2016

Cattle Lameness Conference

CATTLE LAMENESS CONFERENCE

Organised by:

RVC Royal Veterinary College University of London

The Dairy Group

The University of Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Topics are:

- Update on the digital cushion
- Footbathing protocols
- Automatic mobility scoring
- Mycoplasma – an emerging disease
- A veterinary practice's approach

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GENERAL INFORMATION

TIMETABLE of EVENTS

08:45	ARRIVE / REGISTRATION / COFFEE and POSTER DISPLAY	
09:25	CHAIRPERSON'S INTRODUCTION Brian Pocknee, The Dairy Group	
09:35	The digital cushion story – an update	Georgios Oikonomou University of Liverpool
10:15	Questions and Discussion	
10:30	COFFEE and POSTERS	
	Session 2 Chairperson: Jon Huxley, University of Nottingham	
	INTRODUCTION TO SESSION 2	
11:00	Foot bathing protocols: Evidence and legalities	Nick Bell Royal Veterinary College
11:40	Questions and Discussion	
11:50	Developments in automated monitoring of lameness and locomotion	Toby Mottram Royal Agricultural University
12:30	Questions and Discussion	
12:40	LUNCH and POSTERS	
	Session 3 Chairperson: Nick Bell, Royal Veterinary College	
14:00	INTRODUCTION TO SESSION 3 and VOTING ON POSTERS	
14:05	Mycoplasma – the Dutch experience of an emerging disease?	Menno Holzhauer GD Dutch Animal Health, Deventer, The Netherlands
14:50	Questions and Discussion	
15:00	An in-practice vets approach to minimising lameness – Managing the mobility team	James Dixon Westpoint Farm Vets, UK
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16.00	TEA and DEPART	

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CHAIRPERSON'S INTRODUCTION

Welcome to the 7th Cattle Lameness Conference.

Our aim is to find the best speakers with the most relevant (and latest) information to present to the CLC. This is only achievable due to the financial support of all our generous sponsors, some of whom are first time supporters. This year our sponsors are Kilco, Dartington Cattle Breeders Trust, Norbrook Laboratories (UK) Ltd, Giltspur Scientific Ltd and Provita Eurotech Ltd. Without their support this conference would not be possible.

At this conference we will be exploring several major topics. Dr Georgios Oikonomou, University of Liverpool, will provide an update on the digital cushion story. Following the coffee break Dr Nick Bell, Royal Veterinary College, will provide a practical insight into footbathing strategies and treatments. Taking the conference up to lunch Professor Toby Mottram, Royal Agricultural University and ecow will explore automatic mobility score detection.

After lunch Dr Menno Holzhauer, GD Animal Health Services, The Netherlands will discuss the Dutch experience of the emerging lameness disease - Mycoplasma. The conference will close with the practitioner's approach, which this year is delivered by James Dixon, Westpoint Farm Vets, Derbyshire, who will discuss his approach to minimising lameness on farm.

In addition to the papers delivered by the expert panel of speakers, there are also a number of scientific posters. We encourage you to read the posters and discuss the findings with the presenting authors.

The organising committee have been encouraged by the increasing number of delegates from overseas. This is a trend we are keen to encourage.

Finally, thank you for attending and supporting the conference. I trust you will have an enjoyable and worthwhile day.

Brian R Pocknee
Chairperson of the 2016 Cattle Lameness Conference, The Dairy Group
On behalf of the CLC Organising Committee

FURTHER INFORMATION

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PAPERS

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THE DIGITAL CUSHION STORY - AN UPDATE

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SUMMARY

The potential role of the bovine digital cushion, a structure composed mostly of connective and adipose tissue located underneath the distal phalanx, in the aetiopathogenesis of claw horn lesions has recently been the subject of several studies. It has been suggested that the thickness of the digital cushion is associated with body condition and the susceptibility to claw horn lesions. Interestingly, digital cushion thickness is a moderately heritable trait and is genetically correlated with the incidence of sole ulcers and white line lesions.

INTRODUCTION

Lameness is undoubtedly one of the most important issues the modern dairy industry faces today. It is a debilitating, painful condition with significant animal welfare implications. Apart from being an important animal welfare issue, lameness can be extremely costly too. The severe impact of lameness on milk yield, fertility, survivability, and carcass quality is well established and has been reviewed recently (Huxley, 2013). Average total cost estimates per lameness case in the UK range between £180 and £273 (Kossaibati and Esslemont, 1997; Dairy Co, 2015). At an incidence of 80 new cases per 100 cows per year (Lim et al., 2015), lameness could be costing the UK dairy industry more than £200 million annually. Unfortunately, despite the known and well accepted negative impact of lameness on welfare and productivity, the dairy industry worldwide does not seem to be successful in reducing lameness prevalence in dairy herds. In an epidemiological study on lameness prevalence that was conducted approximately 20 years ago in the UK the mean annual herd prevalence over the whole study period was 20.6% with a range from 2.0 to 53.9% (Clarkson et al., 1996). More recent studies reported the UK prevalence at 37% (Barker et al., 2010), which is consistent with estimates in other countries worldwide (Dippel et al., 2009; Chapinal et al., 2014).

In dairy cattle, several diseases are associated with lameness. Sole hemorrhages, sole ulcers and white line disease are claw lesions associated with lameness and often, especially in the past, attributed to subclinical laminitis. Hoblet and Weiss, (2001), focusing on the abnormalities of claw horn formation per se regardless of whether an initial primary inflammatory response has occurred, suggested the use of the term claw horn disruption. Raber et al., (2004) suggested that claw horn lesions are a consequence of contusions within the claw horn capsule. This hypothesis may also better explain the fact that sole ulcers usually occur on the lateral claw of the hind limbs. Measurements of ground reaction forces showed that the lateral claws of the hind limb of cows received significantly higher average and maximum vertical pressures than the medial claws (Phillips et al., 2000; van der Tol et al., 2003). In an enlightening study, Tarlton et al., (2002) further improved our understanding of claw lesions aetiopathogenesis. These authors reported that, around the time of calving, there is increased laxity in the connective tissue supporting the third phalanx within the claw, which results in increased mobility of the third phalanx and consequently increased pressure between the tuberculum flexorum and the sole.

The potential role of the digital cushion in the development of claw horn lesions has also been receiving increased attention lately. The digital cushion is a complex structure composed mostly of connective and adipose tissue located underneath the distal phalanx and plays an important function in dampening compression of the corium tissue (Raber et al., 2004). With the suspensory apparatus in cattle being less developed than in the horse, the bovine digital cushion must support a considerably greater proportion of body weight (Maierl et al., 2000; Lischer et al., 2002).

RECENT RESEARCH FINDINGS REGARDING THE ROLE OF THE DIGITAL CUSHION

Bicalho et al., (2009) conducted an observational cross-sectional study on 501 lactating Holstein dairy cows and described for the first time the association between claw horn lesions and the thickness of the digital cushion. The thickness of the digital cushion was evaluated by ultrasonographic examination of the sole at the typical ulcer site. Cows in the upper quartile of digital cushion thickness had a significantly lower prevalence of claw horn lesions than the cows in the lower quartile. Digital cushion thickness was also found to be highly associated with body condition score, increasing gradually as body condition score increased. The authors suggested that lactating dairy cows are not only mobilizing adipose tissue from other parts of the body such as subcutaneous fat, muscle, and intra-abdominal fat, but also from the digital cushion, potentially reducing its shock-absorbing capacity.

The same group of researchers conducted a second prospective longitudinal cohort study with the objective of investigating the association between the thickness of the digital cushion at dry-off and claw horn lesions incidence in the subsequent lactation (Machado et al., 2011). A total of 574 Holstein dairy cows were enrolled in that study, and body condition score, and ultrasonography of the sole for measurement of digital cushion diameter were performed. Cows that were diagnosed with sole ulcers and white line disease in the subsequent lactation had significantly lower digital cushion thickness at dry-off when compared to non-affected cows, and body condition score was again linearly associated with digital cushion diameter.

Oikonomou et al., (2014b) recently investigated the association between digital cushion thickness and sole temperature measured by infrared thermography. Data were collected from 216 lactating Holstein cows at 4 to 10 days in milk (DIM). Cows were locomotion scored and sole temperature was measured after claw trimming using an infrared thermography camera. Temperature was measured at the typical ulcer site of the lateral digit of the left hind foot. Results described in this study may support the hypothesis that the decrease in digital cushion thickness observed during the first months of lactation is associated with primary damage to the corium, which may aggravate and eventually lead to claw horn lesions. Reduced digital cushion thickness was associated with early signs of inflammation (increased sole temperature) in the beginning of lactation and before the development of detectable claw lesions.

Toholj et al., (2014) examined the correlation between ultrasonographic measurements of solar soft tissue thickness in the early phase of lactation and the formation of sole ulcers later in lactation. Using data from 50 cows the authors were able to show that animals in the low solar soft tissue thickness group were approximately four times more likely to develop a sole ulcer later in their lactation.

