Proceedings of the

17th International Symposium and 9th International Conference on Lameness in Ruminants

11th – 14th August 2013

Bristol Marriott City Centre Hotel
Bristol, UK

Edited by Dr Becky Whay and Dr Jo Hockenhull

University of BRISTOL


SUPASCRAPER
PLEASE
WIPE YOUR
FEET

With Special Thanks to our Sponsors:

Platinum Sponsor
Zinpro Performance Minerals

Gold Sponsor
Zoetis

Silver Sponsors
De Laval
Provita
GEA Farm Technologies (UK) Ltd

Bronze Sponsors
Demotec
Intracare
Vettec
Pre-Treatment Solutions
Kraiburg

Conference Supporters
Giltspur Scientific Ltd
Synergy Farm Health Ltd
National Association of Cattle Foot Trimmers (NACFT)
Shoof International Ltd
Dutch Hoof Health Centre
Hoof-it ® Technologies by HIMG ™
Comfort Hoof Care Inc.
KVK Hydra Klov
Laboratoire M2
Massey University

Farm Workshop Support
National Association of Cattle Foot Trimmers (NACFT)
Dairy Co
Synergy Farm Health Ltd

Organising Committee

Dr Becky Whay
Professor David Barrett
Dr Jo Hockenhull
Miss Margit Groenvelt
Mrs Sarah Wood
Dr Gabriela Olmos Antillon
Mrs Sue Horseman
Mr Justin McKinstry
Mrs Lynn Harding
Dr Fran Whittington
Dr Clare Phythian
Dr Rose Grogono-Thomas
Professor David Main
Mr David Tisdall

Scientific Committee

Mr Roger Blowey
Professor Laura Green
Dr Jo Hockenhull
Professor David Main
and
Dr Becky Whay

Draft constitution for the International Society for the Study of Lameness in Ruminants

Name
The society will be named the International Society for the Study of Lameness in Ruminants

Objectives
The objectives of the Society will be to improve our understanding and control of lameness in ruminants by promoting the exchange of ideas, practices and research results in all aspects of ruminant lameness by holding a biennial conference, the International Conference on Lameness in Ruminants (ICLR)

Membership
Membership of the society will have only one requirement, i.e. attendance at least one of the previous two conferences.
There are neither other conditions of membership nor costs of membership.

Officers of The Society
The Officers of the Society will be the President, Past-President, Vice President and Honorary Secretary. The President of the society will be the President of the organising committee of the next ICLR. The Past-president will be the President of the organising committee of the previous ICLR. The Vice-president will be the president of the next ICLR but one.

Committee
The Executive Committee of the Society will normally comprise the officers of the Society and the President of the last but one conference. However, the Committee will have powers of co-option.

Confirmation and Election
The membership of the committee will be confirmed during the business meeting of each ICLR. At each business meeting the position of Secretary will be decided by popular vote of those members present. The Secretary will hold the post until the next business meeting. There are no restrictions on how long the Secretary can hold the post provided they are re-elected at each business meeting.

Finance
The Society will hold no funds. The costs of each ICLR will be met by the individual organising committees of those conferences.

Meetings
Ordinary general meetings of the Society, open to all members, i.e. attendees of the current ICLR, will be held as part of the business meeting of each ICLR. The President will organise all general meetings and will be the Chairperson for the meeting. If for any reason the President is unable to preside then a chairperson will be identified prior to the business meeting, such a person will usually be chosen from the Executive Committee of the Society.
The conduct of all business transacted will be under the control of the Chairperson, to whom all remarks must be addressed and whose ruling on a point of order, or on the admissibility of an explanation, will be final and will not be open to discussion at the meeting at which it is delivered.
The Secretary of the Society will be responsible for recording the minutes of the meeting. These minutes will be printed in the Proceedings of the next ICLR
It is not intended that there will be any meetings of the executive committee outside of informal meetings at the ICLR.

International Conference on Lameness in Ruminants
These meetings will be held every two years, alternating with the World Buiatric Conference. The venue for the meeting will be decided four years in advance at the business meeting of each ICLR.
The committee should be advised of potential venues, at least four weeks prior to the business meeting. The potential venues will then be then circulated to members prior to the business meeting. Choice of venue will be made after presentations from the potential countries and will be based on a popular vote of the members present at the business meeting. Once the venue has been decided the meeting will then confirm the identity of the vice-president.
Organisation of the meetings will be devolved to a local organising committee. The executive committee of the Society will be available for consultation if necessary.

