BRITISH MASTITIS CONFERENCE

2017

Organised by

The Dairy Group

Topics:

- Mastitis management on AMS
- Milk buyers needs v sustainable dairying
- Research updates
- Liner development work
- Vaccine development for mastitis control
- Mastitis case study

Wednesday 15th November 2017

Ricoh Lounge, Worcester Rugby Club, Sixways Stadium, Warriors Way, Worcester, Worcestershire WR3 8ZE

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GENERAL INFORMATION

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General information

CHAIRMAN'S INTRODUCTION

Welcome to the 2017 British Mastitis Conference.

The Organising Committee has worked hard since last year's conference to bring together a group of speakers, both international and home grown, that we believe will prove thought provoking and stimulating presentations. We have strived to balance the latest research with practical presentations and clear take home messages.

Our first paper looks at mastitis management on automatic milking system farms. This is followed by a paper on the conundrum of matching the needs of the milk buyers with the needs of farmers requiring a sustainable and profitable dairy business.

Building on the previous success, and endorsement by delegates, we have selected four posters from the Knowledge Transfer section for oral presentation. The four papers are followed by an opportunity for delegates to debate with the presenters.

After lunch, we will turn our attention to the latest work in liner development and its implications on teat health and mastitis. This will be followed by a paper on vaccine development in mastitis control. The conference will be closed with a practical look at a mastitis control case study.

This year sees another excellent selection of high quality poster submissions. I would urge you all to make time to review the posters and speak with the authors. Each year the presenters put a great deal of effort into providing the abstracts and preparing and presenting their posters.

We endeavour to find you the best speakers with the most relevant (and latest) information. This is only achievable thanks to all our generous sponsors, with a record eleven supporting the conference. This year our sponsors are: Vetoquinol (Platinum), Ubrocare (Gold), Zoetis (Silver), Milkrite InterPuls (Silver), CID Lines (Silver), ADF Milking (Silver), Venkteshwara Hatcheries (Silver), Ambic (Bronze), Norbrook (Bronze), Kilco (Bronze), Progiene (Poster Competition).

As always, the event could not happen without able administration, provided by Karen Hobbs and Anne Sealey at *The* Dairy Group.

Finally, thank you for attending and supporting the conference. I trust you will have an enjoyable and worthwhile day and we hope to see you at our 30th BMC in 2018.

Ian Ohnstad, British Mastitis Conference Chairman, *The* Dairy Group

TIMETABLE of EVENTS

09:00	**ARRIVE / REGISTRATION / COFFEE and POSTER DISPLAY**	
09:45	**CHAIRMAN'S INTRODUCTION**	**Ian Ohnstad** *The* Dairy Group, UK
	Session One	**Brian Pocknee** DHC, UK
09:55	Mastitis Management on AMS farms.	**Torben Bennedsgaard** Cattle Veterinarians Himmerland, Denmark
10:25	Milk buyers needs v sustainable dairy business needs. The conundrum.	**Ian Powell** *The* Dairy Group, UK
10.55	Questions and Discussion	
11:10	**COFFEE and POSTERS**	
	Research updates (also presented as posters)	**Brian Pocknee** DHC, UK
11:40	A retrospective study evaluating the efficacy of Cloxacillin in lowering intramammary infections during the dry period in order to reduce bovine mastitis incidence	**Rebecca Callaway** Hartpury College, UK
12.00	Mastitis pathogens and antibiotic sensitivities from Vale Laboratory isolates 2014 - 2016	**Andy Biggs** The Vale Veterinary Group, UK
12:20	Is STAT3 a future therapeutic target in ovine and bovine mastitis?	**Katherine Hughes** University of Cambridge, UK
12:40	Characterisation and typing of mastitis causing *Staphylococcus aureus* in Indian subcontinent: Search for a vaccine candidate	**Vinayak Brahmakshatriya** Ventri Biologicals, India
13:00	**LUNCH and POSTERS**	
14:10	**WELCOME BACK AND VOTING ON POSTERS**	
	Session Three	**Elizabeth Berry** BCVA, UK
14.15	Liner development work – effect of pulsation rest phase duration on teat end congestion	**John Upton** TEAGASC, Ireland
14.45	Vaccine Development in mastitis control	**Ricardo Tassi** Moredun Research Institute, UK
15.15	Implementation of the AHDB Dairy Mastitis Control Plan to reduce clinical mastitis rate and antibiotic use in a large dairy herd	**James Breen** Orchard Veterinary Group, UK **Nigel Jones** Nanch Goch, UK
15.45	Questions and Discussion	
16:00	**POSTER AWARD and CLOSE**	
16:05	**TEA and DEPART**	

Titles of Papers and Presenters

Scientific programme

Titles of Posters and Authors

Poster abstracts – presented at the Technology Transfer Session
(presenting author underlined):

Titles of Posters and Authors - continued

Poster abstracts – also as an oral presentation in the Research Updates session

(presenting author underlined)

FURTHER INFORMATION

Organised by *The* Dairy Group, BCVA, QMMS and University of Nottingham

The Dairy Group

Organising Committee

Chairman: Ian Ohnstad
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A global organization for mastitis control and milk quality

National Mastitis Council is a professional organization that promotes research and provides information to the dairy industry to help reduce mastitis and enhance milk quality. For more than 50 years, NMC has distinguished itself internationally as a leader in meeting those objectives.

What does NMC do?

- Provides a forum for the global exchange of information on mastitis and milk quality
- Publishes educational materials, including books and brochures
- Establishes guidelines for mastitis control and milking management practices
- Monitors technological and regulatory developments relating to udder health, milk quality and milk safety
- Conducts meetings and workshops, providing educational opportunities for all segments of the dairy industry
- Funds the NMC Scholars program

Who are the members of NMC?

NMC membership is comprised of people from more than 40 countries, representing a wide range of dairy professionals who share an interest in milk quality and mastitis control. These people include veterinarians, milk quality consultants, dairy producers, university researchers and extension specialists, milk procurement field staff, equipment and supply representatives, regulatory officials and students.

What can NMC do for you?

The continued pressure to ensure milk safety and improve milk quality, as well as the need to increase production efficiency, requires greater team effort among producers, veterinarians and other dairy professionals. Each team member plays a key role in developing successful mastitis control programs. NMC can serve as your resource for information related to udder health, milking management, milk quality and milk safety.

Why join NMC?

- To receive the latest technical and applied information on udder health, milking management and milk quality
- To provide leadership on milk quality issues within the industry
- To participate and learn about mastitis and milk quality developments at NMC meetings
- To establish valuable industry contacts
- To support education and research efforts that help raise awareness and understanding of milk quality issues

NMC membership benefits

- NMC annual meeting and regional meeting proceedings, which contain all of the papers and posters presented at the meetings
- The NMC electronic newsletter addresses the latest information on udder health, milking management and milk quality
- Access to the "members-only" section of the NMC website, which includes the NMC Proceedings Library, NMC newsletter archives and NMC membership directory
- Opportunities to network with other dairy professionals concerned with milk quality, udder health and mastitis prevention, control and treatment

Working together

Since 1961, NMC has coordinated research and educational efforts to help control the losses associated with mastitis. By bringing together all
segments of the industry, a strong and successful organization has been created to enhance the quality of milk and dairy products. NMC welcomes your active participation and support. Please visit the NMC website for additional information and resources.

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MASTITIS MANAGEMENT ON AMS FARMS

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SUMMARY

Mastitis control on AMS farms represents a different challenge compared to herds with milking parlours. Understanding the consequences of different settings of cow preparation, milking and post milking treatment and monitoring the reliability of the individual milking robots and the workers ability to monitor the robots is essential for solving problems that may build up slowly or arise suddenly.

Differences in the technology between the AMS brands and models mean that farms with different models seem to have different types of mastitis problems. In Denmark, at the moment herds with Lely AMS have more problems with spread of Streptococcus agalactiae whereas herds with DeLaval VMS experience more problems with different species of Staphylococci than the Lely herds. In both cases the problems seem to be related to problems that can be solved if the farmer understands the underlying causes of the disease spread and implement systematic procedures.

Systematic evaluation of the function of each robots on different types of cows and microbiological evaluation of the cleanliness at critical control points will often reveal the causes of spread of mastitis pathogens, high bulk tank SCC or even high bulk tank total bacteria count. Also the cleanliness of the udders and teats play a role.

When evaluating test day SCC or bacteriological results of test day samples the risk of carry over between cows is a bigger challenge in AMS due to short comings in the sampling equipment of the different AMS.

INTRODUCTION

In the AMS each robot is milking 50-70 cows 2-3 times per day. With more robots in the same group even more cows may visit the same robot. Even with 2-3 daily cleaning cycles of the robots bacteria from an infected cow will have better changes to spread compared to conventional milking parlours where each cluster will often only milk 10-20 cows between cleaning cycles.

Different parts of the robot apart from the cluster like the surroundings of the brushes on Lely and Merlin robots, the arm with the laser or the sides of the washing cup on DeLaval VMS will also touch the teats and udder. These parts are not washed automatically, but can be a source for growth or

spread of pathogenic bacteria if the manual cleaning procedures are not sufficient.

ASSESSING THE MILKING PROCESS

It is important to take the time to look at the full preparation, milking and post-milking procedures to locate problems in the herds. Often problems might differ between individual robots.

Critical control points:

Cleaning of teats

- Do all teats get cleaned?
- Do the brushes wash the teats or also the udder?
- Do the teats get cleaned once or twice (AMS setting)
- What part of the robot touches the udder during cleaning
- Cleanliness of parts touching the udder
- Are the teats clean after cleaning?

Attachment of milking cluster

- How long time does it take the robot to find the teats
- Do milking cups always get attached to the right quarters or eventually to other parts of the udder or dirt hanging from the udder
- Do the udders have long hair coat hiding the teats
- How does the cows react to the attachment

Post milking treatment of the teats

- Is teat spraying performed?
- Does the teat spray hit the teats in sufficient amount (video filming and/or post milking check)
- Is the spraying laser guided?

Automatic cleaning between cows

- Do the brushes and their surroundings get disinfected between cows? (amount and concentration, Sampling for microbiology)
- Is the washing cup cleaned and disinfected? (Sampling for microbiology)
- Do milking cups get flushed and/or disinfected? (Sampling)

EVALUATION OF AUTOMATIC AND MANUAL CLEANING

If the manual cleaning of the robots are inadequate biofilms may form at different places on the robots. It is important to check hard to reach areas that come in contact with the clusters or the udder like the underside of the plastic covering for the clusters on Lely robots or the rubber band where the clusters are hanging between milkings on the DeLaval VMS. Again, taking swabs for microbiological culture can both help in localizing problems and have an educational effect.

The manual cleaning is best performed using an alkaline soap placed on the robots as foam and removed by water and brush after wards. Lely specifically wars against cleaning the brush with high pressure water because the hairs on the brushes might be split or removed else.

Lely also advice to change the brushes daily and place the used pair in disinfecting solution for 24 hours.

CHANGES IN CHEMICALS

Due to high prices of the chemicals for cleaning, disinfecting at teat spraying sold by the AMS companies farmers often choose other products. It is important to check if these products work properly. Especially teat sprays have different viscosity and both amount and pressure need to be changed after a change of product. This is often not done!

Another problem is that the different chemicals need to be replenished before they run dry. Just a short period without teat spray of disinfectants for the brushes or washing cup can often be seen as rising SCC and TBC in the bulk tank and more mastitis cases. Good SOPs are crucial in this area.

In Denmark most DeLaval VMS farms have installed the PerAdis system for disinfection of the washing cups and milking clusters. It is important to check the cups and clusters for microbiological growth to see if the dosing is correct. Proper dosing results in nearly sterile swaps. No or to low dosing is often seen as massive growth of Coagulase Negative Staphylococci.
In the Lely AMS it is possible to have the milking clusters cleaned with steam. The system is very effective when if works. In Denmark it is my experience that many farmers give up on the steam system due to high maintenance costs, probably due to the high calcium level in Danish water sources.

Disinfection of the brushes causes a lot of problems. Over the years Lely has developed different strategies for spraying the Astri-L solution. The most important part is that both brushes AND the attached black surfaces are sprayed with a proper amount of disinfectant. That means that a single nozzle, as seen on older AMS, is not enough. Double or triple nozzles can be installed and does a far better job.

CONTROLLING SPREAD OF BACTERIA

Proper cleaning and disinfection procedures in the robots, performed without drop outs for even short periods, can really reduce spread of bacteria to a level comparable to a well-managed herd with milking parlour. However, as in parlour herds, to really control contagious mastitis like *Staph.* aureus or *Streptococcus* agalactiae segregation of infected cows is the best way of controlling disease spread.

This causes problems in AMS herds since each milking unit needs to milk 50-70 cows to be cost-effective. When planning new AMS farms it is relevant to either plan to have a group for heifers and/or a single robot group for cows with high SCC and culling cows. When trying to get the mastitis situation under control in a herd with serious problems with contagious mastitis it might be necessary to establish a group of infected cows for a period of time. Even if it requires compromises on feeding or milking efficiency for a period of time.

When evaluating test day results it is important to know that the carry-over in the milking equipment between cows is bigger in AMS. The carry-over can be reduced be specific settings in the robots, but at the cost of more free fatty acids in the milk due to more pumping. The carry over results in more cows with acutely elevated cell counts and more cows "curing" for an acute elevated cell count - both due to false positive cell counts above the chosen SCC threshold. The problem is of course biggest if low and high cell count cows are milked by the same robot.

ACKNOWLEDGEMENTS

Much of my knowledge on mastitis management in AMS has been collected during research projects at University of Aarhus.