Gard et al., (2015) investigated the effects of exercise on the development of the digital cushion. Twenty two-month old bull calves were randomly allocated to either an exercise or a control group and were euthanized four months later. Mean digital cushion volume and surface area for the exercise group were increased by 37% and 18%, respectively, comparing to those for the control group. It could be hypothesized that early life exercise could lead to increased volume and surface area of the digital cushion and through that to a decreased susceptibility to lameness. Before such recommendations are made though these results should be confirmed by larger scale studies where animals will be followed for longer periods of time.

Baird et al., (2010) reported that dietary fatty acid composition influences the concentration of fatty acids in the digital cushion of cattle. Their findings suggest that diet manipulations could be a way to alter the digital cushion properties and potentially decrease cows' susceptibility to specific claw lesions.

Oikonomou et al. (unpublished data) investigated the periparturient changes in digital cushion thickness in Holstein cows and their association with body condition score, back fat thickness and claw horn disruption lesions. Data were collected from 180 Holstein cows and heifers on one commercial dairy farm in North-West England between November 2014 and January 2016. Data were collected from each animal on three occasions: 15 to 21 days pre-calving, 1 to 7 days post-calving, and 60 to 75 days post-calving. Digital cushion thickness was found to be significantly lower at 60 – 75 days post-calving (comparing to the measurements taken before and right after calving). Interestingly, digital cushion thickness before calving was associated with total digital cushion thickness loss with cows having thicker digital cushions before calving being more prone to mobilise more by 60 days post calving.

THE POTENTIAL ROLE OF GENETICS

High milk production has been reported to be a significant risk factor for dairy cattle lameness (Green et al., 2002; Bicalho et al., 2008). Amory et al., (2008) found that increased milk yield was a significant risk factor for both sole ulcers and white line disease. Studies have already shown a positive (unfavourable) genetic relationship between milk production and lameness, suggesting that cows of higher genetic merit for milk production are also more prone to develop lameness (Van Dorp et al., 1998). Koenig et al., (2005) reported unfavourable genetic correlations between 305-d milk yield and sole ulcers and white line disease. Kougioumtzis et al. (2011) also reported a strong (0.75) significant genetic correlation between milk yield and lameness and suggested that continuous selection for higher milk production without considering lameness in the breeding goal is leading to deterioration of claw health. Oikonomou et al., (2013) reported that higher sire's predicted transmitting ability for milk production was associated with higher daughters' incidence of CHDL. Milk yield is known to have a negative genetic correlation with body condition score (Loker et al., 2012), while low body condition score is phenotypically (Bicalho et al., 2009) and genetically (Van Dorp et al., 1998, Kougioumtzis et al., 2011) associated with increased susceptibility to lameness. It is possible that selecting for high-producing cows that will at the same time better maintain their body condition score level, may also contribute to the genetic improvement of cows' resistance to lameness. These findings could also be associated with the role of the digital cushion in the development of claw horn disruption lesions.

Oikonomou et al., (2014a) recently characterised digital cushion thickness genetically and investigated its genetic association with body condition score, claw horn lesions and milk production. Data from 923 dairy cows were collected from 1 large closely monitored commercial dairy farm located in upstate New York. The heritability estimate of digital cushion thickness was 0.33 ± 0.09, whereas a statistically significant genetic correlation was estimated between digital cushion thickness and prevalence of claw horn lesions (−0.60 ± 0.29). The genetic correlation between BCS and digital cushion thickness in this study was 0.33, suggesting that the traits are correlated but are not genetically the same. It is possible that selection for both better BCS and digital cushion thickness may result in greater genetic improvement of cow resistance to claw horn lesions than selection for better BCS alone. In conclusion, the authors suggested that genetic selection for thicker digital cushion is possible and could lead in increased genetic resistance to CHDL and lameness.

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NOTES

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FOOT BATHING PROTOCOLS: EVIDENCE AND LEGALITIES

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As digital dermatitis spread through the UK and around the World, the adoption of foot bathing practices has become widespread. Foot bathing has been advocated for various reasons, including the control of foul, hardening claws and reducing heel horn erosion but it is for the control of digital dermatitis that it has been most widely adopted. There is some evidence to show as herd size increases the need to foot bath to maintain control increases (Stokes, 2011). Despite the relatively recent demand for foot bathing advice, there is now a substantial body of evidence to support the use of foot baths for the control of digital dermatitis, especially compared to other aspects of lameness prevention and treatment. However, there are some notable areas of conflicting evidence and some obvious gaps highlighted in a recent systematic review of the literature (Potterton et al., 2012) and some researchers still advocate more emphasis on foot hygiene and individual cow treatment (Nuss, 2006). This short review will evaluate legislative regulation with respect to foot bathing dairy cows in the UK and the scientific evidence for the use of various biocides and foot bathing systems.

REGULATION OF FOOT BATHING BIOCIDES

In the early years of digital dermatitis control in the UK many dairy producers resorted to antibiotic foot baths to control epidemics and a variety of products proved effective (Watson, 1997). These treatments are off-license and its common use without adherence to statutory milk withdrawal times has been overlooked and tolerated in the interests of cattle welfare. However, at a time when the industry faces criticism over irresponsible antimicrobial usage, this practice should be now be superseded by alternatives such as effective foot disinfection protocols.
Historically the use of biocides in foot baths was largely unregulated except for the tight restrictions on medicinal (treatment) claims. However, with environmental and human safety concerns, European legislation has been created to regulate use in non-therapeutic situations in a range of industrial and agricultural applications. In September 2013 the European biocides directive was superseded by the EU biocides product regulation. Further details can be found in Table 1.
With respect to legislation there are several considerations for the cattle industry:

1. Are foot bathing products containing licensed biocides according to the latest European Directive?
2. Are products legal and approved for use in the UK by Trading Standards?
3. Are products being used on farm according to the appropriate Health and Safety guidance enforced by the Health and Safety Executive (HSE)?
4. Can products be disposed of safely according to the Environment Agency

Let's consider formaldehyde as an example. Formaldehyde is sold as a product called formalin which contains the necessary stabilisers, methanol and formaldehyde at 38% to provide a safe product according to stipulation by Trading Standards. The EU Biocides Directive was replaced by a regulation which approves the use of biocides. Manufacturers and retailers of formalin were given a period to apply for a approval or remove formalin from sale. Following an application, the Biocidal products Committee (BPC) recommended formalin for approval as a Veterinary Hygiene biocide. It now goes to European Chemicals Agency (ECHA) for final approval, a process which can take 12 months. In January 2016 formaldhyde was re-categorised from carcinogen category 2 ('possible carcinogen') to category 1b ('probably carcinogen') (same level as diesel exhaust fumes), which brings tighter restrictions enforced by the HSE. The interpretation of these restrictions is that only professionals are approved to use formalin, which necessitates training and monitoring. While the safety data sheet remains unchanged in this case, there is an onus on the employer to ensure formalin is handled safely with appropriate personal protective equipment (PPE) and keeping levels below the legal limit of 2ppm, which then falls under the Health and Safety executive to investigate should a concern be reported. Despite all the regulation, there appears to be little monitoring of the situation other than at product manufacture level and product labelling. This may change in future and so the prudent advice should be to use products according to the safety datasheets and take the necessary precautions including provision of staff training and appropriate PPE. What constitutes safe disposal of formaldehyde has been challenged and while dilution in a slurry lagoon is likely to minimise risk, there is a lack of evidence to support or refute this. Perhaps of greater concern is the contamination by toxic heavy metals such as copper and zinc (in sulphate form). These regulations apply to all biocides not just generic compounds. Table 1 shows the various sources of information relating to the biocides regulation in the UK.

Table 1. Useful sources of information on legislation relating to foot bathing agents

Topic	Sources of information
Products with a medicinal license	Veterinary Medicines Directorate
EU Biocides Product Regulation	http://www.hse.gov.uk/biocides/index.htm
List of approved biocides	http://ec.europa.eu/health/biocides/active_substances/index_en.htm
Biocide product claims, sales and marketing	Trading Standards
Biocide disposal	Environment agency

EVIDENCE FOR BIOCIDE EFFICACY

The list of chemicals used for foot disinfection in foot baths is large and growing. The most commonly used generic products are formalin, copper sulphate and zinc sulphate (Cook et al., 2012, Bell, 2004). The number with scientific evaluation are relatively small (Bell et al., 2014) and most remarkably excludes daily formalin regimes (Table 2). The published evidence supporting copper remains sparse and debatable (Thomsen, 2015) despite the observed efficacy on-farm.

Table 2. Published reports for biocides used in foot baths for the control of digital dermatitis (modified from Bell et al. (2014))

Author (date), country	Study design
1. Laven and Hunt (2002), UK	187 Holstein-Friesian cows from a group of 369 cubicle housed lactating cows in a herd of 550 milking cows (8500 litres average milk yield). Randomised positive-control trial involving 2 days of 2.1g/litre Erythromycin (positive control) compared with 7 consecutive days of 6% formalin, 2% copper sulphate or 1% peracetic acid
2. Manske et al (2002) , Sweden	43 Swedish Red and 15 Swedish Holsteins in one herd. Split-leg footbath design with negative control (water). Five periods of footbathing was conducted for a median of 10 days with a gap between bouts of median 5.5 days. Comparison of 0.6% ionized copper (Hoofpro+, SSI, Julesberg, CO) with water as a negative control.