Publications
Print and electronic versions of the proceedings of all ICLR will be made available. All delegates to the ICLR will receive at least a CD copy of the proceedings as part of their conference package. The responsibility for their publication will rest with the Secretary of the conference.
After the conference, these proceedings will be available via the internet on an open access basis.

Website
The organisations website will be www.ruminantlameness.org. The responsibility for the maintenance and upkeep of the website will devolve to the organising committee of the next ICLR

General
No alteration will be made to these rules except by a two-thirds majority of those members voting at a General Meeting of the Society, and then only if notice of intention to alter the constitution will have appeared in the notice convening the meeting.

Conference Programme

	Sun 11th August	Mon 12th August	Tues 13th August	Wed 14th August
07:30	Exhibition stand set-up from 08:00		Dairy Co – UK Researchers Breakfast Meeting	
07:35				
07:40				
07:45				
07:50				
07:55				
08:00		Registration Open		
08:05				
08:10				
08:15				
08:20				
08:25				
08:30			Keynote 4: Jon Huxley *'Searching for the evidence base: What do we now about treating claw horn lesions?'*	
08:35				
08:40				
08:45		Welcome to Conference		
08:50				
08:55				
09:00		Keynote 1: Roger Blowey *'25 years of Digit Symposia – fact, fiction and the future'*		46. Free Paper Session 9: Papers 46 to 51
09:05				
09:10				47.
09:15				
09:20			23. Free Paper Session 5: Papers 23 to 28	48.
09:25				
09:30			24.	49.
09:35				
09:40			25.	50.
09:45				
09:50		1. Free Paper Session 1: Papers 1 to 4	26.	51.
09:55				
10:00		2.	27.	Keynote 6: Peter T Thomsen *'How can we help the busy farmer control digital dermatitis?'*
10:05				
10:10		3.	28.	
10:15				
10:20		4.	Tea / Coffee Break	
10:25				
10:30		Tea / Coffee Break		
10:35				
10:40				Tea / Coffee Break
10:45				
10:50				
10:55				
11:00				
11:05				
11:10			29. Free Paper Session 6: Papers 29 to 35	
11:15		5. Free Paper Session 2: Papers 5 to 11		
11:20			30.	
11:25		6.		
11:30			31.	52. Free Paper Session 10: Papers 52 to 59
11:35		7.		
11:40			32.	53.
11:45		8.		
11:50			33.	54.
11:55		9.		
12:00			34.	55.
12:05		10.		
12:10			35.	56.
12:15		11.		
12:20			'one minute – one slide' Posters 44 to 86	57.
12:25		'one minute – one slide' Posters 1 to 43		
12:30				58.
12:35				
12:40				59.
12:45				
12:50				Nestor – Next Conference - Chile
12:55				
13:00		Lunch	Lunch	Lunch
13:05				
13:10				
13:15	Bus for Farm Workshop – departs Marriott 13:15 – arrived Wyndhurst Farm 14:00			
13:20				
13:25				
13:30				

13:35				
13:40				
13:45				
13:50				
13:55				
14:00	On-Farm Workshop at University of Bristol's Wyndhurst Farm	Keynote 2: Karin Orsel 'Lameness and cow comfort on Canadian dairy farms'	Keynote 5: Nick Evans *'Digital dermatitis of cattle and sheep – laboratory pointers to treatment and prevention'*	Keynote 7: Becky Whay *'Dairy farmers and shepherds: Motivations and barriers for tackling lameness'*
14:05				
14:10				
14:15				
14:20				
14:25				
14:30		Keynote 3: Richard Laven *'Lameness on New Zealand dairy farms: Perceptions and reality'*		
14:35				
14:40			36. Free Paper Session 7: Papers 36 to 42	60. Free Paper Session 11: Papers 60 to 66
14:45				
14:50			37.	61.
14:55				
15:00		12. Free Paper Session 3: Papers 12 to 16	38.	62.
15:05				
15:10		13.	39.	63.
15:15				
15:20		14.	40.	64.
15:25				
15:30		15.	41.	65.
15:35				
15:40		16.	42.	66.
15:45				
15:50		Tea / Coffee Break	Tea / Coffee Break	Close of Meeting
15:55				
16:00				Tea / Coffee and Depart
16:05				
16:10				
16:15				
16:20				
16:25				
16:30		17. Free Paper Session 4: Papers 17 to 22	43. Free Paper Session 8: Papers 43 to 45	
16:35				
16:40		18.	44.	
16:45				
16:50		19.	45.	
16:55				
17:00	Bus Travel – Return from Farm to Marriott Hotel	20.	Zinpro Sponsored Lecture Dorte Dopfer *'Bovine Digital Dermatitis – The Tedious Reality of an Endemic Claw Disease'*	
17:05				
17:10		21.		
17:15				
17:20		22.		
17:25				
17:30		Poster Viewing		
17:35				
17:40				
17:45				
17:50	Registration Open			
17:55				
18:00		De Laval Sponsored Lecture Olga Kuzmina *'Large herds and High yielding cows: Experiences of improving the lameness situation on farms in the Leningrad region of Russia'*	Association AGM (all welcome)	
18:05				
18:10				
18:15				
18:20				
18:25				
18:30	Canapé Welcome Reception		Poster Viewing and Free Time	
18:35				
18:40				
18:45				
18:50				
18:55				
19:00		Start of Evening Entertainment – Depart directly after De Laval lecture		
19:05				
19:10				
19:15				
19:20				
19:25				
19:30			Start of Gala Dinner – 19:30 drinks reception – 20:00 seating for dinner	