NOTES

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MILK BUYER NEEDS V SUSTAINABLE DAIRY BUSINESS NEEDS. THE CONUNDRUM

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SUMMARY

Buyers and sellers need each other in a market economy and both need to operate sustainable businesses. Milk is the single biggest cost to a milk processor and to be a sustainable business it can only pay a competitive price for the milk. The milk buyer communicates to the dairy farmer their requirement through the milk payment schedule, which sets out the price paid for various parameters. The types of milk contract available to a dairy farmer fall in to the supermarket aligned and the non-aligned sectors, with the aligned price significantly above the UK average milk price. A sustainable dairy farm business needs to generate sufficient profit to meet the needs of the business. Whilst the average cost of production has reduced over the past 3 years, the profit has decreased. The conundrum for the milk buyer and the dairy farmer is the milk price going forward, with the dairy farmer particularly exposed to milk price volatility. Whilst Brexit will present new challenges, they are unlikely to be anything worse than has been experienced by dairy farmers in the past 2 years.

INRODUCTION

The UK dairy market was de-regulated in 1994, following the winding up of the Milk Marketing Board, and whilst there have been significant changes in the relationship between buyers and sellers (e.g. supermarket aligned contracts), for many farmers there has been little change at all (discretionary pricing with one months' notice). Buyers and sellers need each other in a market economy and both need to operate sustainable businesses, so in that sense there is no conundrum. The key difference is between the number of milk buyers and the number of sellers. There are approximately 200 buyers (mainly processors and some brokers) of milk and approximately 10,000 sellers (dairy farmers).

MILK BUYER NEEDS

Milk is the single biggest cost to a milk processor and to be a sustainable business it can only pay a competitive price for the milk, which enables the buyer to compete in the market place and to generate a satisfactory profit margin, typically around 5%. The dairy market is a highly competitive global market, but with a very small amount of milk actually traded. The needs of the milk buyer are translated in to a milk price in the payment schedule,

which describes in detail how the milk price will be paid. There is an enormous variation in the components of the milk price, which can be broadly split in to the market sectors. The UK dairy market is approximately 14 billion litres of whole milk, with approximately 50% going in to liquid milk, 25% into cheese, 15% in to other fresh dairy products (yogurt, fresh desserts, etc.) and 10% in to 'commodity' butter and powder. The liquid buyer mainly pays for volume, with some payment for fat and usually little or no payment for protein. The cheese buyer will pay a high price for fat and protein and little or nil for volume. Table 1 shows the actual payments for a range of milk buyers.

Table 1. Milk buyer payments Oct17: standard litre: 4% fat, 3.3% protein, 30 Bactoscan, 150,000 SCC

Buyer	**Arla manu**	**Muller Direct**	**Barber**	**Dairy Crest**
Sector	**Manufacture**	**Liquid**	**Cheese**	**Cheese**
Base p/litre	0	30	1.5	5.392
Fat p/1%	3.396	2.5	3.088	2.268
Protein p/1%	4.754	0	4.768	2.778
Basic milk price p/litre	28.17	30	29.586	23.63
Total price p/litre	30.62	30	31.59	29.62
% basic	92%	100%	94%	80%

In addition to the component payments for milk there will be penalties/bonuses for milk hygienic quality (bactoscan & somatic cell count). There will be a variety of payments (penalties and or bonuses) to do with volume/transport, pattern of supply (spring milk is generally worth less than autumn milk), level of supply and accuracy of supply.

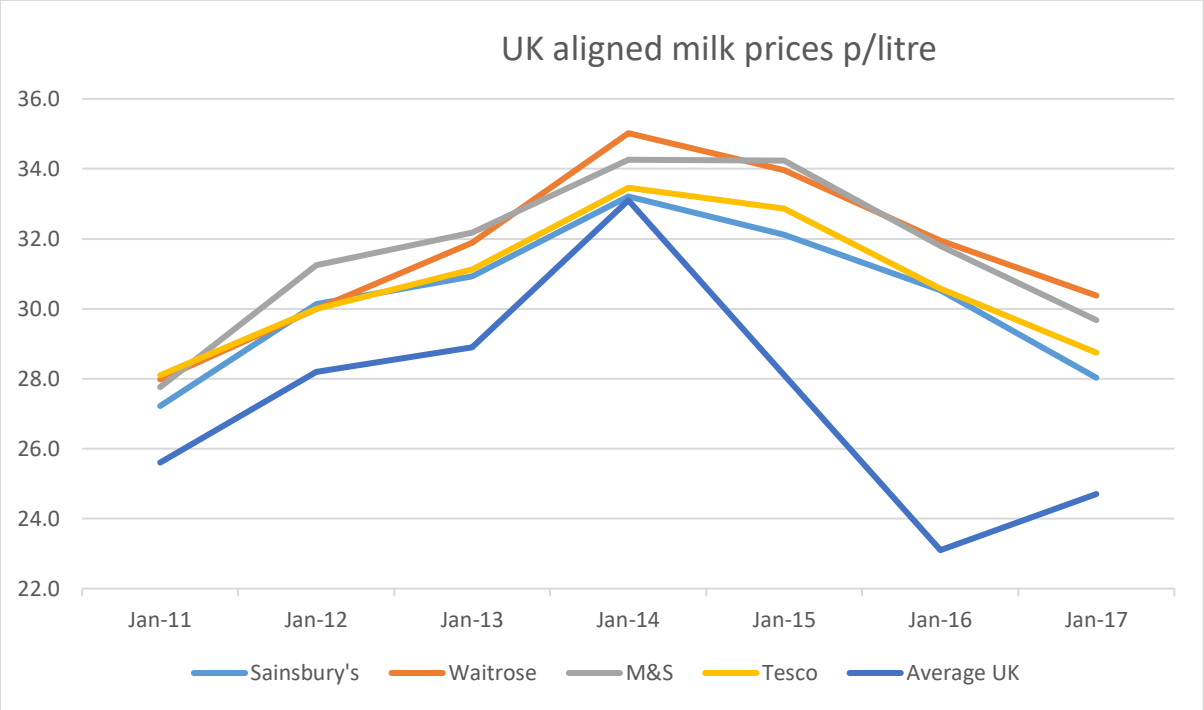
We also need to recognise the type of businesses buying milk in the UK. The vast majority are companies which are either privately or publicly owned, with one of the biggest owned by a private individual Theo Muller. There are two farmer owned co-operatives in the UK, with the largest being Arla (approximately 3,000 UK dairy farmers) and First Milk (approximately 800 UK farmers). Arla is a pan European co-op with around 12,000 dairy farmers.

The other major market distinction is between supermarket 'aligned' milk suppliers and the so called 'non-aligned'. The 'aligned' farmers supply milk to major supermarkets including Sainsbury's, Tesco, Waitrose and Marks and Spencer. More recently Arla have an aligned supply to Morrisons. The aligned arrangement has been around for at least 14 years and started with Dairy Crest supplies to Marks and Spencer and Waitrose, followed a few years later by Sainsbury's and Tesco. They all have above average standards for health and welfare and Sainsbury's and Tesco have 'cost tracking'

elements to their payment system. Table 2 compares the 'aligned' 12 rolling milk price as reported by milkprices.com for the 7 years to May 2017.

Table 2. Milkprices.com : 12 month rolling milk price (1ml, eodc)

	May-11	May-12	May-13	May-14	May-15	May-16	May-17	Average
Sainsbury's	27.2	30.1	30.9	33.2	32.1	30.5	28.0	30.3
Waitrose	28.0	30.0	31.9	35.0	34.0	32.0	30.4	31.6
M&S	27.8	31.2	32.2	34.3	34.2	31.8	29.7	31.6
Tesco	28.1	30.0	31.1	33.5	32.9	30.6	28.8	30.7
Average UK	25.6	28.2	28.9	33.1	28.1	23.1	24.7	27.4
Average	27.8	30.3	31.5	34.0	33.3	31.2	29.2	31.0



On average the 'aligned' milk price was +3.3ppl above the UK average and during the last 2 years of poor UK average milk prices they paid 5.8ppl above the UK average. Clearly, these 'aligned' milk contracts are highly valued and especially in a market down turn.

The most recent development in the UK is the fixed forward milk price. The most significant is from Muller who launched a web portal from 1st October 2017, which allows their 700 'direct' suppliers to trade in multiples of 120,000 litres per annum for up to 12 months ahead. Another milk buyer, Crediton Dairies, is offering a much simpler fixed price of 28ppl for 2 years from 1st October 2017, for a minimum of 10% of annual milk supply. Ireland has been offering fixed price schemes since 2011, with Glanbia reporting that 20% of their milk supply is from fixed price schemes with 50% of their

suppliers fixing around 30% of their milk. Fixed price schemes should provide the opportunity to provide greater price stability, although at an 'insurance' cost to the milk producer.

SUSTAINABLE DAIRY BUSINESS NEEDS

A sustainable dairy business is like any other business and needs to generate sufficient profit to meet the needs of the business, including living expenses, tax, debt repayment, investment and pension provision. Dairy businesses are normally operated as either sole trader, a partnership, a private limited company and occasionally a LLP (limited liability partnership). The point being that for sole-traders and partnerships there are no wages paid to the sole trader or to the partners, which means the profit has to cover their labour input. There will be a wide range in what level of profit a business needs and often we are more concerned about the cash needs and the peak borrowing requirement. In the recent down turn cash became critical, with many farmers running up against their overdraft limit and delaying the payment of invoices. There are some wider issues in relation to sustaining a business other than profit and a key one for the dairy sector is succession and availability of skilled staff. With recent low profits there may be less willingness for the next generation to continue with the dairy operation and with Brexit there may be an increased labour supply issue, with many larger units relying on eastern European labour.

The Dairy Group has for many years examined the cost of milk production primarily to benchmark performance, but to also provide an independent measure of dairy profitability. Table 3 provides the average cost of production for the 3 years ending March 2017 based on actual accounts data for specialist dairy farms.

Whilst the average cost of production has reduced from 33.3ppl in 2014/15 to 29.8ppl in 2016/17, the profit after unpaid family wages has decreased from 0ppl in 2014/15 to -4.3ppl in 2016/17, due to the fall in milk price. There is also a huge range in cost of production of 13ppl from 25ppl to 38ppl, with the top 25% around 27ppl. The low and negative profits should not be sustainable, but surprisingly the exit rate from dairying has reduced from around 4% to 1.5% per annum. There are around 10,000 dairy farmers in the UK and I don't pretend to understand the dynamics of decision making, but cost of production is clearly not the only factor. Most farm businesses do have other sources of income from subsidy, countryside stewardship, rental income, solar/wind and other sources, which provide a cross subsidy to the dairy operation. A key business factor will be cash flow, so these family businesses will often reduce drawings and delay machinery replacement, which enables them to continue operating in a down turn.

Table 3. The Dairy Group: Cost of milk production analysis

Year end	**2014/15**	**2015/16**	**2016/17**
	AVERAGE	**AVERAGE**	**AVERAGE**
Cows	236	200	202
Yield	7980	8101	7909
Milk sales	1,885,471	1,662,271	1691885
Dairy costs	**ppl**	**ppl**	**ppl**
Milk sales	30.7	24.7	22.9
Livestock sales	2.7	2.8	2.8
Valuation change	-0.1	-0.5	-0.2
Total output	**33.3**	**27.0**	**25.5**
Feed	9.7	8.2	8.0
Forage	2.1	1.7	1.4
Vet & med	1.3	1.2	1.2
AI/recording	0.5	0.5	0.5
Sundries	1.7	1.9	1.8
Total Variable Costs	**15.3**	**13.5**	**13.0**
Gross Margin	**17.9**	**13.5**	**12.4**
Wages paid	2.4	2.3	2.1
Power & Mach	7.1	6.5	6.3
Property costs	1.2	1.0	2.0
Administration	1.7	1.7	1.0
Rent & finance	2.6	2.2	2.3
Total overhead costs	**14.9**	**13.7**	**13.6**
Profit before unpaid wages	**3.0**	**-0.2**	**-1.2**
Unpaid family wages	3.0	2.9	3.1
Profit after unpaid wages	**0.0**	**-3.1**	**-4.3**
Total costs	**33.3**	**30.1**	**29.8**

THE CONUNDRUM

A conundrum for the milk buyer and the dairy farmer is what will be the milk price going forward. I would argue that it is a greater conundrum for the dairy farmer as the milk buyer has the ability to reduce the milk price they pay in order to maintain their operating profit. The dairy farmer is effectively a price taker and it is only the supermarket aligned dairy farmers which are effectively guaranteed a 'sustainable' milk price. Whilst forward milk pricing is a recent development it is currently dealing with a relatively small amount of the annual milk sales and so will have a marginal impact

on milk price. The dairy sector is exposed to world dairy markets and competition, so will have little option other than to improve efficiency and reduce cost of production. Brexit will present some new challenges, but it is unlikely to be anything worse than has been experienced in the last 2 years. The UK is a major importer of dairy products, which also tend to have high tariff levels, so the potential from a weaker Pound and any form of import tariffs would be beneficial to milk price.

NOTES

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A RETROSPECTIVE STUDY EVALUATING THE EFFICACY OF CLOXACILLIN IN LOWERING INTRAMAMMARY INFECTIONS DURING THE DRY PERIOD IN ORDER TO REDUCE BOVINE MASTITIS INCIDENCE

R. L. Callaway and P. Watson
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Cloxacillin is a penicillinase-resistant penicillin, which primarily targets strains of *staphylococcus* that produce β-lactamase (1). Cloxacillin was first used to reduce intramammary infections in dairy herds in 1980 (2) however, despite its continual use, studies disagree with its efficacy. Whilst some studies identified the success of Cloxacillin in reducing intramammary infections (3,4), others determined Cloxacillin was ineffective in lowering somatic cell count (SCC) (5). The lack of consistent literature does not assist in concluding an informed decision on which antibiotic to use at the time of dry off.