3. Silva et al (2005), Brazil	120 Holsteins from two herds. Randomised field trial with no control and the following four groups: 1. Hypochlorite 1% solution in footbath twice daily for 30 days AND intravenous oxytetracycline 10mg/kg q48hrs repeated 4 times 2. Hypochlorite 1% solution in footbath twice daily for 30 days 3. Intravenous oxytetracycline 10mg/kg q48hrs repeated 4 times 4. Commercial topical ointment
4. Holzhauer et al (2008), The Netherlands	140 lactating dairy cows (95% Holstein-Friesians). Randomised control trial involving: Control=1 once per week through 4% formalin Gp 1=twice on one day, every other week, 4% formalin Gp 2=on days 7,28 and 90 water sprayed clean and bathed with commercial compound Gp 3= once per week commercial compound Gp 4= once per week 3% sodium carbonate solution
5. Thomsen et al (2008), Denmark	Four herds per product;100 randomly selected cows from each farm; Danish breeds. Split leg footbath design with negative control. Three products were tested: 1. 1.5% Virocid (glutaraldehyde, didecylmethylammoniumchloride, and alkyldimethylammoniumchloride; Cid Lines, Ieper, Belgium) 2. 2% Hoofcare DA(quaternary ammonium compounds; DeLaval, Drongen, Belgium) 3. 1% Kickstart 2 (hydrogen peroxide, acetic acid, and peracetic acid; Cid Lines) Cows walked through footbathing solutions 2 days per week for 8 weeks.
6. Speijers et al (2010), Northern Ireland	118 lactating Holstein-Friesians (95%). Three biocides were tested: 1. Copper sulphate pentahydrate (2% and 5%) 2. Sodium hypochlorite (2%) 3. Sodium chloride (10%) 'No footbath' was used as a control. Three footbathing regimes were tested: 1. Four consecutive milkings every week (X4/W1) 2. Four consecutive milkings every other week (X4/W2) 3. Alternating weeks of X4 copper and X4 salt
7. Teixeira et al (2010), USA	406 lactating Holsteins in a 2800 herd. A commercial biocide tested using formalin and copper as positive controls in twice weekly footbathing regimes: 1. Dragonhyde 5% 2. Formalin 5% 3. Copper sulphate 5% and 10%
8. Holzhauer et al (2012), The Netherlands	120 Holsteins. A 4 month, split-leg footbath trial comparing 4% formalin (1 day per week) with acidified, ionized copper sulphate (5 days per week)
9. Logue et al	408 Holstein-Friesians. Split-leg footbath design with 5% copper

(2012), Scotland	sulphate as a positive control compared with a commercial heavy metal product. Foot bathing twice daily for 3 consecutive days over 103 days in total. Some herds treated with footbaths in serial (4.4m), some with single baths (2.2m).
10. Relun et al (2012), France	4677 lactating dairy cows on 52 farms. 6 month quasi-randomised trial with negative control (no foot bathing and individual treatment of cases) compared with: 1. Footbath four consecutive milkings every 4 weeks (FB/4W) 2. Four consecutive milkings every 2 weeks (FB/2W) 3. Collective spraying for two milkings every 2 weeks (CS/2W) Chelated copper (3.5g/litre) and zinc (0.5g/litre) was used in the footbath. A stronger solution was used in the spray (20g/litre for both chelated copper and zinc).
11. Speijers et al (2012), Northern Ireland	Experiment 1: 70 lactating Holstein-Friesian cows with BDD lesions Experiment 2: 64 Holstein-Friesians without BDD lesions. Experiment 1 involved 14 weeks of footbathing using: 1. 5% copper sulphate every week, 4 consecutive milkings 2. 5% copper sulphate every two weeks, 4 consecutive milkings Experiment 2 involved 14 weeks of footbathing using: 1. 5% copper sulphate every two weeks, 4 consecutive milkings 2. 5% copper sulphate every four weeks, 4 consecutive milkings
12. Relun et al (2013), France	4678 dairy cows on 52 farms (80% Holsteins, 20% Normande breed). Farms allocated to treatments by minimization which some authorities advocate over the randomized control trial (Scott et al., 2002). Farms allocated to either: 1. Footbath vs collective spraying 2. 2 days every 2 weeks vs 2 days every 4 weeks Chelated copper and zinc solutions were used in the footbath (5% Hoofit solution, Intracare, The Netherlands) and spray solution (50% Hoofit liquid, Intracare, The Netherlands)
13. Smith et al. (2014)	Three herds, 120, 170, and 200 lactating Holsteins, Split leg trial comparing 3% Hoofsure endurance and 5% copper sulphate

There are clearly a number of ways to evaluate biocidal efficacy (Table 3). Researchers have assessed in vitro biocidal potency (Hartshorn et al., 2013) which has informed of likely performance in the face of environmental contamination. However, it does not fully predict the full response on farm perhaps due to the benefit of the physical cleaning of feet, the potential for some products to permeate epidermal layers and lesions more readily and it does not evaluate the effect on cows with open lesions. For instance, Thomsen et al. (2012) reported a positive effect of detergent washing of feet; and some chemicals appear to chemically cauterise lesions with potential welfare consequence to be balanced by improved recovery rates. The complete trial would evaluate the effect of a biocide in protecting cows without lesions and exposed to infection but also the response (behaviour and cure) of cows with lesions. Most studies evaluate clinical cure, defined as improvement from ulcerated or hyperkeratotic stages to regressed forms of digital dermatitis but it may be necessary to evaluate longer term bacteriological cure

(Berry et al., 2012). Far too many products make it to market without robust evaluation leading to significant welfare problems for cows and economic problems for producers.

Table 3. Study designs used to evaluate biocidal efficacy

Study design	Example
In vitro Minimum Inhibitory Concentration study	Hartshorn et al. (2013)
Observational study	Cook et al. (2012)
Split-leg trial – with or without cross-over	Manske et al. (2002)
Within herd randomized control trials	Laven and Hunt (2002)
Non-random and quasi-randomised trials	Relun et al. (2012)
Allocation by minimisation	Relun et al. (2013)
Multiple herd randomized control trials	None
Meta-analysis	None

Current replenishment rates are based on the findings of Holzhauer et al. (2004) who showed formalin concentrations remained acceptable when 300 cows passed through 200 litre foot baths (leading to the 1 cow per 1 litre of solution rule). More startling, this study demonstrated the massive variation in concentrations of solutions in freshly made foot baths and the discrepancy between intended concentrations and actual. This may explain frequent foot bath failures observed on farm.

EVIDENCE FOR OPTIMAL FOOT BATH DESIGN

When designing foot baths researchers have approached the question of 'what is optimal design' in a number of ways:

1. What will increase contact time with biocides
2. What will encourage cows to walk through baths voluntarily
3. What will minimise biocide loss or contamination

Only one trial has examined the concentration of biocide in foot baths (Holzhauer et al., 2004). No trials have evaluated foot bath design in relation to the obvious outcome measure: control for digital dermatitis lesion.

Wide versus narrow design

A debate has started about whether the single lane foot bath or the very wide foot bath is optimal. One research group have concluded the long single lane is best for maximising contact time within the bathing solution, by increasing foot plunges and slightly obstructing the route to make cow passage slower (Cook et al., 2012). Another advisor advocates short (2.5-3m) and wide (>1.5m) baths that facilitates calm cow movement for maximal cow flow and minimal stress and defaecation (Chesterton, 2013). Without a well-constructed study, the optimal design remains elusive and based on observations. Another valid view may be that there is no universally optimal design.

Pre-wash versus no pre-wash

Observations of dairy cows in Wisconsin suggested cows were more likely to defaecate in a treatment bath than a pre-wash bath. However, in an undergraduate study involving a randomised control trial, contamination rates were compared with and without a pre-wash which revealed significantly less contamination in the treatment bath when a pre-wash bath was used. However, no measure of biocidal properties were monitored. So it may be that at levels of biocide used in practice, foot baths work adequately well with or without a pre-wash water bath. Furthermore, there are valid concerns about the potential for splashing of dirty water onto udders and so a better recommendation may be to compartmentalise a long treatment bath to minimise contamination in the final section. This has some small cost implications but has to represent best practice.

While cheap products such as formalin are in use the cost of a large volume bath is small compared to the benefit of reduced digital dermatitis, but in a least cost control scenario (Cook et al., 2012) then reductions in chemical usage warrants further investigation.

Manual fill and empty versus automatic foot bathing systems

Remarkably there is very little published evidence to demonstrate the efficacy of the automated foot bathing systems. With a range of systems now available, including sprays and wash systems, it is surprising that few are supported by robust evaluation.

