proved efficient, nontoxic and financially affordable, this is especially important for poor or natural disaster- affected areas.

Wound location	Wound status	Udder wound location	Wound status after several „Apimelem” applications	Healing	Duration of treatment
Udder wounds n=8	Bad n=8	Base n=2 Ventral part n=3 Caudal part n=3	Improvement	100%	≤14 days
Teat wounds n=11	Moderate n=9 Bad n=2	Body and teat apex	Improvement	100%	≤14 days

P.13

Relationship between body condition of pregnant dairy cows and insulin-dependent glucose metabolism of their offspring

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The metabolic state of pregnant cows influences the calf's risk of metabolic disease in postnatal life. We have hypothesized that obesity in pregnant dams may disturb insulin-dependent glucose metabolism in their offspring. Twenty late pregnant cows were selected and divided in two groups based on their body condition score. First group (n=10) included obese pregnant cows (BCS > 4.0) and second group (n=10) included cows with optimal body condition score (3.0 > BCS < 3.50). Calves born from these dams were weighed at birth, and subjected to intravenous glucose tolerance test (GTT) at day 7 of age. Calves from obese dam had significantly lower birth weight and modified insulin response to glucose infusion, compared to calves that originated from optimal body conditioned dams. At day 7 of neonatal life, calves from obese dams had significantly lower basal glucose concentrations, significantly higher glucose AUC, significantly higher basal insulin, insulin AUC and insulin peak concentrations compared to calves from optimal body conditioned dams. Glucose elimination rates were lower in calves from obese dams than in calves from optimal conditioned cows. The RQUICKI was significantly lower in calves from obese dams than in calves from optimal conditioned cows, indicating on insulin resistance of calves that originated from obese dams. In conclusion, differences in the metabolic state of pregnant cows during late gestation may be related to their offspring's birth weight and glucose metabolism.
Keywords: obese pregnant cows, neonatal calves, glucose metabolism
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P.14

Assessing resilience of dairy cattle by studying impact of heat stress on predicted feed intake

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Milk production and feed intake of dairy cows are both affected by heat stress (HS) which is also a potentially important cause of discomfort for animals. Therefore, strategies allowing mitigation of HS effects are required. Genetic selection appears to be a good solution because this tool permits to improve cumulatively and continuously traits of interest. In this context, the goal of this study was to estimate genetic variation of milk yield and predicted feed intake over the whole trajectory of temperature humidity index (THI) using a reaction norm approach. A total of 30,161 fat and protein corrected milk (FPCM) yield records from 4,577 Holstein cows were used. These data were collected between June 2009 and December 2010 in 453 herds in the Walloon Region of Belgium. Daily dry matter intake (DMI; g/d) of dairy cows were estimated at the day of FPCM records from the prediction equation of NRC (2001), which is based on predicted body weight, FPCM, and week of lactation. Body weight of cows was estimated using a two-step approach allowing to predict body weight throughout the lactation from body weight calculated using linear conformation traits. Daily values of THI were computed from meteorological data using the mean of daily values of dry bulb temperature and relative humidity. Bivariate random regression test-day models with random linear regressions on THI values were developed for FPCM and DMI. Estimated average daily heritability for FCPM was 0.08 and decreased slightly at extreme THI values (from 0.10 (THI = 17) to 0.06 (THI =75)). Heritabilities of DMI also decreased with increasing THI values: from 0.11 (THI=17) to 0.05 (THI=75). Genetic correlations between FPCM and DMI were positive and ranged from 0.85 (THI=17) to 0.55 (THI=75). This decrease could be explained by the decrease of DMI under HS which could be balanced by the buffering effect of body tissue mobilization. Combining these novel results with known effects of HS on body fat mobilization might help to disentangle complex relationships between mobilization and intake under HS; this being also an important issue in assessing well-being of dairy cattle and their resilience potential to HS.