In a retrospective study the efficacy of Cloxacillin in reducing intramammary infections during the dry period was evaluated. Cows from Hartpury Home Farm (n = 60) were recruited with a strict criteria determined by their lactation number and somatic cell count (SCC) before dry off (group 1 = SCC <200,000 cells/mL, group 2 = SCC >200,000 cells/mL). Group 1 (n = 30) received OrbeSeal™ teat sealant whereas group 2 (n = 30) received Orbenin Extra™ which contained Cloxacillin as the active ingredient in addition to OrbeSeal™. Both treatments where administered at dry off with follow up SCC being measured monthly for three months post calving.

Kolmogorov Simonov test was used in order to determine normality which was found to be non-parametric. Mann Whitney U tests were carried out in order to determine significant differences between the SCC before dry off and after calving between the two groups. Finally, the Kruskal Wallis test was used to determine significant difference in SCC across lactation numbers.

The results suggest that Cloxacillin is effective in reducing intramammary infections during the dry period irrespective of parity status. With a significant decrease between the SCC before dry off and after calving in group 1 (P= 0.002) and group 2 (P = <0.01). In addition, no significant difference between the SCC after calving between the two groups (P = 0.174). This indicated that both the Orbenin Extra™ and OrbeSeal™ enabled cows to have a similar SCC after the dry period, despite cows receiving Orbenin Extra™ being dried off with a significantly higher SCC. Overall the results suggest that the combination of OrbeSeal™ and Orbenin Extra™ was effective in lowering high SCC during the dry period to acceptable levels (<200,000 SCC cells/mL) which was similar to those who had a lower SCC and received no treatment other than OrbeSeal™.

Factors such as milk yield and the identification of the causal pathogens were not evaluated. Therefore, future research would benefit from evaluating the efficacy of Cloxacillin with respect of the factors not considered within this study. In respect of long-term benefits, new antimicrobial drugs are required in order to ease the burden of antibiotic resistance. Due to the retrospective nature of this study, the procedure of dry off was not observed. Although hygienic practice is standard protocol, the procedure may not have been adhered to, thus promoting infection into the mammary gland and affecting the results of the study.

The primary conclusion is that Cloxacillin is an effective antibiotic in reducing the incidence of mastitis, which will ultimately increase cattle welfare in addition to minimising production losses in the dairy industry.

ACKNOWLEDGEMENT

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NOTES

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MASTITIS PATHOGENS AND ANTIBIOTIC SENSITIVITIES FROM VALE LABORATORY ISOLATES 2014 - 2016

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INTRODUCTION

Mastitis remains an extremely important endemic disease on UK dairy farms. In recent years there has been a shift in causal pathogens from those that behave in a predominantly contagious manner, to an increasing proportion caused by environmental pathogens such as *E. coli* and *S. uberis.*

MATERIAL AND METHODS

Milk samples were submitted to The Vale Veterinary Laboratory and a standardized protocol based on NMC guidelines for culture was followed. Where 3 or more isolates were recovered, the sample was considered contaminated, but *S. aureus* was recorded if cultured. An antibiogram was performed, where requested, on pathogens isolated using Kirby Bauer disc diffusion method.

RESULTS

Mastitis bacteriology results were collated from 15,194 samples submitted to Vale Laboratories from 2014 to 2016. Within this dataset, there were 2812 Boehringer-Ingelheim (BI) sponsored samples. In total, 58% of samples were from cases of clinical mastitis and 42% from high somatic cell counts.

The most commonly isolated organisms were *S. uberis (31.1%), E. coli (23%)* , coagulase-negative staphylococci (CNS) (10.8%) and *S. aureus (*7.5%). For clinical cases, 66.2% were Gram positive and 33.8% Gram negative. For high SCC samples the percentage of Gram positive isolates was higher - 78.6% with 21.4% Gram negative.

Antibiograms were performed on 15.9% (2417) of the submissions. Isolates were classed as sensitive, intermediate or resistant. The antibiotic sensitivity patterns are shown in Table 1.

The majority of *S. uberis* isolates were sensitive to antimicrobials routinely used to treat mastitis with the exception of neomycin (62.3% sensitive) and to a lesser extent novobiocin (89.1% sensitive). Only 2 (0.2%) isolates showed intermediate sensitivity to penicillin and none were resistant.

Most isolates of *S. aureus* were sensitive to penicillin (95%). Only 9 (4.0%) had intermediate sensitivity and 2 (0.9%) isolates were resistant.

E.coli was the second most commonly identified pathogen. The antibiogram results show that there is more antimicrobial resistance to the common antimicrobials used in mastitis treatment. This included resistance to ampicillin with 58% sensitive (10% intermediate, 31% resistant) and amoxicillin/ clavulanic acid with 75% sensitive (11% intermediate 14% resistant).

SUMMARY AND DISCUSSION

The most commonly isolated pathogens in this study were *S. uberis* and *E. coli*, a finding common to various recent UK studies [1]. These results highlight the importance of the environmental pathogens in UK mastitis – both clinical and sub-clinical.

The mastitis organisms were generally sensitive to routinely used antibiotics. However, the variation in resistance patterns between organisms is typical of those reported nationally with resistance to ampicillin, amoxycillin / clavulanic acid and neomycin [2].

In vitro penicillin resistance was extremely uncommon for *S. uberis* and few *S. aureus* isolates showed resistance. These findings support the use of first line antibiotics for treatment of mastitis cases and that resorting to critically important antibiotics is not only not needed but could be considered irresponsible use of antimicrobials.

Table 1. Frequency of susceptibility of *S. uberis*, *E. coli* and *S. aureus* to antibiotics

	S uberis % Resistant N= 1007		E coli % Resistant N= 829		S aureus % Resistant N=224	
	Intermediate	Resistant	Intermediate	Resistant	Intermediate	Resistant
P	0.2%	0.0%			4.0%	0.9%
AMP	0.0%	0.2%	10.4%	31.1%	3.6%	1.3%
AMC	0.0%	0.1%	11.1%	14.1%	0.9%	0.0%
N	2.2%	35.5%	5.8%	0.7%	1.3%	0.0%
NV	9.8%	1.1%			0.9%	1.3%
OB	1.8%	4.0%				
TY	2.5%	1.2%			0.0%	0.9%
CEQ	0.8%	0.2%	1.2%	1.4%		
OT			4.1%	14. 0%		
SH			4.7%	13.1%		
SXT			4.0%	13.5%		

Cloxacillin [OB], Ampicillin [AMP], Amoxycillin/Clavulanic acid [AMC], Penicillin [P], Neomycin [N], Novobiocin [NV], Cefquinome [CEQ], Co-trimoxazole [SXT], Oxytetracycline [OT], Spectinomycin [SH], Tylosin [TY], Cefapirin [CPR]

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IS STAT3 A FUTURE THERAPEUTIC TARGET IN OVINE AND BOVINE MASTITIS?

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SUMMARY

The Signal Transducers and Activators of Transcription (or STAT) family are factors that coordinate mammary gland development. Importantly, STAT3 coordinates glandular regression at the end of lactation (involution). We have previously demonstrated, using a murine model, that during involution, mammary epithelial STAT3 activity appears to polarize macrophages towards an immunosuppressive "alternatively activated" phenotype.

A subset of ewes and cows with mastitis exhibit epithelial pSTAT3 expression, in addition to expression of the transcription factor in cells with morphology consistent with infiltrating immune cells. We hypothesise that an immunomodulatory mammary microenvironment may accompany cases of mastitis associated with pSTAT3 expression. This may mirror the changes observed in association with STAT3 activity in mouse models of involution and mammary tumourigenesis. Proving or disproving this hypothesis is critical as STAT3-induced alternatively activated macrophages may be potentially disadvantageous in the control and elimination of bacterial pathogens. Given the development of small molecule STAT3 inhibitors, and given the possibility that STAT3 activity may modulate the mammary microenvironment in an immunosuppressive manner in mastitis, further work is required to investigate STAT3 as a potential therapeutic target in mastitis.

INTRODUCTION

The Signal Transducers and Activators of Transcription (STAT) family are transcription factors that have a pivotal role in coordinating mammary gland development. In murine models, different STATs control the phases of the mammary cycle of epithelial proliferation and regression associated with lactation and weaning respectively (1). STATs are activated by phosphorylation so assessment of expression of phospho-STATs provides a surrogate read-out of STAT activity. The aim of this study was to characterize the expression of STATs 1, 3 and 5 in the ruminant mammary developmental cycle and in mastitis, with the overarching goal of achieving a better understanding of epithelial cell signalling in the ruminant mammary gland.

MATERIALS & METHODS

STAT expression was assessed by immunohistochemistry in tissue collected from ewes and cows *post mortem*. Western blotting was used to validate IHC results. Ovine mammary epithelial primary cell cultures were established and STAT expression was assessed following cytokine stimulation.

RESULTS

Expression of phosphorylated STAT3 (pSTAT3) and STAT5 varies with the stage of mammary developmental cycle, but with some unexpected overlap in expression profiles. Interestingly, a subset of ruminants with mastitis exhibit epithelial pSTAT3 expression, in addition to expression of the transcription factor in infiltrating immune cells. STAT3 target genes have been identified using primary cell culture. STAT1 signalling may also be important in immune cells in mastitis.

DISCUSSION AND CONCLUSIONS

Identification of STAT3 activity (pSTAT3 expression) and STAT3 target gene transcription, suggests that there may be an immunosuppressive microenvironment associated with mastitis cases in which STAT3 is the predominant STAT to be activated. This may be similar to the mammary microenviroment described in association with STAT3 activity in mouse models of involution (2) and mammary tumourigenesis. Primary ovine mammary epithelial cell culture forms a powerful, tractable, system for further analyses including investigation of STAT3 as a potential future therapeutic target.

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NOTES

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CHARACTERIZATION AND TYPING OF MASTITIS CAUSING *STAPHYLOCOCCUS. AUREUS* IN INDIAN SUBCONTINENT: SEARCH FOR A VACCINE CANDIDATE

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INTRODUCTION & SUMMARY

Staphylococcus aureus is a major pathogen associated with bovine mastitis, one of the most important infectious diseases occurring in dairy cattle herds worldwide. In the present study, a total 1991 milk samples were collected from which total 2487 different bacterial isolates ware isolated, identified, further characterized phenotypically and molecularly. 0ut of all isolates, 49 % isolates were identified as Staphylococcus species, coagulase positive staphylococcus (CPS) 599 **(30.09%)** and coagulase negative staphylococcus (CNS) 381**(19.13%).** Out of these 599 staphylococcus bacterial isolates only 48 isolates were selected which showed capsular gene "Cap5k+" type and strong biofilm producing ability and having biofilm associated genes; ICA, type Sig B, Sar A and rbf. To identify most prevalent staphylococal isolates, the selected isolates were further characterized based on protein and gene based studies, such as MALDI-TOF, Pulsed Field Gel Electrophoresis (PFGE) and MLST. Based on these studies the phylogeny was studied and potential Vaccine candidates were identified.

MATERIALS & METHODS

Isolation and Phenotypic Characterisation:

Pure colonies were grown on Nutrient agar. DNA was extracted from bacterial culture and screened for *S.aureus* by PCR. The strains positive for *S.aureus* were then screened for Capsular gene and different genes involved in Biofilm formation. The Biofilm production was also confirmed by *in vitro* tests.

In vitro Characterisation of Field Isolates:

To identify most prevalent staphylococal isolates, all Field isolates were further characterized based on protein and gene based studies, such as MALDI-TOF, Pulsed Field Gel Electrophoresis (PFGE) and MLST. Based on these studies the phylogeny was studied and potential Vaccine candidates were identified MALDI-TOF: Bacterial cultures to Microbiology Dept. Veterinary College, Udgir for identification and confirmation of the isolates sent to them. Total 198 samples of bacterial cultures sent for MALDI-TOFF testing and confirmation.

PFGE: This test was conducted at Nagpur Veterinary College for the Staphylococci isolates. At 70% cutoff, four groups were formed that covered majority of the strains.

MLST: Seven housekeeping genes (arcC, aroE, glpF, gmk, pta, tpi, yqiL) using gene specific primers. The PCR products were purified and used as amplicons for sequencing with Ion Torrent™ Next Generation Sequencing. The data obtained in the form of sequences was aligned using NCBI BLAST. The aligned sequences were then used to obtain allelic profile of each isolate on MLST database (http://www.mlst.net) followed by identification of Sequence Types. Phylogenetic tree was constructed using START software.

RESULTS & DISCUSSION

The present study conducted in the different areas of India. Total 1991 milk samples were collected from which total 2487 different bacterial isolates ware isolated, identified, which were further characterised, out of which, 49 % isolates were identified as Staphylococcus species, out of which 30.09% were coagulase positive and 19.13% coagulase negative staphylococcus (CNS)**.** Out of these 599 staphylococcus bacterial isolates only 48 isolates were selected which were positive for capsular gene Cap5k type and had a strong biofilm producing ability and had biofilm associate gene type Sig B, Sar A and rbf. And slime associated antigen complex using Tissue Culture plate method and confirmed molecularly by screening for Intra cellular adhesion (ICA) genes (ABCD).