CONCLUSIONS

Evidence for foot bathing regimens is substantial in relation to a range of biocides but there are substantial gaps particularly involving multiple herd studies. Less well researched are the features of optimal foot bath design. Regulation is constantly tightening and producers are advised to follow safety precautions for any biocide used for the control of digital dermatitis.

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DEVELOPMENTS IN AUTOMATED MONITORING OF LAMENESS AND LOCOMOTION

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SUMMARY

This paper will summarise some of the recent developments in methods of measuring locomotion and lameness. The main technologies being developed have been force plates and ground reaction measurement, kinematic and vision based systems, movement measurements, thermography and behavioural change. Take up of the commercially available systems has been slow which indicates either a lack of accuracy, unreliability or a lack of sustained demand.

INTRODUCTION

Locomotion scoring and early detection of impaired mobility is an important tool to improve foot health in dairy herds. Milk buyers increasingly require mobility scores to be recorded for welfare assurance in their supply chain. Engineers have been attempting to solve this problem with a number of technological approaches made easier by the advent of low cost, low power microprocessors, by vision systems and wireless telemetry. Little of what has been developed recently would have been possible even 10 years ago. The use of RFID is a key component to identify the individual cow automatically and except in territories where such systems are standardised and mandatory there has been difficulty in integrating with third party systems using proprietary hardware systems. The challenge for humans doing manual scoring is often the difficulty of identifying individual cows in large groups leaving milking parlours.

The main challenges have been the variability between different forms of impaired locomotion, the vague specifications of what is required (locomotion or lameness) and the lack of significant demand in an industry that was ossified by government policy for thirty years. Since the change in CAP in 2015 change and pressure on margins has focused the minds of some managers on the need for technology.

The benefits of automation are that it can be omnipresent and always performs the same task even if its ability to detect problems is poorer than a human. Or to put it simply humans are brilliant but unreliable while automated systems are limited in perception but reliable. Automated systems can build up a database from which trends can be determined and do not cause interaction with the animal which can perturb a scoring done by a human. Another benefit of automation is that data can be acquired for multiple purposes, force plates can measure weight, pedometers can measure oestrus and lying behaviour, this sometimes confuses the marketing messages as it is not always clear which application gives the best return and it requires a data driven farm team to derive the benefit by using the information.

SYSTEMS ON OR NEAR THE MARKET

The Boumatic Stepmetrix system has been on the market for several years. It grew out of work by Mark Varner at University of Maryland and was patented in 2001 as a method and apparatus for detecting lameness in animals “to detect and analyze ground reaction forces produced by an animal passing through the diagnostic system” by measuring the magnitude and location of a force applied to a series of force plates in sequence. It is a relatively expensive system and suffers from the load plates being in exactly the most difficult place on a dairy farm to keep clean and dry to enable electronics to work reliably. Bicalho et al. (2007) showed that at a single test visual scoring performed better than the Stepmetrix although its proponents say that it is the trend in locomotion that is more important than a single spot reading.

Vision based systems have been in development for a number of years in a major project led by Leuven University and including the major manufacturer of systems de Laval. It appears to have focused on building a 3D image of the cow's back using off the shelf Kinect cameras and measures the curvature of the spine as an indicator of lameness. It is claimed to be able to distinguish between mobility scores 2 and below from 3s and above. It is confused by shifting light patterns from solar glare and works best at night as cows leave a milking system singly.

A UK based vision system which is now close to market testing is being developed by Kingshay in Somerset. Howsmycow system also measures body condition score and is looking for test sites.

SYSTEMS IN DEVELOPMENT

A number of papers have been published and these usually report the effectiveness of proprietary systems the operations of which are not always fully disclosed. Most oestrus detection collars, eartags and pedometers now use tri-axial accelerometers and these provide a rich harvest of data which with suitable processing can indicate impaired mobility either by analysing lying times, speed of walking, standing times and even asymmetric accelerations. These data can also be combined with rumination times, milk yield data and historic data and in some reports have given high specificity and sensitivity (Van Hertem et al. 2013). None of these systems is thought to be close to market release and it is unlikely that lameness detection or mobility scoring will be the prime purpose of the purchase.

CONCLUDING REMARKS

There has been a wide variety of approaches taken to develop methods of automating the time consuming task of scoring the mobility of dairy cows but developments in progress particularly in vision based systems and accelerometer analysis look the most likely to provide the data required in commercial systems in the next decade.

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MYCOPLASMA – THE DUTCH EXPERIENCE OF AN EMERGING DISEASE?

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SUMMARY

This paper will consider the Dutch experience with a relatively new disease, Mycoplasma bovis (M. bovis), causing very serious problems (extremely painful cows) with serious consequences for farmer and practitioner (euthanizing cows). In all herds with M. bovis arthritis problems, mainly front legs were involved (carpal, fetlock joint). At the start of reporting of the arthritis problems, 16 herds with arthritis problems were investigated and an average incidence of 8%, was estimated 10 of these herds (63%) had proven concomitant mastitis problems. At cow level arthritis and mastitis were seldom seen together (3%). Six herds (38%) had respiratory problems in calves (laboratory confirmation on mycoplasma not performed). Laboratory confirmation of the diagnosis on farm level was done by cultivation of joint punctations of synovial fluid or materials derived at necropsy and milk samples. For estimating risk factors, each herd was compared with 2 neighbouring herds (same practice) without problems. Problems seemed to be related with increasing herd size (average size case 185, average Dutch 2013: 95), and in a multivariable analysis, case herds were significantly associated with purchase of cattle (OR= 6.1) and a higher protein percentage in milk (OR= 2.6). a tendency was found toward vaccinating cattle and the presence of mycoplasma arthritis (OR= 3.9; p= 0.10).

All cultivated mycoplasma isolates (from joint infections dairy cows/calves, pneumonia cases calves (in stock), and (clinical) mastitis samples) were genotyped using MLVA typing and compared to historical isolates to determine phylogenetic relationships between the isolated M. bovis isolates both within and between herds. Using MLVA typing several distinct groups of M. bovis isolates could be distinguished. M. bovis isolated from affected joints in dairy cows did not form a distinct group as compared to the M. bovis isolates from infected lungs in calves, from mastitis- and historical samples. Typing results indicated that the recent outbreaks of M. bovis in the Netherlands were not due to entrance or spread of one single strain and, therefore, these outbreaks might be related to increased susceptibility of the animals, due to changed management practices.

INTRODUCTION

Mycoplasma is a bacteria that may affect animals of different species (swine, cattle, sheep, dogs cat etc.), but in general each species is affected by its own mycoplasma subspecies. In cattle, mycoplasma and mainly Mycoplasma bovis (M. bovis) was considered as a component in bovine respiratory disease problems in veal calves in The Netherlands especially, since the eighties of the previous century (ter Laak, 1992). Mastitis and arthritis problems related to M. bovis infections were incidentally diagnosed in Western Europe (Pfützner H et al., 1979, Wentink et al., 1987). In a mastitis project of GD, about 950 milk samples with the diagnosis “no pathogens found” were tested for the presence of M. bovis by cultivation and only in 15 samples (1.6%) M. bovis was proven. So, until 2012, M. bovis was rarely diagnosed in dairy herds and it was considered to be a veal calves problem Since the mid-2012, GD was contacted about the presentation of extremely lame cows, during the same period GD was more contacted about M. bovis related mastitis. Therefore, a(pilot) case-control study was initiated, in which different herds with problems were visited in a short period and compared with similar herds without these problems. The objective of this paper is to describe the clinical presentation, diagnostic tools, found risk factors in the different M. bovis outbreaks investigated and current advice and problems to be solved.

CLINICAL PRESENTATION

The clinical presentation of M. bovis arthritis in dairy cows is presented to the practitioner as a front leg problem (carpal and fetlock joint). Cows are presented to the practitioner as extremely lame cows with symptoms of inflammation of 1-2 joints (tumor, calor, dolor, rubor, and functio laesa). A general investigation of the cows showed thin cows with increased temperature (> 40° C), that tried to avoid crowded areas and are reluctant to pu weight on the affected leg. cows were frequently placed in a pen with straw bedding. Applied therapies by the farmers generally failed. In case of the probability diagnosis M. bovis, dairy cows were checked next milking for the presence of mastitis and the herds were checked for M. bovis mastitis suspected cows (anamneses: mastitis at more quarters, worse reaction on applied therapy, increased cell count or spontaneous drying quarters, and/or severe respiratory problems in calves.

Punctuation of affected joints showed a sero-fibrinous exudate, that can be send to the laboratory for cultivation. Note that after performing arthrocentesis for diagnostic goals, intra-articular therapy can be applied using the same needle(Desrocher and Francoz, 2014).