Keynote and Sponsored Evening Lectures

Free Papers – Oral Presentations

Free Paper – Poster Presentation Programme

Levels of Lameness and Disease		
P1 (a)	J Borkert **Prevalence of lameness in 548 bulls and the type of claw lesion in 29 lame bulls from 23 dairy herds in southern Chile**	48
P1 (b)	L Petrie **Lameness in Breeding Beef Bulls**	49
P2 (a)	M Holzhauer, M Gongrijp, E van Engelen, G van Schaik, M van Bostelen, A Velthuis **Non-healing white-line lesions: prevalence, causing organisms and risk factors**	51
P2 (b)	F Galleguillos, J Borkert **Prevalence of lameness in 2370 cows and the type of claw lesion in 511 lame cows from 4 dairy herds in central area of Chile**	53
P3 (a)	RN Chesterton **Bovine Digital Dermatitis in New Zealand – the past the present and the future**	54
P3 (b)	B Brummelman, M Holzhauer **Prevalence and severity of claw disorders in female calves and young dairy cows**	55
P4 (a)	M Knappe-Poindecker, M Gilhuus, TK Jensen, K Klitgaard, RB Larssen, T Fjeldaas **Interdigital dermatitis, heel horn erosion and digital dermatitis in 14 Norwegian dairy herds**	57
P4 (b)	RE Junni, MR Kontturi, ER Seuna, MJ Kujala, HK Simojoki, ES Malinen, KK Pekkanen, MS Pelkonen, TT Soveri **Outbreaks of interdigital phlegmon in Finland**	59
Lameness and Genetics		
P5 (a)	F. Bosma, R.A. Laven **The impact of reduced mobility score in the pre-breeding period on the fertility of dairy cattle in a seasonally breeding pasture-based system**	71
P5 (b)	T Wuliji, JGH Hickford, B Shanks, W Lamberson, H Zhou, S Azarpajouh **Establishing a footrot resistant sheep flock by footrot gene marker test screening**	72
Animal Behaviour and Lameness		
P6 (a)	GG Miguel-Pacheco, J Huxley, J Kaler **To go or not to go: Impact of lameness in dairy cows on visits to an Automatic Milking System**	74
P6 (b)	L. Kovács, J. Tőzsér, V. Jurkovich **Association between lameness, heart rate and heart rate variability during different activities of dairy cows**	75
P7 (a)	N Kayes, H Bishop, NJ Bell **Changes in cow flow following Installation of rubber matting in the milking parlour**	76
P7 (b)	J Borkert, N Tadich **Effect of lameness on milk production of dairy cows from eight herds in southern Chile**	78
P8 (a)	MA Palmer, NE O'Connell **Weekly changes in locomotion score and milk yield in dairy cows**	79
P8 (b)	P. Levet, J.P. Smulder, N. Tadich **Use of GPS to assess walking behaviour of lame cows in Chilean grazing dairy herds**	80
Monitoring and Measuring Lameness		
P9 (a)	F Galleguillos, J Borkert **Locomotion score of cows as a strategy for the control and prevention of lameness**	104
P9 (b)	HJ Thomas, D Byron-Chance, G Miguel Pacheco, JN Huxley **Development of a weighted visual lesion scoring system to assess the severity of claw horn lesions in dairy cows**	105
P10 (a)	A Van Nuffel, P Briene, J Vangeyte, KC Mertens, W Saeys, S Van Weyenberg **Farmers opinions concerning lameness detection systems compared to oestrus detection systems**	107
P10 (b)	AM Englisch, E Ullrich, U Bergfeld, J Fleischer, U Roesler, KE Mueller **Animal suitability index and lameness in dairy farms in Saxony, Germany**	109