Using PFGE Analysis we were able to identify banding pattern that was similar in 50% Isolates that were tested. Charachterization based on MLST, the phylogenetic analysis identified three sequence types ST2454, ST1993, ST2459 and five novel sequence types. The sequence type ST2454 was represented by 50% of the isolates, indicating it as a predominant group prevailing in India. Also, comparison of MLST data of *S.aureus* from different parts of the world revealed that the strains causing bovine mastitis in India are different from those causing bovine mastitis in other countries. Thus, the dominant sequence type identified in this study, ST2454 might possess great potential for development of vaccine targeting the mastitis affected bovine population of India.

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NOTES

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LINER DEVELOPMENT WORK - EFFECT OF PULSATION REST PHASE DURATION ON TEAT END CONGESTION

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SUMMARY

Analysis of milk flow from the udder is important in studying the physiological response of the animal to milking and indicating the efficiency of milk ejection. Moreover, understanding how milking machine settings influence the flow-rate of milk from the udder is important for the development of best practice parameters for their use and for appropriate sizing of milking facilities. The more accurately milk flow can be measured and analysed, the more closely the effect of milking machine settings (i.e. vacuum level, pulsation settings, liner compression) and other conditions on the physiology of the udder and teat during milking can be studied.

The objective of this study was to quantify the effect of d-phase (rest phase) duration of pulsation on the teat canal cross-sectional area during the period of peak milk flow from bovine teats. Pulsator rate and ratios were adjusted to achieve seven levels of d-phase duration: 50 ms, 100 ms, 150 ms, 175 ms, 200 ms, 250 ms and 300 ms. These seven d-phase durations were applied during one milking session and were repeated for two vacuum levels (40 kPa and 50 kPa), two b phase durations (500 ms and 700 ms) and two levels of liner overpressure (9.8 kPa and 18 kPa). We observed a significant reduction in the estimated cross-sectional area (= congestion) of the teat canal with d-phase durations of 50 ms and 100 ms when compared with d-phase durations of 150, 175, 225, 250 and 300 ms. Although there was confounding of the day effect with other effects, the magnitude of the day effect was investigated and estimated to be on the order of +/- 3% of peak milk flow rate. There was no significant interaction between the effect of d-phase duration and b-phase durations, vacuum level or liner overpressure indicating that we found no basis for applying increased d-phase durations for higher vacuum levels, longer b-phase durations or lower liner compression.

INTRODUCTION

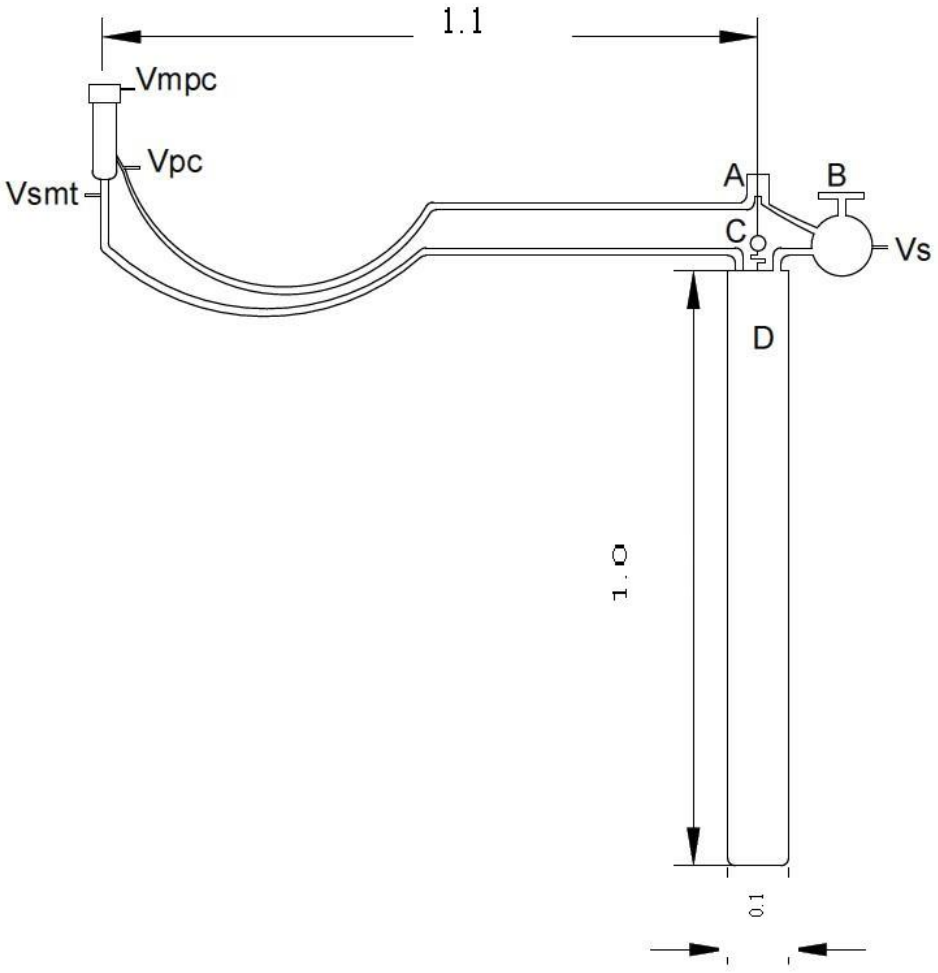
Teat-end congestion can be reduced by adequate magnitude and duration of liner compression, primarily during the d-phase of pulsation [3]. The International Standards Organisation specifies a minimum d-phase duration of 150 ms per pulsation cycle [1]. The scientific basis for this recommendation is unclear due to a lack of resolution of d-phase durations

applied in previous studies. The objective of the present study was to analyse the effect of the duration of the d-phase of pulsation on the cross-sectional area of the teat canal (CA) during the period of Peak Milk Flow-rate (PMF) from bovine teats. A secondary objective was to test if the effect of d-phase duration on teat canal cross-sectional area was influenced by milking system vacuum level, milking phase (b-phase) duration and liner overpressure.

MATERIALS AND METHODS

A quarter milking analyses device (Mi4) was used to implement the experimental treatments (Table 1). The Mi4 was used to record milk yield within each pulsation cycle (and thus flow-rate), short milk-tube vacuum (Vsmt), mouthpiece chamber vacuum (Vmpc) and pulsation chamber vacuum (Vpc) at the quarter level along with milking system vacuum (Vs) (Figure 1).

Figure 1: Diagram of one teat-cup arrangement of the Mi4. Where A = pulsator, B = vacuum regulator, C = weigh cell, D = milk collection tube. Dimensions in meters



Cow selection and experimental design

Eighteen cows were milked with the Mi4. Cows were chosen for the experiment that had a PMF period (defined as being within 80% of the maximum MF) of at least 60 seconds. Cows with less than three suitable quarters were dropped from the selection process. After these processing steps eight cows were dropped.

Table 1: Treatment description for combinations of pulsator ratio, rate, system vacuum and liner overpressure (OP)

Day	Treatment	b-phase (ms)	d-phase (ms)	Ratio (%)	Rate c/min	Vacuum-kPa	OP kPa
1	D50	500	50	0.82	85.7	40	9.8
1	D100	500	100	0.77	80.0	40	9.8
1	D150	500	150	0.72	75.0	40	9.8
1	D175	500	200	0.70	72.7	40	9.8
1	D200	500	250	0.68	70.6	40	9.8
1	D250	500	300	0.64	66.7	40	9.8
1	D300	500	350	0.61	63.2	40	9.8
2	DB50	700	50	0.86	66.7	40	9.8
2	DB100	700	100	0.82	63.2	40	9.8
2	DB150	700	150	0.78	60.0	40	9.8
2	DB175	700	200	0.76	58.5	40	9.8
2	DB200	700	250	0.74	57.1	40	9.8
2	DB250	700	300	0.70	54.5	40	9.8
2	DB300	700	350	0.67	52.2	40	9.8
3	DV50	500	50	0.82	85.7	50	9.8
3	DV100	500	100	0.77	80.0	50	9.8
3	DV150	500	150	0.72	75.0	50	9.8
3	DV175	500	200	0.70	72.7	50	9.8
3	DV200	500	250	0.68	70.6	50	9.8
3	DV250	500	300	0.64	66.7	50	9.8
3	DV300	500	350	0.61	63.2	50	9.8
4	DC50	500	50	0.82	85.7	40	18
4	DC100	500	100	0.77	80.0	40	18
4	DC150	500	150	0.72	75.0	40	18
4	DC175	500	200	0.70	72.7	40	18
4	DC200	500	250	0.68	70.6	40	18
4	DC250	500	300	0.64	66.7	40	18
4	DC300	500	350	0.61	63.2	40	18

d-phase duration

The pulsator off time was manipulated to achieve d-phase duration treatments of 50 ms, 100 ms, 150 ms, 175 ms, 200 ms, 250 ms and 300 ms. Each treatment had a minimum duration of 8 seconds and consisted of an integer number of pulsation cycles. The seven d-phase durations were applied at two vacuum levels (40 kPa and 50 kPa), two b phase durations (500ms and 700 ms) and two levels of liner over pressure (OP) (9.8 kPa and 18 kPa), over the course of 4 days as described in Table 1.

Estimating teat canal cross-sectional area

Canal area (CA) was determined from milk flow rate using the following equation:

$$CA = \alpha \times Q \times MR^{-1} \times (V_{SMTb} + 4500)^{-1/2}$$

Where:

- α is a constant for an individual teat canal and is estimated as 28.4 $(kg/m^3)^{1/2}$
- V_{SMTb} is the vacuum in the short milk tube (Pa) during the milking phase
- Q is the volumetric flow-rate (m^3/s) of milk from the teat
- MR is the milk ratio, i.e. the fraction of the pulsation cycle during which milk is flowing

For a detailed derivation of equation 1, see [2].

Statistical analysis

A mixed model procedure (Proc Mixed, SAS 9.4 Statements: Reference, Fourth Edition, SAS Institute Inc, NC, USA) was used to analyse the effect of the treatments on CA as follows:

$$CA = Day + Treatment$$

Where Day = Day (Vacuum level, b-phase duration and Liner OP), and Treatment = d-phase duration. Day, treatment, quarter and cow were declared as class variables. Quarter nested within cow was defined as a repeated measure.

RESULTS

Effect of d-phase duration on CA

The main effect of d-phase duration on CA was highly significant ($P<0.001$). The estimates of CA for each of the seven d-phase durations are presented in Table 2. The CA of the 100 ms and 50 ms d-phase durations were significantly different ($P<0.05$) than CA of the five other d-phase durations.

Effect of b-phase duration, vacuum level and liner OP on CA

The main effect of Day on CA was highly significant (P<0.001). The lack of significance of the (Day x d-phase) interaction indicates that the effect of d-phase duration was not different for the long b-phase, high vacuum or high liner OP conditions. The estimates of CA for each of the 4 Days are presented in table 3.

Table 2: Effect of d-phase duration on canal area across experimental days

d-phase (ms)	Canal area (mm^2)	SE	Letter Group[1]	Change from control 175 ms
300	3.21	0.27	A	1.5%
250	3.20	0.27	A	1.0%
200	3.21	0.27	A	1.5%
175	3.18	0.26	A	0%
150	3.17	0.26	A	0.5%
100	3.09	0.27	B	-2.3%
50	3.07	0.26	B	-3.1%

[1] d-phases with different letter groups differ significantly (P < 0.05)

Table 3: Effect of Day on canal area across all d-phase durations

Day	b-phase (ms)[1]	Vacuum (kPa)	OP (kPa)	Canal area (mm^2)	SE	Letter Group[1]
1: Control	500	40	9.8	3.16	0.27	B
2: Long b-phase	700	40	9.8	2.91	0.27	C
3: High vacuum	500	50	9.8	3.06	0.27	BC
4: High OP[2]	500	40	18	3.51	0.27	A

[1] Days with different letter groups differ significantly (P < 0.05), [2] over pressure

CONCLUSION

There was a significant reduction in CA with d-phase durations of 100 ms and 50 ms when compared with d-phase durations of 150, 175, 225, 250 and 300 ms. These results support the ISO specified minimum 150 ms d-phase duration. There was no significant interaction between the effect of d-phase duration and b-phase durations, vacuum levels or liner OP indicating that we found no basis for applying increased d-phase durations for higher vacuum levels, longer b-phase durations or lower liner compression.

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VACCINE DEVELOPMENT IN MASTITIS CONTROL: *MANNHEIMIA HAEMOLYTICA* MASTITIS VACCINATION IN SHEEP

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SUMMARY

Mastitis affects both the dairy and the meat sheep industry with losses due to reduction in milk quality and quantity, increased medical treatment costs and reduced growth of lambs. Vaccination would be therefore an important tool in the control of sheep mastitis. However, the development of vaccines against mastitis is difficult due to the inadequate knowledge of the pathogenesis and immune response occurring in the mammary gland. In order to better understand the immune host response occurring naturally during Mannheimia haemolytica mastitis in sheep we developed an intramammary challenge model. We then used this model to test whether local administration (i. e. in the mammary gland) of a vaccine originally developed against the respiratory and systemic disease caused by *Mannheimia haemolytica* confers protection against the intramammary infection. Preliminary results show that the intramammary vaccination (i. e. vaccine infused in the mammary gland) protected the ewes to the subsequent experimental infection whereas no protection was observed in the animals that received the vaccination in the udder skin. Further research is needed to ascertain if any immune memory is induced and wheatear this could be enhanced by means of a different administration protocol or the use of other adjuvants. The host response in both the unvaccinated controls and in the vaccinated animals showed an increased concentration of cytokines in milk. These include the pro-inflammatory Interleukin-1β, the anti-inflammatory Interleukin-10 and Interleukin-17A. The presence of IL-17A in milk suggests the involvement of a Th17 type response to the intramammary infection.