DIAGNOSTIC POSSIBILITIES

The dairy farmer is very concerned and wants to have a diagnosis, therapeutic plan and prognosis. To confirm the diagnosis the punctuation sample can be used for cultivation, but M. bovis is a slow grower and needs special conditions (see below). An advantage of cultivation is that this technique can be used to determine an antibiotic sensitivity, although the therapeutic possibilities are limited (see later). Another option is to use the punctuation sample for PCR M. bovis (much faster), this is in GD laboratory however limited to M. bovis (no cross reactions with other subspecies), but the good news is, that arthritis is almost always caused by M. bovis (see later). Either PCR and antibiotic sensitivity testing was at this moment not possible. The third option is serology testing for M. bovis antibodies (Bio-X Diagnostics, Jemelle, Belgium), whereby only results of more than ++ are indicative for a recent M. bovis infection (again M. bovis only). To exclude mycoplasma mastitis in the herd, it is advisable to check a bulk milk sample for the presence of M. bovis mastitis, but remember that bulk milk sample testing generally excludes cows with mastitis and dry cows In addition, M. bovis excretion may vary, so bulk milk sample testing should be done repeated in order to confirm the diagnosis (Nielsen et al., 2015).

MICROBIOLOGICAL ANALYSES

Biological materials collected during the herd visits and during post mortal investigation from (affected) joints, tissues and organs can be cultured for detection of bacterial pathogens on sheep blood agar (Biotrading, the Netherlands) on standard aerobic conditions for 2 days at 37 °C and for the detection of Mycoplasma species on pleuropneumonia-like organism (PPLO)–agar for 7-11 days at 37 °C. Colonies that are typical for Mycoplasma can be confirmed with a Mycoplasma bovis (M. bovis) specific PCR. In a previous study, the isolated mycoplasmata were typed using Multiple Locus Variable Number Tandem Repeats Analysis (MLVA) to evaluate within and between herd diversity. Based on this typing diverse types of M. bovis isolates were diagnosed and the arthritis causing M. bovis in dairy cows was not a specific or new clone, but comparable with the M. bovis found in M. bovis causing mastitis in dairy cows and pneumonia in beef calves. MLVA typing showed that M. bovis isolates could be divided into 36 different Variable Numbers Tandem Repeat (VNTR) groups. A part of these VNTR types seems clonal related and belong probably to the same Clonal Complex (publication in preparation).

RISK FACTORS

Purchase of asymptomatically infected cattle is thought to be the primary means by which Mycoplasma free herds become infected. Transmission is probably limited and delayed until shedding occurs (stress?) and this can make it difficult to identify the source of infection. M. bovis disease outbreaks occur in seemingly closed herds (Wilson et al., 2007). Transmission of M. bovis in respiratory secretions is considered important in the epidemiology of infection, although there is little experimental data to support this assumption (current project in The Netherlands). In dairy cattle, M. bovis has traditionally been regarded as a contagious mastitis pathogen, with udder-to-udder spread being the major means of transmission (Fox, 2012). Whether Upper Respiratory Tract transmission with bacteraemia and subsequent dissemination to organ systems (udder, joint) is important in the epidemiology of M. bovis has not been determined, but M. bovis can be isolated from nasal secretions of cows with mastitis also (Bennett and Jasper, 1977). M. bovis might be transmitted in respiratory secretions via aerosols, nose-to-nose contact, or indirectly via feed, water, housing, or other fomites. M. bovis bacteria are susceptible to desiccation and sunlight, but M. bovis can survive for long periods in protected environments especially in cool, humid conditions. M. bovis has been shown to persist for months in recycled sand bedding. Further studies are needed to determine the role of environmental reservoirs in M. bovis epidemiology (Maunsell et al., 2011). Risk factors found in the Dutch experience were larger herds, the median size in outbreak herds were 185 dairy cows present, while the Dutch average size in 2013 was 95 (CBS, 2013). In a case control study performed in 2012-2013 (16 case and 32 control herds) and analysed in a multivariable analysis, case herds were significantly associated with purchase of cattle (OR= 6.1) and a higher protein percentage in milk (OR= 2.6). Vaccinating cattle was a trend with the presence of M. bovis arthritis (OR= 3.9; p= 0.10) and finally concentrate delivered by a certain feed supplier (OR= 6.6; p=0.03)

CURRENT ADVICES TO CONTROL

Mycoplasma arthritis affected cows should be remove immediately from the dairy milking herd to a sick cows pen. Usually these cows are in a lot of pain and need optimal space for lying down, getting up, access to food and drinking water etc., minimal undesirable animal contacts and to be nursed optimally. Additionally, very few information is available how M. bovis is shed by these stressed cows. It is therefore very unwise to combine sick cows and calving cows in a single pen Considering the poor responses to therapy it might be (if liable to be transported) the best option to slaughter the cows in a short time.

M. bovis mastitis positive cows should be removed from the milking herd also and the options here are slaughtering and/or fattening. In case of mastitis, initial transmission might occur via nose-to-nose contact and result in an outbreak of M. bovis mastitis, or it might occur during the milking process. To control the infection, incoming animals should be put into quarantine before being comingled with original herd animals. Quarantining does not seem to be a biosecurity strategy often practiced in control of mycoplasma mastitis and may not be warranted in herds with excellent milking time hygiene practices. The ability to monitor for the incipient stages of an outbreak, often done through bulk tank milk culturing, is recommended (Fox, 2012).

PROBLEMS TO BE SOLVED

Mycoplasma in cattle herds is mainly caused by M. bovis and is a relatively emerging agent in the Netherlands which may cause serious health problems not only in (veal) calves but in dairy cattle also. But a lot of questions remained unsolved so far, as there is the way of introduction, transmission from the upper respiratory tract to the joints, within cows transmission etc. The other point is the hardly untreatable situation of affected cows, simply because the bacteria is hardly reachable. M. bovis is really is a tough bacteria to beat and big challenge for the veterinary world.

CONCLUDING REMARKS

The challenges of the dairy farmer and his professional advisors are to keep M. bovis infections outside the herd. This means in the first place a closed herd strategy; this includes keeping the herd from direct or indirect animal contacts with neighbouring herds. In case of vaccination, this needs to be done according to GMP standards. These measures cannot guarantee not having outbreaks and in case of both mycoplasma mastitis and arthritis problems, infected cows are a risk for their herd mates and should be isolated or culled as soon as possible, to prevent further damage to the herd.

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NOTES

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AN IN-PRACTICE VETS APPROACH TO MINIMISING LAMENESS – MANAGING THE MOBILITY TEAM

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SUMMARY

Lameness management is increasingly becoming a team affair involving many people from on and off the farm in question. The challenge for vets in practice is to use our unique appreciation of the pathophysiology of lameness as well as experience in tackling both infectious and management diseases to set the agenda when it comes to improving mobility and to help coordinate the efforts of all the separate stakeholders to ensure the best outcome for the client and their cows.

INTRODUCTION

Until relatively recently, veterinary involvement in lameness was limited to being asked to look at the odd lame cow at a routine fertility visit, often when her foot was the size of a watermelon and unfortunately, largely beyond repair. Now, thanks to the efforts of a number of agencies and individuals to raise the profile of herd lameness, and with the widespread acceptance of the AHDB Dairy Mobility Score as a simple means of measuring and, more importantly, comparing herd prevalence, dairy cow mobility has risen sharply up the agenda and is considered a key element of successful dairying. I will use this presentation to discuss some of the key principles of lameness control in practice as well as sharing experiences of where the team approach has been particularly beneficial.

KEY PRINCIPLES OF LAMENESS MANAGEMENT

These have been very eloquently and succinctly set out in the AHDB Dairy Healthy Feet Program (DHFP) and regardless of whether or not a particular farm has enrolled on the program, they are still a sound basis for the thought process of any practitioner seeking to improve mobility on their clients' farms.

The approach is based around the 'four success factors':

- Low infection pressure
- Good horn quality and hoof shape
- Low forces on the feet – good cow comfort and cow flow
- Early detection and prompt, effective treatment of lame cows

These factors are all influenced by the farm infrastructure, the management practices in place, the skills and diligence of the farm staff and the input of contractors/advisers such as foot trimmers, vets and nutritionists. The job of anyone leading a lameness reduction program is to gather information on all these aspects, and interpret this alongside the mobility scoring and lesion data to identify areas where changes in the status quo are likely to lead to improved mobility.

PUTTING IT INTO PRACTICE

The challenge for the veterinary practitioner is to combine their own clinical knowledge and experience with the information coming out of both the research community and the farming press and then distill this down to form a workable strategy that can be delivered repeatably onto our clients farms. This is often easier said than done when we consider that lameness control is all too often being discussed while scanning cows or performing a TB test so we need to make it a topic in its own right and set aside time to develop a lameness reduction plan for each of our farms.

What tools are available to manage lameness?

1. Mobility scoring

    a. Can be performed by vet, paraprofessional, or farmer but consistency is key
    b. Requires a suitable system to collate, analyse and report results

2. Foot-trimming

    a. Routine trimming by professional trimmer or farmer
    b. Referred cases or salvage procedures by the vet
    c. Farmer trimming of lame cows
    d. Must collect as much data from these as possible to assess causes of lameness

3. On-farm risk assessment

    a. AHDB Dairy Healthy Feet Program
    b. Listen to views of farmer, staff on farm, and any outside stakeholders such as trimmers etc

We can use all of these tools and the data they generate to build up a complete picture of the factors influencing lameness on an individual farm and it is this which we must then look to influence through the lameness control plan.