Keynote Papers

Twenty five years of Digital Symposia – fact, fiction and the future

Roger W. Blowey, FRCVS
125 Bristol Road, Gloucester, GL2 8JG, UK

Introduction
The title of this this presentation, and the timespan that it was to cover, was the concept of the organisers, as it encompasses the period when I have been attending the Symposia. However, as is often the case when given a title, I wish to deviate slightly. I hope that delegates will be interested in the very beginnings of this highly successful and for me, enjoyable, series of meetings, and I would like to use this opportunity to record for the future, the many meetings and venues that we have enjoyed. Much of the information (and opinion) for the first 12 years of Symposia has been supplied to me by David Weaver and Paul Greenough, two of the founder members, to whom I would like to formally express my gratitude, both for their contributions to this paper, and for involving me in the Symposia over the years.

Our History
The first meeting of this organisation was in Utrecht in 1976. Initially those present attended by invitation, hence the small numbers (25-30) and the mix was highly academic. The meeting planned for Greece in 1984 had to be abandoned, and attempts to allocate one day at the Dublin Buiatrics as a Digit Symposium meeting met with political opposition, so although the proceedings for that meeting are entitled the '5th ', the Majorca meeting is also designated as the 5th.
As with any discipline, an important first step is to establish definitions and classifications of the conditions that you wish to study. Every country had its own specific terms for foot diseases, and in England there were even five terms one could use to refer to "foot rot"!This culminated in the publication of a *Colour Atlas of Disorders of Cattle and Sheep Digits*, published in 1984. Early meetings very much revolved around 'laminitis' being the significant factor in the pathogenesis of lameness and potential causes of laminitis were discussed at some length, using the work of StureNeilsen as a guide. At that stage the word was still loosely used to include haemorrhageof the sole. It was at the Paris meeting (1982) that Bovine Digital Dermatitis (BDD) was first considered to be'a plague of the bovine digit' and of course at this stage the condition had not reached the UK.
My own first meeting was in Liverpool (1990) where,following the first reported case of BDD in the UK I presented a paper on Infectious Causes of Cattle Lameness. Hence the title of this presentation *"Twenty Five Years of Digit Symposia"*, as I have been fortunate to attend almost every meeting since Liverpool. The Banff Symposium (1994) was dominated by papers from Pete Ossent and Christoph Lischer each giving superb presentations on the anatomy and biomechanics of the bovine digit, and this has been continued in more recent years by excellent presentations from Christoph Mulling and his group. I think Banff, under the direction of Paul Greenough will also be remembered for one of the more rowdy social occasions, the Mediaeval Banquet, where unruly delegates (such as Bob Ward) were chained in the stocks! At Jerusalem (1996) attendance was low due to political issues, but fortunately the meeting was assisted by Zinpro, without whose generous financial support these symposia may not have continued. For me Jerusalem will also be remembered for its history and culture, including the presentation by Uri Bargai and the 'son et lumiere' evening in the Temple of David.
With Toussaint Raven being one of the founder members of the Symposia, clearly functional claw trimming was originally, and has continued to be, a very important part of all Congresses. There has been much discussion on the correct procedures and certainly much discussion on the correct frequency. We attempted to set up some clear guidelines in Florida (2002), but an overall consensus could not be reached. Further issues will be raised in the current meeting. It seems that no-one doubts the importance of claw trimming: the issues mainly arise around the correct frequency and whether over-trimming in some circumstances can be a problem. Soft soles in housed US cows were reported as an issue, and some doubts were being expressed about the frequency of foot trimming. At Florida, there was much discussion on the importance of nutrition, although since then other factors have been discussed in greater detail.
In the mid 1990's there were many efforts made to find a mineral or trace element that would provide a boost to hoof horn structure and result in a decrease in lameness. Oral supplementation with biotin had been shown to decrease the incidence of sole haemorrhage in heifers, then Hedges and others demonstrated that the addition of 20mg/day of biotin would half the incidence of lameness caused by white line defects. Biotin papers were presented in Lucerne (1998).
Around 2004 (Maribor) marked the start of regular participation by hoof trimmers, notably Peter Kloosterman, Karl Burgi and others. It was also in Maribor that we were first joined by Neil Chesterton who presented excellent data on the importance of cow tracks, cow behaviour and the effects of cow handling and hence the Symposia took a further step forward by incorporating information from large grazing herds.