INTRODUCTION

Mastitis affects both the dairy and the meat/wool sheep industry. In dairy sheep, it causes loss of milk, reduction of milk quality and increased costs due to medical treatment of the affected animals. In meat and wool sheep farming the reduced quantity and quality of the milk directly affects the growth of the lambs. Moreover, mortality of ewes is observed in per acute cases. (1). The most common bacterial species associated with mastitis in sheep are *Staphylococcus aureus*, *Streptococcus uberis*, *Mannheimia haemolytica* and several coagulase negative staphylococci (CNS) species (8, 10, 11).

In dairy sheep farming, as in dairy cattle farming, control strategies aiming to reduce contamination due to the environment, correct milking practices and treatment of clinical cases, if implemented correctly reduce the impact of mastitis in the flock (5). In sheep meat production systems limited knowledge of the factors involved in the acquisition of the infection limits the options available to the farmer to culling of old or previously affected ewes, and breeding for an udder conformation that minimizes the risk of teat damage (3).

Despite many vaccines having been experimentally developed for ruminant species in the last decades, very few are available on the market. Notable examples are the vaccine against *E. coli* and *S. aureus* in cattle (2) The current research efforts focus on developing vaccines that induce not only a strong humoral immunity (i. e. mediated by antibodies) but also a strong cellular response (i.e. mediated by lymphocytes) targeting the mammary gland . To support this, recent studies suggest that the cellular response may be the key factor in clearing an intramammary infection (4, 7, 9). In order to better understand the immune response during infection with *Mannheimia haemolytica* we developed an intramammary challenge model. We then used this model to test whether local administration (i. e. in the mammary gland) of a vaccine originally developed against the respiratory and systemic disease caused by *Mannheimia haemolytica* also confers protection against the intramammary infection.

EXPERIMENT DESIGN

For the experiment, 29 lactating Scottish Mule ewes were used. The animals were approximately 1 month into lactation and free of intramammary infection. The animals were weaned and vaccinated after 24h with the commercially available vaccine Ovipast plus (MSD animal health, Milton Keynes, U.K.). This vaccine is used in the control of the respiratory disease in ewes and lambs. Aluminium hydroxide is used as the adjuvant in this vaccine formulation. The vaccine was administrated either 1) subcutaneously: in each side of the udder in the skin of the mammary gland, approximately 5 cm from the supramammary lymph node (n=10) or 2) intramammarily: in this case the vaccine was administered directly in each mammary half via a teat infusion cannula (n=10). The control group (n=9) did not receive any local vaccination.

The animals were milked once a day for 7 days, then intramammarily challenged in each mammary gland half with approximately 2000 cfu of *Mannheimia haemolytica* strain FSL Z1-008 which was isolated from a sheep mastitis case (11). The animals were euthanized 7 days after the intramammary challenge. Clinical data and milk samples for SCC and bacteriological analysis were collected daily throughout the study. All experiments were conducted at the Moredun Research Institute (Penicuik, UK) with approval of the Institute's Experiments and Ethical Review Committee in accordance with the Animals (Scientific Procedures) Act 1986.

RESULTS AND DISCUSSION

The intramammary vaccination caused an inflammatory response characterized by the increase of the SCC between 24 h and 72 h post vaccination. The SCC returned to a level comparable to the control animals by the time the intramammary challenge took place (Figure 1)

All the control animals challenged in the experiments became infected with *Mannheimia haemolytica*, developing mastitis in at least one mammary half, with 15 of the 18 mammary halves bacteriologically positive 24 h after the challenge (Figure 2). The bacterial concentration in milk reached its maximal levels of 9.7×10^6 bacteria/ml, then gradually decreased with several animals clearing the infection, resulting in 5 infected mammary halves at the end of the study (Figure 2) After the challenge SCC increased by approximately 4-fold and remained at these levels for between 24 to 72 h post challenge (Figure 3)

Figure 1 Somatic cell count

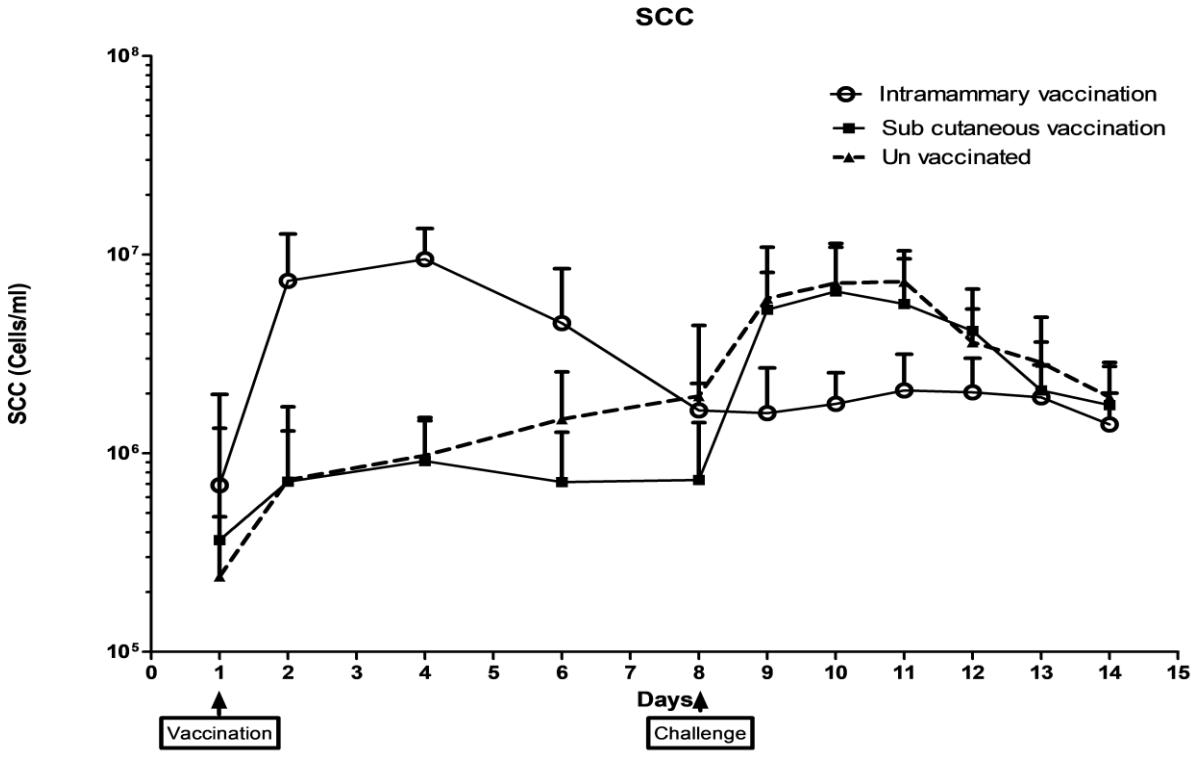


Figure 2 Percentage of the mammary bacteriologically positive after the intramammary challenge

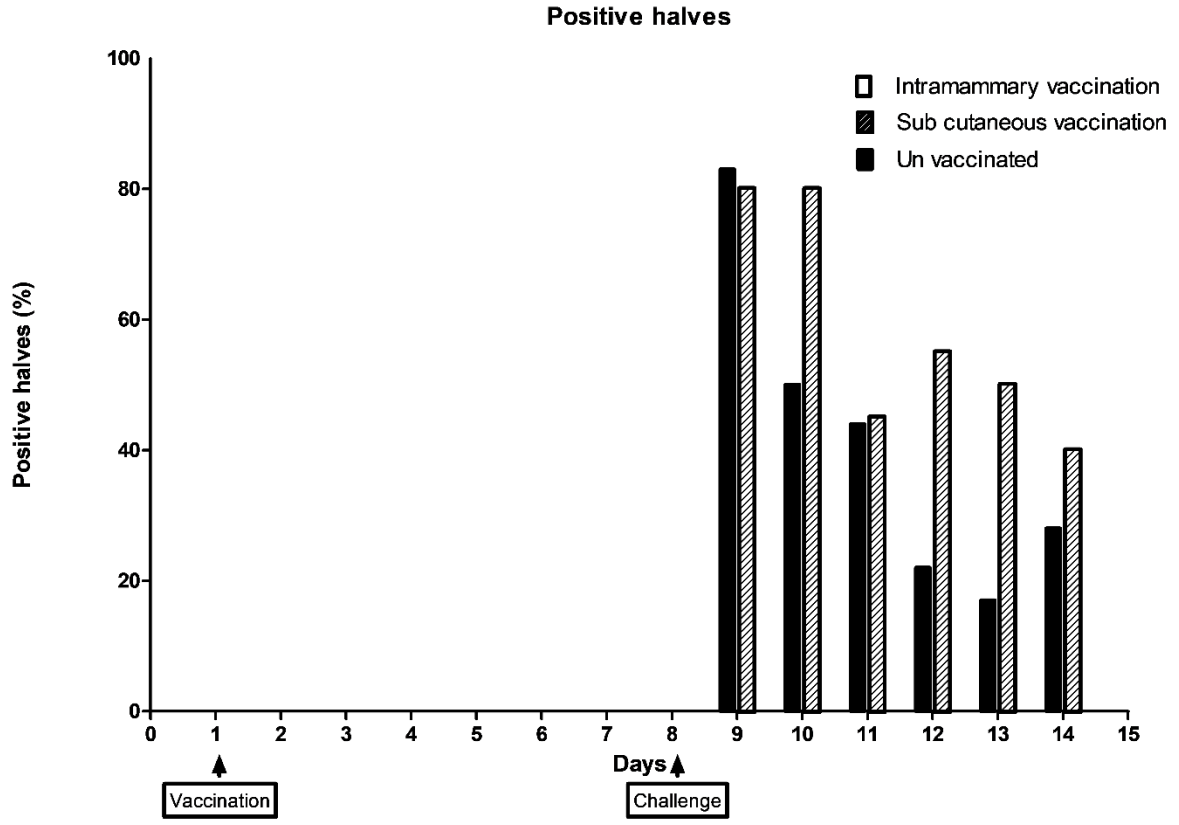
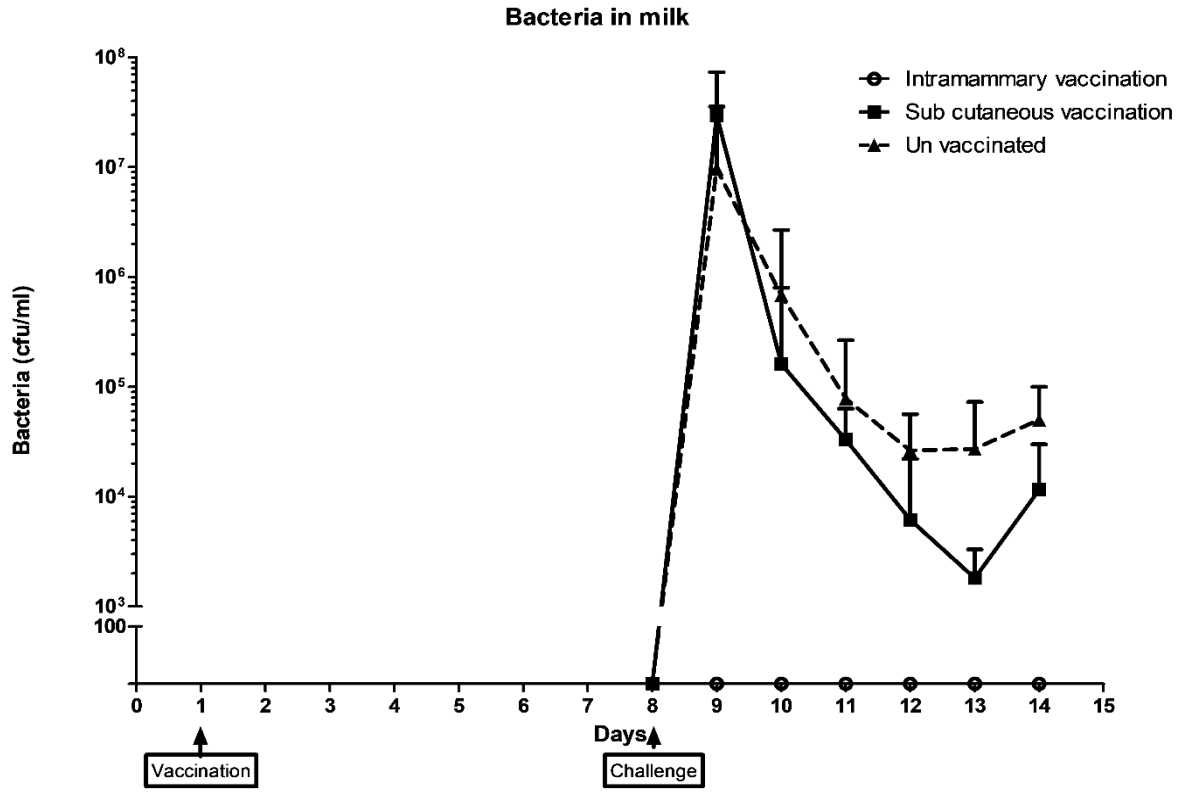


Figure 3 Concentration of *M. haemolytica* bacteria in milk



No apparent protection was observed in the animals vaccinated subcutaneously, with 16 of the 20 challenged mammary halves becoming infected. The concentration and the pattern of bacterial count and SCC were similar to those observed in the unvaccinated animals (Figure 1-3). Conversely, none of the intramammarily vaccinated animals became infected with *Mannheimia haemolytica*. For those animals, the maximal level of SCC after the challenge was observed 72 h post-challenge and was approximately 3-fold lower than that observed in the unvaccinated animals at the same time point (Figure 1-3).