NOTES

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FIVE POINT PLAN FOR THE CONTROL OF DIGITAL DERMATITIS

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SUMMARY

First reported by Cheli and Mortellaro digital dermatitis has now become an infection of major importance worldwide, and probably accounts for around 30% of all cattle lameness. Although much has been published on control measures, the current authors felt that the various measures available could be presented in a more logical format. This was achieved following a meeting in Ghent in January 2016, supported by Delaval, and resulted in a Five Point Plan for the Control of Digital Dermatitis.

INTRODUCTION

Digital dermatitis (DD) is an ulcerative lesion of the digital skin (Cheli and Mortellaro 1974) causing severe lameness in dairy cattle and was first reported in the UK by Blowey and Sharp (1988). The disease has more recently spread into sheep in the UK (Harwood et al 1997) where it is known as contagious ovine digital dermatitis (CODD) and has been confirmed in beef cattle (Sullivan et al 2013) and tail biting and other lesions in pigs (Clegg et al – in press). Three Treponema phylotypes have been isolated from dairy cattle foot lesions (Evans and others 2008).

DD treponemes are also associated with other lesions on the skin of cattle, including non-healing foot lesions (Evans et al 2011) mammary dermatitis on udders ischaemic teat necrosis (Clegg et al 2016) and pressures sores on hocks and flanks (Clegg et al 2016 – in press). Much has already been published about potential modes of transmission of DD and potential control measures (Holzhauer et al 2006; Sullivan et al 2014). The current paper attempts to present DD control measures in a logical format that would be easily understood and followed by those working in the field. The format follows that of the Five Point Plan for mastitis control (Kingwell et al 1970) which has been frequently quoted and has remained an important template for the past 40 plus years.

It is very important to appreciate that the Five Point Plan applies to young stock, precalving heifers, dry cows and milking cows. Failure to control DD in dry cows and heifers precalving is a common reason for the breakdown of DD control. A much more detailed explanation of the Five Point Plan and how it might be used on farm is given in an appendix to these proceedings, and is also available at www.delavalcorporate.com/five-point-plan-digital-dermatitis.

FIVE POINT PLAN FOR CONTROL OF DIGITAL DERMATITIS

1. External biosecurity to keep disease out of farm
    a. Avoid introduction by animals
    b. Avoid introduction by equipment and visitors

2. Internal biosecurity to minimise infection pressure on cows
    a. Maximize cow comfort
    b. Avoid transmission between cows

3. Early identification, recording and treatment of clinical cases, in association with hoof care
    1. Daily observe lame cows and visible foot lesions
    2. Treat immediately all detected lesions. Establish treatment protocol with hoof care specialist
    3. Consider culling chronically infected animals

4. Frequent foot disinfection to reduce new cases
    a. Hoof bath design and use
    b. Consider foot cleaning before disinfection

5. Define and monitor hoof health targets
    1. Review incidence and prevalence of DD lesions at a regular basis

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USING ACCELEROMETERS FOR LAMENESS DETECTION: COMPARISON OF FRONT-LEG VERSUS HIND-LEGS

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SUMMARY

Leg-mounted IceQube® accelerometers measure lying time (LT), number of lying bouts (LB), step count (Steps) and Motion Index (MI, overall leg activity) of dairy cattle automatically. Studies have shown that legs may differ with respect to LB generated. We collected data from three IceQube® accelerometers simultaneously on the front left (FL), hind right (HR), and hind left (HL) legs of 94 cows over eight months. Daily sums of LT, MI, Steps and LB were calculated for days of visual mobility scoring (MS). LT, MI and Steps were consistent across legs, with all legs correlating very well, other than MI and Steps at MS4. LB correlated well on both hind legs, but was higher on FL compared with hind legs, likely due to more false LB in FL. As expected, LT and LB increased and Steps and MI decreased with increasing lameness severity, except HR MI at MS4. Video recordings are needed to verify that very lame cows exhibit an increased number of unsynchronized leg movement. In conclusion, IceQube® accelerometers automatically and reliably measure behavioural changes caused by lameness.

BACKGROUND

In dairy cows, behavioural changes measured using accelerometers can be used for automated heat and disease detection. For instance, daily LT increases, whereas MI decreases due to lameness [1]. Left-right hind leg differences in LB can occur due to short, false LB, which can filtered out by ignoring very short LB [2]. To our knowledge, studies comparing lying behaviour measured simultaneously on front and hind legs are lacking.

MATERIALS AND METHODS

Ninety four Holstein Friesian cows from the Harper Adams University herd were each fitted with IceQube® accelerometers (IceRobotics Ltd, Edinburgh, UK) on the FL, HR, and HL. Daily LT (%), LB, Steps, and MI were calculated. Cow mobility was scored weekly by one of two observers on a scale from 1 to 5 [3]. From March to November 2015, 2078 observations of MS with simultaneous accelerometer data for all three legs were assessed. Daily sums were calculated. Pearson correlation coefficients were used for leg comparison.

Table 1. Mean and standard deviation of daily sums by leg and mobility score (MS)

		Mean				Standard deviation			
Variable	Leg	MS1	MS2	MS3	MS4	MS1	MS2	MS3	MS4
MI	FL	7077	5921	5506	4540	3096	3627	3013	2488
	HL	7082	5749	5321	5151	2777	3307	2898	3392
	HR	6984	5736	5433	5882	2679	3388	2967	4503
Steps, no	FL	2139	1812	1664	1247	880	1096	931	707
	HL	2039	1655	1476	1200	738	911	815	714
	HR	2000	1648	1501	1434	685	925	813	1106
Lying bouts, no	FL	25.4	25.6	26.4	31.7	9.17	8.81	10.85	16.07
	HL	22.0	21.4	22.4	25.5	7.24	6.99	9.06	10.48
	HR	22.1	21.4	22.4	25.4	7.31	6.96	9.04	10.55
Lying time, %	FL	44.7	44.5	46.4	56.2	9.15	9.84	11.64	9.36
	HL	44.9	44.9	46.9	56.9	9.13	9.86	11.56	9.34
	HR	44.9	44.8	46.9	57.0	9.12	9.93	11.52	9.29

RESULTS

The number of observations of MS1 to MS5 was 133, 1597, 312, 36, and 0, respectively. The 36 MS4 observations originated from 17 cows, one of which accounted for 9 observations of MS4 despite several treatments for diseases on HR. As expected, LT and LB increased numerically with increasing MS (Table 1). Steps and MI decreased numerically with increasing MS, except HR for which MI was numerically higher at MS4 than at MS2 and MS3. LB was numerically higher on FL than hind legs. Leg-pairs correlated well, except hind legs at MS4 for Steps and MI (Table 2).

Table 2. Correlation coefficient by leg-pair and mobility score (MS) with level of significance indicated: [a] P<0.01, [b] P<0.001.

Variable	Leg-pair	MS1	MS2	MS3	MS4
MI	HR-HL	0.91[b]	0.95[b]	0.87[b]	0.12
	HL-FL	0.88[b]	0.94[b]	0.89[b]	0.64[b]
	HR-FL	0.89[b]	0.93[b]	0.86[b]	0.46[a]
Steps	HR-HL	0.89[b]	0.95[b]	0.88[b]	0.21
	HL-FL	0.88[b]	0.95[b]	0.92[b]	0.67[b]
	HR-FL	0.88[b]	0.94[b]	0.87[b]	0.48[a]
Lying bouts	HR-HL	0.98[b]	0.98[b]	0.99[b]	0.99[b]
	HL-FL	0.88[b]	0.80[b]	0.84[b]	0.88[b]
	HR-FL	0.89[b]	0.80[b]	0.84[b]	0.88[b]
Lying time	HR-HL	1.00[b]	0.99[b]	1.00[b]	1.00[b]
	HL-FL	1.00[b]	0.99[b]	0.98[b]	0.97[b]
	HR-FL	1.00[b]	0.99[b]	0.97[b]	0.98[b]

DISCUSSION AND CONCLUSION

Daily LT was similar across legs, but LB was higher on FL than hind legs, possibly due to more FL flexibility and movement causing false LB. This comparison was based on daily sums, future analyses should compare simultaneous leg behaviour within cow to verify that hind leg data are the most reliable. As expected, LT and LB increased whereas Steps and MI decreased when lameness severity increased, except MI of HR, which increased at MS4. Video recordings should verify if cows perform an increased number of unsynchronized leg movements causing elevated MI and hind legs to be uncorrelated regarding MI and Steps when cows are very lame. In conclusion, leg-mounted IceQube® accelerometers reliably measure changes in behaviour brought about by lameness.

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PREVENTION OF DIGITAL DERMATITIS IN DAIRY COWS USING AN ORGANIC ACID SOLUTION

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SUMMARY

Hoof disinfection is an important step in the prevention and management of infectious hoof diseases such as digital dermatitis (DD). Routinely used disinfectants like formalin and copper sulphate raise serious human health and environmental concerns. Sustainable and efficacious alternatives are needed. Applying the disinfectant by spraying instead of hoof bathing has the advantage that there is no risk of contaminating the disinfectant solution with manure and less residues end up in the environment as the consumption per animal is extremely low. The aim of this study was to evaluate the preventive efficacy of an organic acid based disinfectant when sprayed during milking.

MATERIALS AND METHOD

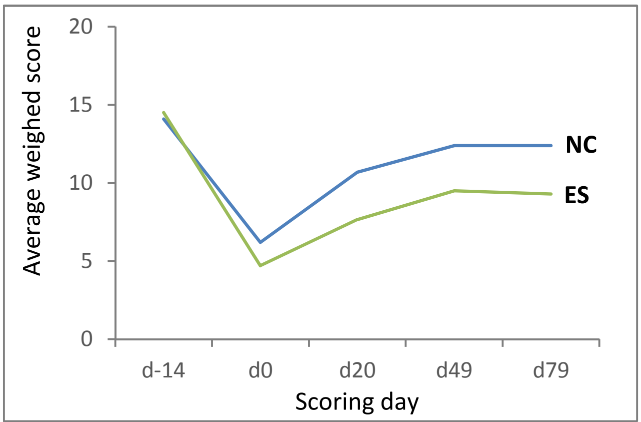
A total of 83 cows in a commercial dairy farm in Germany were included in the study. All animals underwent hoof trimming during the first visit (day -14). Of these, 95 feet presented acute (M2 = 27,7%) or chronic (M4 or M4.1 = 29,5%) DD lesions and were treated with salicylic acid (Novaderma®, WDT, Germany) and wrapped. After 5 days the wraps were removed. The spray test started 14 days later (day 0) after confirming the treatment success. The protocol in the parlour was as follows: a) Hind feet were cleaned with a water hose, b) A 4% solution of the organic acid based disinfectant (ES, EasyStride, DeLaval) was sprayed on all right hind feet while left feet remained as a control group (NC) and were not sprayed. This procedure was done three times a week for all cows enrolled in the study. Every foot was evaluated in a trimming chute on day 0, 20, 49 and 79 following a weighed DD lesion score (Döpfer, 1997): M0=0, M1-I=1, M1-II=2, M1-III=3; M2-I=30, M2-II=40, M2-III=60, M3-I=4, M3-II=5, M3-III+6, M4-I=7, M4-II=8, M4-III=9.

RESULTS

Prevalence

At the start of the study (day 0), no statistical difference existed between the treatment groups in DD scores (p=0,504). By the end of the study (day 79), the ES group had lower weighed scores than the NC group (P=0,010).

Figure 1: Average weighed score of the treatment groups on scoring day d-14, d0, d20,

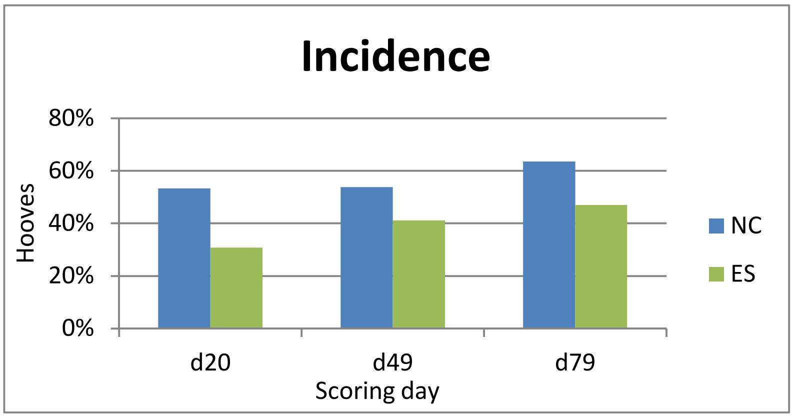


d49 and d79

Incidence

The proportion of hooves with score M0 at the previous scoring day transitioning to an M1, M2,M3, M4 or M4.1 lesion on each scoring day after the start of the trial were calculated (Figure 2). The ES group had a lower incidence of DD throughout the trial compared to the NC group. Due to the limited amount of hooves in the data set with a score M0 significance could not be demonstrated (P>0,05).

Figure 2: Transition from M0/M3/M4 to M1/M2/M4.1 per treatment group on scoring day d-14, d0, d20, d49 and d79



DISCUSSION AND CONCLUSION

In contrast to the use of footbaths where slurry contamination increases with every cow passing through, individual application of a disinfectant after pre-washing is able to provide a steady concentration of the disinfection solution leading to better results in DD prevention. The organic acid based disinfectant meets the expectations of producers and consumers in being a reliable and non-hazardous chemical. The topical spray application resulted in an acceptable prevention on new DD lesions. It is to be noted that hoof disinfection can only be part of a consequent hoof health management, based on a good hygiene regimen, appropriate housing conditions, regular trimming and individual treatments.

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THE PRACTICAL USE OF BLOCKS TO ALLEVIATE PAIN AND IMPROVE RECOVERY IN LAME COWS

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SUMMARY

The Dutch 5 step foot trimming method has become well established as the recognized method of trimming dairy cow's feet across the world. Modifications have been suggested but generally they still use the general principles outlined by Toussaint Raven (1985).

The first three steps of this method tend to describe the method for a preventative trim and steps four and five tend to only be required where lesions are present on the foot. Toussaint Raven described in step four the need to remove weight from an affected lesion. He describes that this may require a block.

Potterton et al. (2012) summarized all the peer reviewed literature involved in the treatment and prevention of lameness for the previous 10 years. This highlighted an absence of evidence based research relating to the effective treatment of claw horn lesions.

The University of Nottingham in partnership with AHDB – Dairy (formerly Dairy Co) highlighted the need for further research in this area. Thomas et al. (2015) demonstrated that there was a definite benefit from the addition of a block to the non diseased claw and this effect was enhanced further when a non steroidal was also used.

Percentage sound after 5 weeks (MS Score 0) – Thomas et al. (2015)

- Trim Only 24.4%
- Trim and Block 35.9%
- Trim and NSAID 28.6%
- Trim and Block and NSAID 56.1%

Toussaint Raven in his original book describes applying a block using a rubber block and nails. Technology has moved on considerably since then with the availability of many different glues and block materials.

This poster attempts to try to summarise some of the commonly used blocks as well as the commonly used glues available on the market. Some of the properties of these glues have been researched as part of a 3rd year research project at the University of Nottingham looking at block retention times while another project looked at some of the factors influencing the choice of blocks by vets and foot trimmers.

The poster also introduces some other novel concepts in block application including 'double blocking' and some other success factors to maximise success following block application.

The poster is intended as a practical discussion point at the conference with some examples of blocks on show. We hope that this will stimulate a discussion of how block retention and raid resolution of lameness can be achieved in different operators' hands. The authors do not pretend that the blocks discussed in the poster are an exhaustive list of those readily available in the UK but hope that they are able to stimulate meaningful discussion.

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CHANGING CHEMICAL LANDSCAPE: THE QUEST FOR THE DEVELOPMENT OF SAFE AND EFFECTIVE ALTERNATIVES TO CURRENT FOOTBATHING STRATEGIES

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ABSTRACT

Foot-bathing is one of the most commonly employed hygienic measures for controlling infectious causes of lameness. This study highlights that, due to changes in the regulatory chemical landscape, further research is need to identify the ideal properties that a chemical product(s) must possess in order to replace the current most utilised footbath solutions in the UK – formaldehyde and copper sulphate.

BACKGROUND

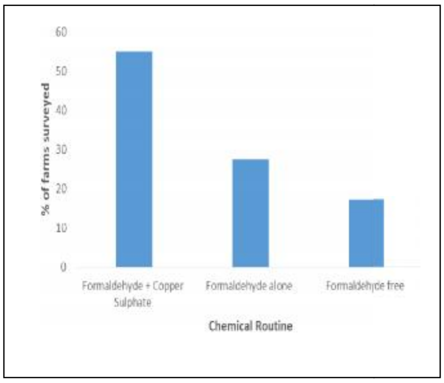
There has been, and continues to be, a large variety of independent and collaborative studies conducted by academia, industry and government agencies to identify strategies that may be implemented to improve animal health and welfare, and environmental / consumer safety along all areas of the agri-food chain. In considering the welfare of dairy cattle, some of the most important consequences of poor welfare are the occurrence of disease conditions, in particular foot and leg disorders and mastitis (1). Indeed, the EFSA Panel on Animal Health and Animal Welfare recommend that "because of the high risk of lameness in dairy cattle all dairy farmers should implement a lameness prevention programme" (1).