These preliminary results suggest that protection against mastitis caused by *Mannheimia haemolytica* could be obtained by vaccinating lactating ewes with a *Mannheimia haemolytica* vaccine delivered intramammarily. It cannot be excluded that the relatively high SCC and the inflammatory state of the mammary gland in the animals intramammarily vaccinated could have protected the animals through nonspecific mechanisms. Further research is needed to ascertain if any immune memory is induced and wheatear this could be enhanced by means of a different administration protocol or the use of other adjuvants.

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NOTES

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The Dairy Group, The University of Nottingham, QMMS and BCVA

IMPLEMENTATION OF THE AHDB DAIRY MASTITIS CONTROL PLAN TO REDUCE CLINICAL MASTITIS RATE AND ANTIBIOTIC USE IN A LARGE DAIRY HERD

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SUMMARY

Implementation of the AHDB Dairy Mastitis Control Plan between 2014 and 2016 resulted in a decrease in the incidence rate of clinical mastitis in a large dairy herd from 60-70 cases per 100 cows/year during 2013 to less than 20 cases per 100 cows/year by the middle of 2017. Following analysis of available clinical mastitis and individual cow somatic cell count data, the herd mastitis diagnosis was one of environmental infections of predominantly dry period origin. Control measures prioritised initially included those around management of the dry cow cubicles and the calving cow loose yard, as well as drying-off technique. Following implementation of the Plan, the rate at which cows were detected with a new case of clinical mastitis during the first 30 days of lactation reduced from more than 2 in 12 cows affected at the end of 2013 to less than 1 in 12 cows affected by the end of 2016. Similarly, the rate at which cows were measured with a somatic cell count >200,000 cells/ml at the first milk recording after calving reduced from 19% of cows and heifers during 2013 to 12% at the end of 2016. Comparing the 12 months ending 2013 with the 12 months ending 2016, the total mg of antibiotic used per Population Corrected Unit (PCU) reduced from 40mg/PCU to 26mg/PCU and the average Daily Defined Dose (DDD) of antibiotic reduced from 14 to less than 7. Implementation of a structured approach to mastitis control reduces intra-mammary infections and mastitis rate and leads to a reduction in antibiotic use.

INTRODUCTION AND BACKGROUND

A national mastitis control scheme was launched in the UK in 2009 by a collaboration of the national dairy levy board (AHDB Dairy) and a team of researchers and veterinary surgeons. The launch followed publication of research that showed that implementation of a structured mastitis control plan in 26 herds reduced the proportion of cows affected with mastitis by an average of 20% in 12 months when compared to 26 herds that did not receive the same plan (1). This research became the AHDB Dairy Mastitis Control Plan (DMCP) and was rolled out to more 1000 herds between 2009 and 2012 during a period of close support from the authors of the research

and funding from AHDB Dairy. The initial progress with the scheme and some of the challenges faced have been reported elsewhere (2) and a full report of the first three years of the scheme is available online (3). Since then, this approach has continued to be used by veterinary surgeons and consultants who have been trained to deliver the DMCP, which has become recognised as a route to mastitis control by the industry, milk buyers and retailers.

In addition, as bovine mastitis is also one of the most common reasons for the use of antimicrobials in dairy cows (4), with the current political drive to reduce antimicrobials in food producing animals the prevention of mastitis on a national scale is now imperative. The UK government has set a target of 50mg/kg Population Corrected Unit (PCU) for antibiotic use in livestock and this raises questions around the current levels of antibiotic used in dairy herds and areas that contribute to this. For example, with mastitis control there is likely to be a large impact with a reduction in the use of both intramammary and parenteral antibiotic use if control of new intramammary infections in the herd is reduced.

This paper presents a recent herd example where a significant reduction in herd antibiotic use followed implementation of the national AHDB Dairy Mastitis Control Plan. In 2013, a large 600-cow dairy herd on the Shropshire-Welsh border requested assistance with mastitis control following discussions with their own veterinary surgeon and consultant. The rate of clinical mastitis was perceived to be very high, with some cases failing to cure and leading to a high rate of clinical recurrence. Whilst the unit was working hard to get the average somatic cell count (SCC) down, a large team of milking staff and variable milk quality meant a coherent approach was not being achieved. Discussions were had during several visits in 2014-15 with the aim of putting in place the DMCP and monitoring progress using on farm data.

IMPLEMENTATION OF THE PLAN: DATA ANALYSIS (2013)

Initial analysis of the on farm database containing clinical mastitis data and individual cow SCC data for 2013 is shown in Table 1. The clinical mastitis incidence rate was increased in the previous 12 months compared to the previous 12 months with no clear seasonal pattern, although the winter period 2011-12 was associated with a lower rate of clinical disease. The all case mastitis rate of more than 70 cases per 100 cows/year was heavily distorted by a small group of cows that contributed around 30% of all the cases reported; this was despite a first case cure rate approaching 50%. **More importantly, the index (new) case rate in the first 30 days of lactation (*i.e.* these cases are likely to arise as a result of dry period origin infections) had increased in the last 12 months, rising from at or below an achievable target of 1 cow affected for every 12 cows eligible to twice or even three times this target in some months (Figure 1).**

Table 1: Mastitis key performance indicators at Nant Goch (April 2013).

Parameter	Rolling 3-recording average	Rolling annual average	Target
Herd average SCC (cells/ml)	**262,000**	**248,000**	**<200,000**
% herd >200,000	**27**	**25.6**	**<20**
% herd chronic*	**18.3**	**14.4**	**<5**
Fresh calver infections	**17.9**	**19**	**<10**
Dry period cures (%)	**73.1**	**77.2**	**>85**
Dry period new infections (%)	**12.5**	**16.7**	**<10**
Lactation new infections (%)	**11**	**14**	**<5**
Cases clinical mastitis (per 100 cows/year)	**66**	**73**	**<25**
Dry period origin 1st cases (per 12 cows at risk)	**1.89**	**2.07**	**<1**
Lactating period origin 1st cases (per 12 cows at risk)	**3.08**	**4.17**	**<2**

* **Proportion of cows with more than one of the last three SCC>200,000 cells/ml**

Regarding the cell count data, the 12-month average cell count was 248,000 cells/ml, with little variation in individual herd test-days. During the initial meeting in the April of 2013, the test-day average of 277,000 cells/ml was distorted by five cows who contributed 20% of this value. Despite this, the prevalence of infection in this herd as measured by increased SCC as a proxy for major bacterial infection of the udder was too high and averaged 25% in the last 12 months. It was pointed out that whilst there were short term approaches to managing a high cell count such as individual cow treatment/drying-off and culling each month, these would **not** reduce the underlying new infection rates. **Importantly, the 'fresh calver infection rate' (*i.e.* proportion of calved cows and heifers >200,000 cells/ml at first test-day) averaged 19% in the last year (achievable target <10%) and clearly showed a significant contribution to herd SCC came from dry period infections.** Finally, the dry period new infection rate (all of the last three SCC<200,000 cells/ml before drying-off but >200,000 cells/ml at first test-day) was increased at 16.7% over the previous 12 months, with considerable variation in the last 18 tests and in maiden heifers (almost 40% of heifers calving down infected by the New Year).

Figure 1: Rate of Clinical Mastitis <30 Days in Milk (DIM) for 2013-14: This graph shows the incidence rate of new clinical cases of mastitis in cows that are less than 30 DIM (i.e. dry period origin). The bars represent the number of cows at risk each month (those between 0 and 30 days calved). The line represents the dry period origin incidence rate. The horizontal line represents a 'target' rate of 1 cow affected for every 12 eligible.

Samples submitted for bacteriology from a mixture of clinical mastitis cases and cows with an elevated SCC predominantly cultured a mixture of Gram-positive environmental and contagious major pathogens, including *Streptococcus uberis* and *Staphylococcus aureus*. The *S. aureus* isolates were phenotypically resistant to penicillin *in vitro* and as such carried a guarded prognosis for cure, even with antibiotic dry cow therapy.

In summary, both the clinical mastitis and the cell count data showed the herd situation was being heavily influenced by dry period origin infection given the rate of clinical disease in the first 30 days of lactation and the proportion of cows and maiden heifers with elevated SCC at the first test-day. Further examination of the data showed environmental disease patterns appeared to predominate (*e.g.* a good dry period cure rate despite some re-infection pressure), and whilst the prevalence of *S. aureus* may have been relatively high in this herd, spread between cows did not appear to be a significant concern from further analysis of new infection rates.

IMPLEMENTATION OF THE PLAN: OBSERVATIONS AND QUESTIONS

The DMCP software ('ePlan', SUM-IT Computers, Thame, UK) was used to generate the full DMCP questions and observations, and these were worked through with the farm owners and herd manager. Areas covered included lactating and dry cow environment management, milking routine, basic milking machine function, treatment, biosecurity, youngstock management and monitoring. The aim was to capture current herd management and husbandry practices that may be relevant to mastitis control, for example frequency of bedding in dry cow yards, teat preparation, stocking rate in cubicle housing *etc*. In all, more than 350 questions and observations were asked or made. All responses were captured electronically as a series of Yes/No responses and entered into the ePlan software and the Plan 'locked' to prevent further amendment. Finally, a herd diagnosis of 'environmental' infection patterns of predominantly 'dry period origin' was entered.

IMPLEMENTATION OF THE PLAN: SELECTION OF CONTROL PRIORITIES

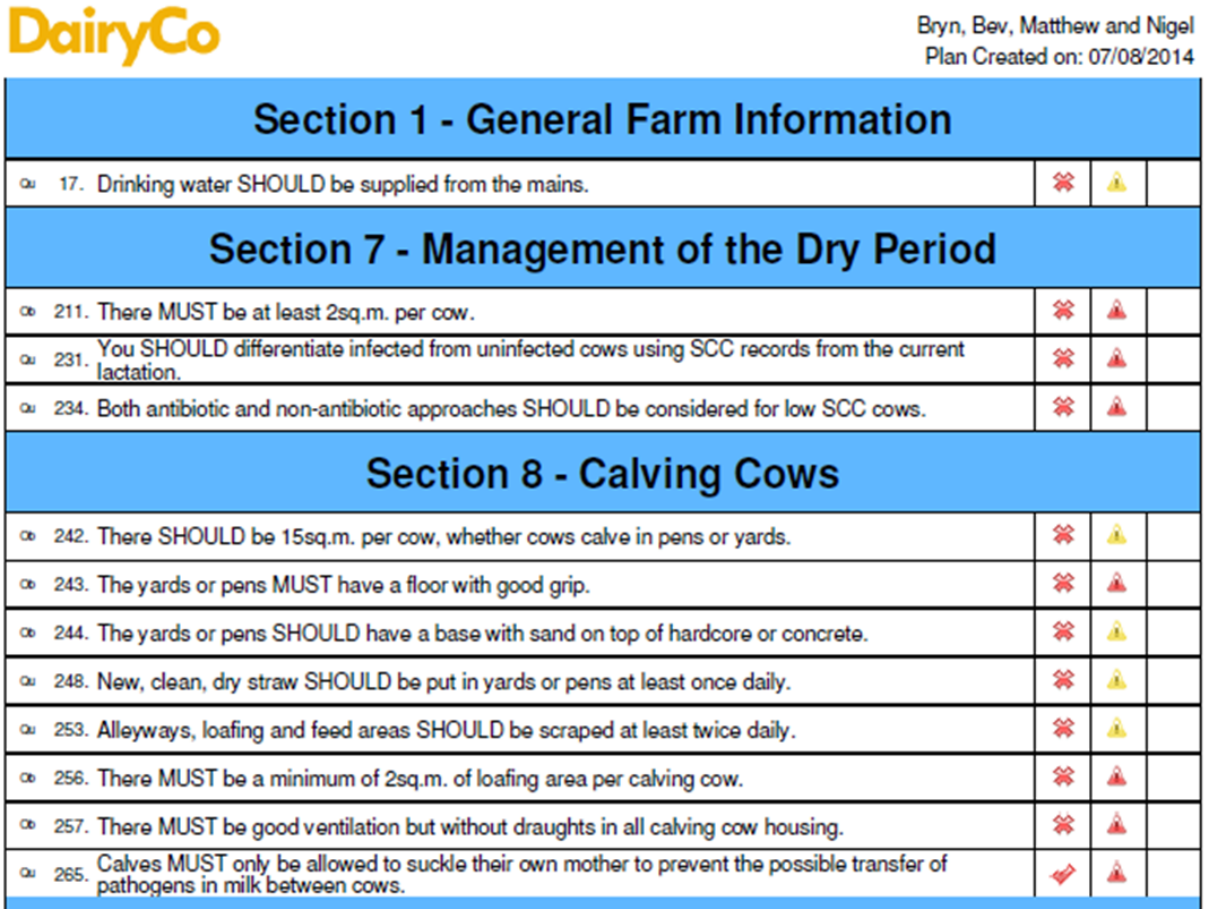
Following entry of current management data, 123 of the 350 questions and observations were 'incorrect' relative to the blueprint of the Plan, for example answering 'No' to a question about the frequency at which loose yards are completely cleaned out where the 'correct' answer is at least once a month. Following entry of the herd diagnosis of 'environmental-dry period origin infections' (based on examination of the mastitis and cell count data as discussed above), the ePlan software was used to filter out areas of management not directly related to the herd diagnosis (*i.e.* any deficiencies in lactating cow management or parlour routine were initially ignored). This stage resulted in removal of 53 'incorrect' responses, leaving 70 potential items that directly related to the herd diagnosis. From these, clinical judgement was used to prioritise 12 of these for discussion with the farm. These priorities fell broadly into three categories, namely management of the dry cow environment, management and husbandry of calving cows and general items including data recording/monitoring. The INITIAL priorities selected are shown in Figure 2 and included:

1. Dry cow cubicles MUST be bedded every day if using organic bedding
2. Dry cow cubicles MUST be cleaned off twice daily to reduce contamination of the beds
3. Transition cow passages, feed and loafing areas MUST be scraped out twice a day to reduce soiling of the feet and environmental infection pressure
4. Early dry period cows at pasture MUST be moved regularly. Aim for no more than TWO WEEKS in one grazing/lying area and FOUR WEEKS before cows are returned to that area to reduce build-up of infection pressure.
5. Early dry period cows AND heifers at pasture should be regularly treated with an effective fly control product, preferably a pour-on that is repeated as per manufacturer's instructions

6. The calving yard and/or pens MUST be bedded with clean dry straw DAILY and the straw used for bedding should be un-chopped
7. Consider converting the existing calving yard to individual calving pens to improve management of infectious disease as well as reduce mastitis infection pressure around calving
8. The yard should have a base of sand to encourage drainage
9. Strongly suggest that a group change 3-7 days prior to calving is discontinued and the yard is used for calving ONLY – *i.e.* move cows as late as possible into the calving area
10. Give serious consideration to the screening of ALL cows in milk for antibodies to *Mycobacterium avium paratuberculosis* (MAP - the bacterial infection that causes the clinical syndrome known as Johnes Disease) given the unknown herd status, and common calving area
11. Organic bedding materials such as sawdust that are used for lactating and dry cow cubicles MUST be stored under cover to keep it dry at all times
12. Submit an up to date on farm software back up in the next three months by email to allow assessment of dry period infection rates (using milk recording data) and index case rates for clinical mastitis.