To aid in minimising the incidences of infectious disease challenges, and minimise the utilisation of antibiotics in the veterinary sector, greater emphasis has been placed for livestock production to implement so called "good farming practices", specifically biosecurity and general hygiene measures. Whilst the implementation of good farming practices dictates the need for enhanced cleaning and disinfection, recently the implementation of EC No 396/2005 (on maximum residue levels of pesticides in or on food and feed of plant and animal origin) and EU 528/2012 (concerning the making available on the market and use of biocidal products) has brought all traditional chemical disinfectants under the spotlight, and will result in wide ranging changes in the availability and practical use of chemical products for this sector.

Foot-bathing is one of the most commonly employed hygienic measure for controlling infectious causes of lameness, and is widely practiced in the UK. Presently, the non-antibiotic chemical solutions used are largely influenced by farmer preference, but it is recognised that those containing either formaldehyde or copper sulphate, or a mixture of both, appear to be the most commonly utilised solutions in the UK (2). The use of formaldehyde for veterinary hygiene applications has been under scrutiny for a considerable number of years, due its negative environmental, health and safety profile. Recently, this scrutiny at an EU level, has reached the anticipated, and yet sceptical, end. On 10th December 2015 the Biocidal Products Committee (BPC) of the European Chemicals Agency (ECHA), adopted the opinion that "finally, it is concluded that on base of the currently available data no safe use of formaldehyde in the animals' feet scenario can be demonstrated" (3). Similarly, the use of copper sulphate for disinfection applications has not been supported under the Biocidal Products Regulation, and should no longer be recommended. As such, there is now a 2 year timeframe for the industry to seek suitable alternatives that may be effectively incorporated, from an efficacy and economic standpoint, into footbathing strategies for the prevention and control of infectious causes of lameness. However, given the wide ranging footbathing practices adopted at a farm level, greater research and focus is needed to identify what properties such alternatives should possess.

RESULTS

A random selection of 29 UK dairy farms were surveyed to evaluate the most common employed foot bathing practices, predominately focused on determining which chemical solutions were being utilised, the reasons for this preference, and the frequency of foot bathing undertaken. The key results of this survey are highlighted in the Figure and Table, below.



	Herd Size		
	50-99	100-149	150 and over
Footbath Routine	Proportion of farms surveyed		
None	1 in 3		
Individual cows as needed		1 in 11	
Every milking			3 in 15
Daily		2 in 11	2 in 15
2-3 times per week		1 in 11	6 in 15
Once a week	1 in 3	2 in 11	3 in 15
Every 2 weeks		2 in 11	
Once a month		2 in 11	
3 -4 times per year	1 in 3		1 in 15
2-3 times per year		1 in 11	

It was found that 83% of farms surveyed were using formaldehyde routinely. All farms reported that they altered their footbath routine at times of increased lameness levels – either by addition of another chemical, increasing the concentration of chemical, or increasing the frequency of foot bathing. The majority of farms surveyed (55%) used copper sulphate in conjunction with formaldehyde, and reported copper sulphate as being the agent most effective of controlling lameness at times of high prevalence.

DISCUSSION AND CONCLUSION

It has previously been suggested that the industry should approach infectious causes of lameness as "mastitis of the foot", and treat it with the same importance by adopting an integrated approach that includes frequent disinfection by foot bathing and improving environmental hygiene (4). The Functional Chemicals Research Centre at Kilco (International) Ltd would suggest that this approach should go one step further, and that the chemical composition of the footbath solution should not only focus upon microbial control, but also be comprised of suitable excipients designed to improve hoof and skin condition, and thereby ensure the integrity of their barrier properties.

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NOTES

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APPENDIX

FIVE POINT PLAN FOR THE CONTROL OF DIGITAL DERMATITIS

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1. External biosecurity to keep disease out of farm
2. Internal biosecurity to minimise infection pressure on cows
3. Early identification, recording and treatment of clinical cases, in association with hoof care
4. Frequent foot disinfection to reduce new cases
5. Define and monitor hoof health targets

* Plan applies to young stock, dry cows and milking cows

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FIVE POINT PLAN FOR CONTROL OF DIGITAL DERMATITIS

The purpose of the Five Point Plan for Control of Digital Dermatitis (DD) is to reduce the prevalence of DD on dairy farms. Implementation of the Plan should reduce the incidence over time. As DD is an infectious disease, with likely many sources of infection on the farm, the reduction in DD will occur over time. Successful outcome should be measured over a longer period of time (12 months). Within a 12-month period, seasonal changes are expected to impact prevalence. Frequent follow up is advised.

1. External biosecurity to keep disease out of farm

    a. Avoid introduction by animals
        1. Prefer closed farm – no buying or bringing in cattle and avoid contract heifer rearing
        2. If not possible, bring in cattle from farms with no DD history (based on regular hoof-trimming records)
        3. Control, and if necessary treat cows brought on farm and before introducing to the herd (including animals brought onto animal shows)
        4. No co-grazing with sheep, pigs, camels, elk, or goats

    b. Avoid introduction by equipment and visitors
        1. No equipment sharing
        2. Sanitation of used equipment entering farm
        3. Sanitation of hoof trimming tools brought on farm
        4. Restrict professional visitors and limit access to animal areas
        5. Prefer Boots and clothing dedicated to farm
        6. Clean, sanitise boots and equipment

2. Internal biosecurity to minimise infection pressure on cows

   a. Maximise cow comfort:
      1. Reduce exposure to manure;
      2. Maintain clean and dry alleyways and bedding, with particular;
      3. attention to areas with frequent cow traffic (e.g. in front of concentrate feeder or water bowl, way to access to pasture ...);
      4. Use manure handling (scrapers, robots, equipment) that does not harm the cows;
      5. Minimise standing times (e.g. before milking parlour);
      6. Design and maintenance of walkways: non pitted, not rough, not slippery, no holes;
      7. No over crowding;
      8. Optimise ventilation;
      9. Score foot hygiene of cows at a regular basis to detect lack of good foot environment;
      10. Conduct regular hoof trimming to maintain good hoof conformation.

   b. Avoid transmission between cows:
      1. Segregate infected cows;
      2. Avoid moving equipment, manure, animals between groups;
      3. Clean and sanitise foot equipment between cows;
      4. Clean or change gloves after treatment of cows with serious infectious lesions;
      5. Use clean computer keyboard and tablet.

3. Early identification, recording and treatment of clinical cases, in association with hoof care

   a. Observe lame cows and visible foot lesions daily.

   b. Treat all detected lesions immediately. Establish treatment protocol with hoof care specialist (vet or hoof trimmer):
      1. Clean feet before treating;
      2. Use products per label direction for treatment: regulatory approved or scientifically proved;
      3. Wrap recommended, applied without harming the cow and removed according to treatment protocol.

   c. Register lame cows and foot lesions observed, as well as treatments.

   d. Follow up on treatment outcome.

   e. Perform regular functional hoof trimming and recording of foot lesions:
      1. Establish hoof trimming protocol with you hoof care specialist;
      2. Rely on qualified and competent hoof trimmer or vet or farmer;
      3. Recommend using ICAR Claw Health Atlas to record foot lesions;
      4. Keep track of animal groups at risk or with high prevalence.

   f. Consider culling of chronically infected animals.

4. Frequent foot disinfection to reduce new cases

    a. Consider collective topical spray as preferred option for improved efficacy and in areas where hoof bathing is not possible (e.g. young stock, dry cows).

    b. Take care to foot bath design:
        1. Hoof bath length to allow for at least 2 dunks of rear feet (about 3 m long);
        2. Hoof bath position to optimize cow flow;
        3. Hoof bath deep enough to cover dew claws;
        4. Designed and placed so cows can't walk with one foot out of the bath;
        5. Easy fill, easy drain, easy clean;
        6. Consider automated hoof bath to simplify replacement and cleaning.

    c. Consider foot cleaning before disinfection (but No cleaning baths without disinfection immediately after).

    d. Provide a clean exit area after disinfection.

    e. Use proven effective disinfecting products per manufactures instructions.

    f. Environment, user and cow friendly disinfecting products.

    g. Use clean hoof bath for hoof bath disinfection.

    h. Accurately assess hoof bath volumes to achieve correct concentration.

    i. Replace hoof bath per label directions.

    j. Monitor hoof bath soiling with manure and adjust replacement frequency (replace hoof bath per label direction or not more than 200-250 passages on average).

    k. Adjust level of disinfectant in foot bath: disinfectant should cover the feet, even of the last cow walking through.

    l. Adjust frequency depending on challenge and infection level.

5. Define and monitor target

    a. Review incidence and prevalence of DD lesions at a regular basis.

    b. Establish farm targets (Key Performance Indicators -KPI).

Examples:

Painful DD cows per 100 cows
M2 prevalence per 100 cows
Cows with no DD lesions per 100 cows
Differentiate between not cured and new lesions
Cows treated for DD per 100 cows
% of cows lame from DD

    c. Define changes in practices: SOPs.

d. Follow up and adjust targets and control measures.

e. Educate staff on hoof health, lesion identification and engage in target setting and achievement.

f. Benchmark KPI with other herds.

An electronic version is available at www.delavalcorporate.com/five-point-plan-digital-dermatitis