Following initial discussions, the farm owners and herd manager put in place several of these control measures, and a cycle of feedback based on monitoring of the clinical mastitis and cell count data every 3 months or so coupled with telephone discussions around management continued. A follow up meeting with the farm and the herd's own veterinary surgeon also addressed other management items, namely aseptic infusion technique at drying-off and the continued use of sawdust cubicle bedding against the possibility of switching to deep sand for the transition group. Over the period 2014-2016, the following items were implemented that related to dry cow and calving cow management:

- Aseptic Procedure at drying-off, including pre-dip and use of surgical spirit and cotton wool swabs
- Filled slatted floor and tractor scrape daily in transition cow environment
- Switch to deep sand beds in transition cow environment
- Apply new, clean sand 1-2 weekly in transition cow cubicles
- Cows held back from calving cow environment until 24-48 hours prior to calving, reducing the stocking rate on loose yard
- Loose yard for calving cows cleaned out every 2-3 weeks
- Apply new, clean, dry straw daily to calving yard



DairyCo

Bryn, Bev, Matthew and Nigel
Plan Created on: 07/08/2014

Section 1 - General Farm Information			
17. Drinking water SHOULD be supplied from the mains.			
Section 7 - Management of the Dry Period			
211. There MUST be at least 2sq.m. per cow.			
231. You SHOULD differentiate infected from uninfected cows using SCC records from the current lactation.			
234. Both antibiotic and non-antibiotic approaches SHOULD be considered for low SCC cows.			
Section 8 - Calving Cows			
242. There SHOULD be 15sq.m. per cow, whether cows calve in pens or yards.			
243. The yards or pens MUST have a floor with good grip.			
244. The yards or pens SHOULD have a base with sand on top of hardcore or concrete.			
248. New, clean, dry straw SHOULD be put in yards or pens at least once daily.			
253. Alleyways, loafing and feed areas SHOULD be scraped at least twice daily.			
256. There MUST be a minimum of 2sq.m. of loafing area per calving cow.			
257. There MUST be good ventilation but without draughts in all calving cow housing.			
265. Calves MUST only be allowed to suckle their own mother to prevent the possible transfer of pathogens in milk between cows.			

Figure 2: Initial AHDB Dairy Mastitis Control Plan for Nant Goch in 2014.

OUTCOME AND DISCUSSION

The headline mastitis and cell count figures for 2016 are shown in Table 2. The overall mastitis rate fell steadily through 2015 and 2016, reaching less than 40 cases per 100 cows/year at the end of 2016. The reduction in mastitis rate was driven by a sustained reduction in the rate at which cows were reported with a new clinical case of mastitis in the first 30 days after calving, as shown in Figure 3. In addition, the '**fresh calver infection rate' averaged 12% to the year end, close to the target of <10%.** These key metrics illustrated the impact of management changes and reflected the improvement in infection status at calving, leading to improvement in mastitis control.

The reduction in estimated total cost of mastitis on farm calculated from farm-specific figures for the cost of a clinical case of mastitis (including milk price, feed and fertiliser cost, treatment cost, herdsperson time, reduction in milk yield, proportion of mastitis cases that are severe, and cows culled from the herd due to mastitis) are shown in Figure 4. Following implementation of the DMCP, the estimated annual saving from improved control of mastitis on

farm was around £50,000 to £60,000 per year in terms of recoverable costs. In the 12 months ending May 2016, there were 256 less cases of mastitis on the farm than for the 12 months ending May 2013, meaning 1,536 fewer antibiotic tubes were used, at an average of six tubes per case. Comparing the 12 months ending 2013 with the 12 months ending 2016 (Figure 5), the total mg of antibiotic used per Population Corrected Unit (PCU) reduced from 40mg/PCU to 26mg/PCU and the average Daily Defined Dose (DDD) of antibiotic reduced from 14 to less than 7.

In conclusion, the implementation of a structured approach to mastitis control reduces intra-mammary infections and mastitis rate and leads to a reduction in antibiotic use.

Table 2: Mastitis key performance indicators at Nant Goch (December 2016).

Parameter	Rolling 3-recording average	Rolling annual average	Target
Herd average SCC (cells/ml)	159,000	158,000	<200,000
% herd >200,000	14.1	13.9	<20
% herd chronic*	5.6	6.7	<5
Fresh calver infections	10.3	12.0	<10
Dry period cures (%)	85.1	74.7	>85
Dry period new infections (%)	9.2	9.0	<10
Lactation new infections (%)	8.7	7.8	<5
Cases clinical mastitis (per 100 cows/year)	38	39	<25
Dry period origin 1st cases (per 12 cows at risk)	0.48	0.66	<1
Lactating period origin 1st cases (per 12 cows at risk)	2.22	2.45	<2

Figure 3: Rate of Clinical Mastitis <30 Days in Milk (DIM) for 2015-16: This graph shows the incidence rate of new clinical cases of mastitis in cows that are less than 30 DIM (i.e. dry period origin). The bars represent the number of cows at risk each month (those between 0 and 30 days calved). The line represents the dry period origin incidence rate. The horizontal line represents a 'target' rate of 1 cow affected for every 12 eligible.

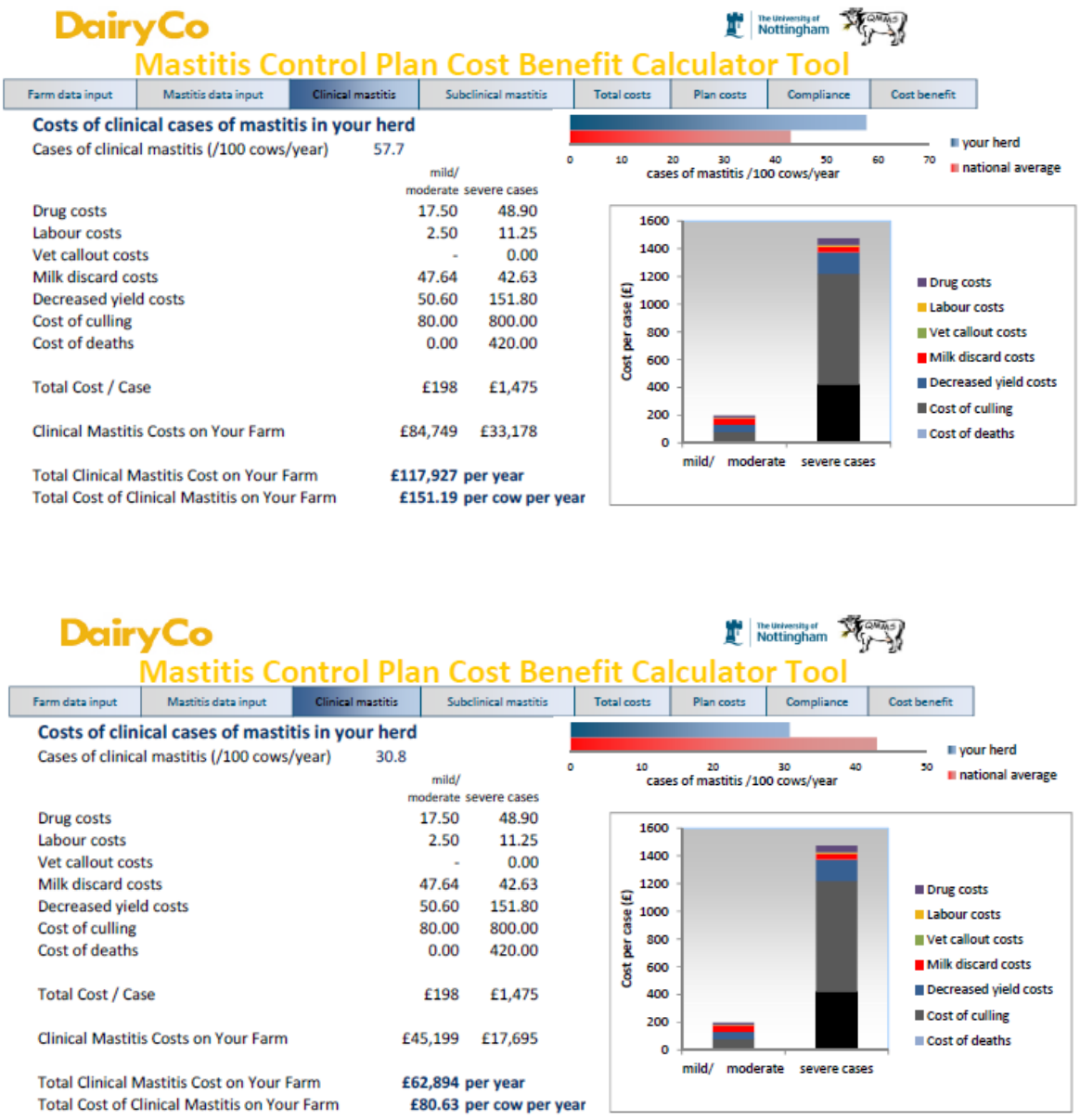


Figure 4: Cost breakdown comparing 12 months ending May 2013 (top) with the 12 months ending May 2016 to show recoverable costs with reduction in mastitis rate from ~60 cases per 100 cows/year to ~30 cases per 100 cows/year. Estimated total cost calculated from farm-specific figures for the cost of a clinical case of mastitis, including milk price, feed and fertiliser cost, treatment cost, herdsperson time, reduction in milk yield, proportion of mastitis cases that are severe, and cows culled from the herd due to mastitis.

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AHDB DAIRY

	TOTAL	Critical
Total mg/PCU in herd	40.39	1.27
Total DDD	14.59	5.07
Total DCD	5.08	1.65

Route	Product	Amount used	Units	mg/PCU	Critically important?
Injectable	Alamycin 100mg/ml Solution for Injection	52.00	ml	0.02	
Injectable	Betamox LA 150mg/ml Suspension for Inject	9671.00	ml	5.69	
Injectable	Ceftiocyl 50mg/ml suspension for injection f	964.00	ml	0.19	CRITICAL
Drytube	Cepravin Dry Cow 250 mg Intramammary sus	2036.00	Tubes	2.00	
Lactatingtube	Cobactan MC Intramammary suspension 75 r	2768.00	Tubes	0.81	CRITICAL
Injectable	Draxxin 100 mg/ml solution for injection for	101.00	ml	0.04	
Injectable	Excenel 50 mg/ml Sterile Powder for Solutio	18.00	ml	0.00	CRITICAL
Injectable	Naxcel 200 mg/ml Suspension for Injection f	340.00	ml	0.27	CRITICAL
Injectable	Norocillin Injection	30.00	ml	0.04	
Injectable	Norodine 24 Solution for Injection	22387.00	ml	21.07	
Lactatingtube	Tetra-Delta Intramammary Suspension	133.00	Tubes	0.21	
Injectable	Tetroxy Vet 200mg/ml	790.00	ml	0.62	
Injectable	Tylan 200, 200mg/ml Solution for Injection	11820.00	ml	9.27	
Other	Metricure 500 mg Intrauterine suspension	83.00	Units	0.16	

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	TOTAL	Critical
Total mg/PCU in herd	26.77	1.06
Total DDD	6.99	2.16
Total DCD	2.84	0.96

Route	Product	Amount used	Units	mg/PCU	Critically important?
Injectable	Alamycin 100mg/ml Solution for Injection	358.00	ml	0.11	
Injectable	Betamox LA 150mg/ml Suspension for Inject	17290.00	ml	8.03	
Drytube	Cefimam DC	788.00	Tubes	0.37	CRITICAL
Lactatingtube	Cobactan MC Intramammary suspension 75 r	1419.00	Tubes	0.33	CRITICAL
Injectable	Excenel 50 mg/ml Sterile Powder for Solutio	9.00	ml	0.00	CRITICAL
Injectable	Marbocyl™ 10% Solution for Injection	23.00	ml	0.01	CRITICAL
Injectable	Marbox 100 mg/ml	286.00	ml	0.09	CRITICAL
Injectable	Naxcel 200 mg/ml Suspension for Injection f	430.00	ml	0.27	CRITICAL
Injectable	Norocillin Injection	50.00	ml	0.05	
Injectable	Norodine 24 Solution for Injection	10962.00	ml	8.15	
Lactatingtube	Tetra-Delta Intramammary Suspension	240.00	Tubes	0.30	
Injectable	Tetroxy Vet 200mg/ml	180.00	ml	0.11	
Injectable	Tylan 200, 200mg/ml Solution for Injection	9920.00	ml	6.14	
Other	Metricure 500 mg Intrauterine suspension	86.00	Units	0.13	
Drytube	Ubro Red Dry Cow	1705.00	Tubes	2.64	
Injectable	Zactran 150mg/ml solution for injection for c	114.00	ml	0.05	

Figure 5: Antimicrobial use breakdown comparing 12 months ending 2013 (top) with the 12 months ending 2016 to show itemisation of antibiotic products, Defined Daily Dose (DDD) and total mg/PCU.

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This case is also available as a press releases on the Farming Connect web page at https://businesswales.gov.wales/farmingconnect/posts/case-study-nant-goch-mastitis-control

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AN INVESTIGATION INTO THE EFFECTS OF MASTITIS ON FERTILITY IN A COMMERCIAL DAIRY HERD

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During the transition from pregnancy to lactation, changes in nutrient partitioning leaves dairy cows in a negative energy balance, predisposing them to reduced immune competence and greater susceptibility to production diseases, such as mastitis (1). Mastitis can contribute to poor reproductive performance in infected cows, through alterations in hormone production and essential regulatory elements of the oestrus cycle (2). Somatic cell count (SCC) is used to detect immune defence systems within the udder and is an indicator for subclinical mastitis. Both mastitis and infertility are common disease complexes in dairy cattle worldwide, and major reasons for premature culling and decreased profitability of a herd (3).

A retrospective longitudinal study was conducted to investigate whether the presence of clinical mastitis and SCC during early lactation affected fertility in lactating dairy cows at Home Farm, Hartpury College (n=268). Fertility events, SCC and mastitis cases were recorded, with the timing of mastitis occurrence used to group cows. Statistical analysis was performed using SPSS to establish whether mastitis and SCC significantly impacted on key fertility performance indicators.

The calving to first service (CFS) interval was extended by 7.3 days ($p=0.052$) and number of services per conception (S/C) increased by 1.1 ($p=0.475$) when mastitis was present beforehand. An increase of 14.4 days was seen for both days to conception (CC) ($p=0.103$) and calving interval (CI) ($p=0.067$) in cows with mastitis. There was no correlation between SCC and days to first service ($r= -0.050$, $p=0.420$) or days to conception ($r= -0.028$, $p=0.671$).

When values were adapted to account for confounding factors, the majority of the 'non-mastitis' group cows with a CFS interval > 90days were removed. This resulted in a significant difference ($p=0.020$) of an extended CFS interval of 9.1 days between cows that suffered from clinical mastitis during the period and those that had not. Days between first service and conception for cows with mastitis was double that of reported values.

Mastitis during early lactation had a detrimental effect on fertility that manifested itself through an increased period for CFS, CC, CI, and more S/C. The effect on the overall fertility of the animal was greatest when mastitis occurred during the first service and conception period making it a critical time in mastitis avoidance.

Future on farm studies should consider the multi-factorial nature of fertility, and create a more sophisticated way to identify and account for confounding factors.

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DRY COW MANAGEMENT: A PRACTICAL GUIDE TO EFFECTIVE MASTITIS CONTROL

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SUMMARY

Drying off is a key time for mastitis control. Decisions made at this time can influence the herd's performance for the next 6 to 12 months. Working in partnership, AHDB Dairy and the University of Nottingham have released a series of factsheets on "Dry cow management: a practical guide to effective mastitis control" and two short films.

Not only is drying-off a significant investment in terms of money and effort for farmers, it is usually the single biggest opportunity to make a difference to an individual cow's infection status as well as the overall herd's mastitis status. The factsheets and films provide information and recommendations on drying off along with a pictorial protocol on clean infusion technique at dry-off. The guidance encourages farmer and their farm staff to work together with their veterinary surgeons to decide on the most effective dry cow management strategy to prevent and treat the development of mastitis.

Filmed on the farm and presented in a clear and practical way to help farmers implement best practice, the films and associated factsheets will help to develop skills on farm for long term mastitis control. The resources cover decision making at dry off, drying-off, clean infusion technique, monitoring the dry period performance as well as consideration on nutrition, housing and calving management.

The new factsheets will be available to order and download from the AHDB Dairy website.

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UDDER HEALTH INDICATORS FOR 118 UK SENTINEL HERDS IN 2016

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SUMMARY

The AHDB Sentinel Herds Project involves collating data from sentinel farms in an attempt to monitor trends in mastitis over time at a national level. Whilst it will provide an insight into mastitis incidence and prevalence, its primary value is seen as a way of monitoring change rather than absolute national levels of disease.

Monitoring national mastitis levels is notoriously difficult. The last national survey was conducted in 2003-4 (1). Information on the incidence of clinical cases is dependent on accurate recording on farm. Although processor/retailer schemes may require clinical mastitis recording, the quality and accessibility of such data is likely to be variable. Whilst bulk milk somatic cell count data can give an insight into milk quality, it only reports on the quality of milk sold, and is open to manipulation through the withholding of milk from problem animals. In contrast, whilst more robust somatic cell count data are available from recording herds, indicators of subclinical mastitis are, by definition, restricted to that self-selecting population of herds where individual cow somatic cell counts (ICSCC) are regularly recorded.

Within the AHDB Mastitis Research Programme, the decision was taken to attempt to monitor udder health at a national level using a geographically representative population of approximately 100 “Sentinel Herds” with the primary requirement that herds were deemed to be reliably recording clinical mastitis in an electronic format and preferably undertaking monthly ICSCC recording. In the first instance, data collation and analysis from these herds will continue until December 2019. This poster reports the first year’s findings.

Herds were initially recruited through a network provided by contact with QMMS Ltd. and the University of Nottingham. Dairy Veterinary Practitioners in areas under-represented by the initial recruitment were contacted, to recruit additional herds. Participating farms provided clinical mastitis data and milk recording information including ICSCC, in electronic format. Data were analysed and key udder health parameters calculated using TotalVet. Data were “cleansed” by removing ‘implausible’ figures using specified thresholds, thus reducing n for some parameters. The occurrence of such figures illustrates the challenge of obtaining reliable data.

The rolling 12 month indices as of 31st December 2016 are summarised in Table 1.

Table 1 Key farm indices and udder health indicators 2016

Variable	N	Mean	Median	SE Mean	Min	Max
Herd size	118	316	252	23.5	63	1492
Annual rolling 305 day yield (l)	110	8,668	8,806	163.5	4,323	11,872
Calculated bulk milk SCC (,000/ml)	112	156	138	6.6	39	391
Clinical mastitis (CM) rate (cows affected/ 100 cows/year)	117	38.5	35.0	2.02	2.00	123
Quarter CM rate (/100 cows/year)	117	42.9	38.0	2.30	5.00	128
Dry period origin CM rate (cows in 12)	117	0.87	0.80	0.05	0.00	2.86
Lactation origin CM rate (cows in 12)	117	2.20	2.07	0.10	0.36	6.18
Lactation new infection rate (%)	112	7.9	7.4	0.3	2.4	23.2
Dry period new infection rate (%)	109	15.9	15.1	0.7	0.0	35.7
Dry period cure rate (%)	109	76.9	78.0	1.4	0.0	100.0
Fresh calver infection rate (%)	109	17.6	16.7	0.7	0.0	36.5
% chronically infected	112	9.9	9.4	0.5	0.8	25.8
% > 200,000 cells/ml	112	17.6	16.9	0.6	5.4	38.3

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DEVELOPMENT OF A MASTITIS PATTERN ANALYSIS TOOL (PAT) TO AID IN A HERD DIAGNOSIS AND ROUTINE MONITORING ON FARM

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SUMMARY

In recent years in Great Britain, the AHDB Dairy Mastitis Control Plan (DMCP) has had a significant positive impact on-farm. More than 400 vets and advisors have been trained to use the Plan and it is estimated that >15% of GB cows have received mastitis control through the Plan. Although the DMCP has performed well, feedback from participants and businesses indicate that the first stage of the Plan, making a herd diagnosis, is often a problematic stage for Plan Deliverers. **This is an essential first step because the control measures that are identified are dependent upon a correct diagnosis at this point.** This represents a key barrier that prevents the Plan being used more successfully and on an even wider scale nationally, and there continue to be many examples of where mastitis control advice becomes confused and ineffective in the absence of a clear herd diagnosis.

As part of research funded by AHDB, a study has been conducted to create and test an electronic automated herd mastitis pattern analysis tool (PAT) to complement what is already available alongside the DMCP (for example cost calculators). The PAT uses key parameters from herd clinical mastitis and somatic cell count (SCC) records to provide guidance on the likely herd mastitis patterns and the importance of the dry period or lactating period epidemiology, as well as environmental or contagious transmission. For example, parameters required to define herds as predominantly 'dry period origin' or 'lactating period origin' will relate to the pattern of clinical mastitis and SCC through the lactation cycle, particularly during the first 30 days of lactation, whereas parameters required to define herds as predominantly 'environmental' or 'contagious' will be focussed on mastitis and dry period cure rates, as well as the prevalence of chronic cows. The PAT also accounts for seasonal patterns by requesting these parameters every three months over an 18-month period, and takes into account the importance of heifers as a source of intra-mammary infection in herds by requiring clinical mastitis and SCC parameters for parity 1 animals only.

In all, the PAT developed requires 30 input parameters for each of six 3-month periods, some of which are straight-forward to obtain (e.g. proportion of cows >200,000 cells/ml in the last three months), some of which require software to calculate (e.g. the rolling 3-month average dry period new

infection rate as measured by SCC), and some of which are calculated by the tool itself (e.g. a clinical mastitis 'Recurrence Factor' to enumerate the likely importance of recurrent mastitis). For each input parameter thresholds for 'high' and 'low' scores were selected, using published research and expert opinion. For example, an apparent dry period cure rate of greater than 75% would be considered above average and be weighted towards a diagnosis of 'environmental' mastitis, whereas a dry period cure rate of less than 60% would be considered well below average and be weighted towards a diagnosis of 'contagious' mastitis. All input parameters are assigned 'high' and 'low' scores consistent with their importance regarding differentiating 'dry period' and 'lactating period' origin mastitis and 'contagious' and 'environmental' infection patterns. For each 3-month period, a collated score is obtained from all input parameters and totalled to provide a numerical output. For example, if the herd average SCC has remained <200,000 cells/ml for each of the six rolling 3-month average periods of interest, this input parameter would contribute a score of 'zero' in each quarter to the 'contagious' diagnosis. A score for 'seasonality' is also calculated using the differences between the minimum and maximum collated scores and the mean across the 18 months of interest, to take into account large 'swings' in the input parameters depending on time of year. The collated scores are expressed as percentages for each 3-month period and a breakdown for 'current' (this latest quarter only), 'recent' (during the last 12 months only) and 'historic' (between 12 and 18 months previously) periods summarised and used to illustrate the importance of each section of the herd diagnosis.

Clearly, this herd diagnosis tool has the potential to *assist* the Plan Deliverer in the field arrive at a herd diagnosis, requiring minimal extraction of data from existing dairy herd analysis software packages. The PAT highlights the need for robust data - herds with infrequent or absent milk recording data and/or clinical mastitis data will not be able to take advantage of this process. In all cases, the automated herd mastitis PAT does not replace a fuller diagnosis by the veterinary surgeon or consultant Plan Deliverer, but will assist in the decision-making process, and be an important 'first step' as well as ongoing monitoring aid for udder health and mastitis control.

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COMPARISON OF MILK SOMATIC CELL COUNTS BY ON-LINE SCC_{ATP} MONITORING INSTRUMENT LUCI® AND FLOW CYTOMETRY

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INTRODUCTION

Healthy cows are essential for a dairy farm. A healthy cow produces more and better quality milk and uses fewer antibiotics. One of the most obvious health indicators for lactating cows is the somatic cell count (SCC) in milk. High cell counts are indicative of infection. Mastitis is such an infection that leads to inflammation of the udder and negatively impacts the production of milk. Mastitis untreated can detrimentally impact the health of the cow. Increased use of automatic milking systems (AMS) has created a demand for an on-line monitoring device. Here we present our newest data from LUCI® and compare our on-line SCC_{ATP} measurement with traditional laboratory results.

AIM

To improve cow health in dairy farming by on-line monitoring of milk quality SCC_{ATP}

METHODS

Automated monitoring of somatic cell count SCC_{ATP} was integrated in the automatic milking system (AMS). LUCI consists of a sampling unit, reaction chamber and detection module. The chemical method is based on ATP analysis using customized reagents with a shelf life optimized for usage in the stall. Milk samples were collected in Friesland at the Wageningen University Dairy Campus and at several other test farms and analysed direct on-line and in the laboratory via flow cytometry.

RESULTS

Our data indicate an advantage to increase the sample frequency without increasing time at the robot to detect early on-set (sub-clinical) mastitis. Statistical correlation between the methods is good. LUCI's advantage is the automation she brings to sample analysis: reducing operator time and transport costs.

CONCLUSION

In the Netherlands milk samples are typically taken and analyzed once every six weeks in a regional laboratory. To ensure the requested hygienic status of the milk fast and reliable methods for on-line measurement of relevant infections are required. LUCI is a reliable method to measure SCC_{ATP} in a range between 50k-1000k cells/ml.

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