One of the strengths of our Symposia is the involvement of a wide discipline of scientists, vets in general practice and hoof trimmers leading to an excellent mix of practice and theory, which is so important for the development of any discipline. Looking back through our history, I note that many of those making significant contributions have been general practitioners, starting with Paul Greenough and StureNeilsen, both of whom were founder members. I hope that this will encourage others in practice – now joined by our hoof trimmer colleagues –to put in that little extra effort and continue the tradition.

Cow comfort, standing times and walking surfaces have been significant contributions to many meetings and certainly from Liverpool onwards. Ward, Clarkson, Murray and others from Liverpool, and Christer Bergsten and colleagues from Sweden were among the first to study risk factors in depth. Looking back, I note that part of my summary of the Maribor meeting (2004) was entitled 'The rush to rubber', with the Swedish group under Christer Bergsten contributing data on floor surfaces and cow comfort.

The large multidisciplinary and multinational EU LAME COW projectwas almost a subgroup of the Symposia, and reported at Maribor (2004), Uruguay (2006) and Finland (2008). In addition to the biennial Symposia, the EULAME COW project had additional business and technical meetings.

In Colonia, Uruguay (2006), we again reviewed nomenclature, and the review was presented in Kupio, Finland (2008). As the years have progressed there has been less emphasis on the importance of nutrition, less emphasis on frequent foot trimming and increased emphasis on management and behaviour. Digital Dermatitis has become increasingly important, especially with the recent knowledge that the organism is now associated with infections of the corium, including toe necrosis.

Our Future

It is always difficult to predict the future. At the inaugural meeting of this Symposium in 1976 who could have envisaged mobile phones and the internet!There is no doubt that part of a person's vision of the future will be tempered by their knowledge of current research and developments, and this will certainly apply to my own comments.

A detailed understanding of the anatomy, function and functional pathology of the bovine digit must be a primary requirement of our understanding of lameness, and I believe that as new investigative techniques are developed, this will our advance our knowledge of the foot. A good example is increased understanding of fat pad structure.

Digital Dermatitis (BDD) and CODD in sheep remain major issues, particularly as these infections are now associated with (but not necessarily caused by) a range of hoof and bone lesions, both of which will be discussed at this Conference. The control of these conditions therefore remains a major issue, and control by vaccination and by breeding are options for the future. A greater understanding of the genomics of Digital Dermatitis must be important in our quest for an effective vaccine. In Uruguay we saw how sheep had been naturally selected to become resistant to foot rot – sheep with foot rot developed fly infestation and had been culled naturally! In New Zealand we saw how a single nucleotide polymorphism (SNP) at position 46MB on Chromosome 26 altered the resistance and susceptibility of cattle to BDD. At this symposium we will hear about gene regulation, and how the Treponemes associated with BDD,are able to alter gene transcription, thus modulating MRNA to produce proteins that can assist in the survival of the Treponeme. A fuller understanding of these detailed mechanisms will be important in our quest for a vaccine. At the same time practical measures such as foot-bathing and environmental considerations remain important.

Details of the mode of transmission of BDD, as yet unknown will eventually be determined. A paper will be presented at this Conference to show how the presence of BDD has been identified on both hands and hoof knives, but further study is required to determine if this is an important means of transmission. BDD has also been identified on sheep hoof knives, so perhaps this could be one explanation of the excellent work by Laura Green and her group, showing that foot trimming increases the risk of foot rot in sheep.

Mobility scoring, (formerly locomotion scoring) was introduced many years ago but the paper by Margit Groenvelt and others from the Bristol group showing that early identification of lame cows produced significant improvements in healing was, in my opinion, a major step forward. This ties in extremely well with the description of chronic changes in the pedal bone that will be presented at this meeting. Maybe one of the ways forward for hoof trimming is to concentrate slightly less on regular trimming of all cows and more on correcting cows showing impaired mobility. Work to be presented will show large variations in the size of the pedal bone within a population of 'normal' cows, suggesting that the 'one size fits all' system of foot trimming may be incorrect and needs re-assessing The data should certainly persuade those of us dealing with lame cows that we should apply a block more often, and perhaps place emphasis on a block where weight bearing is on the wall. More work is needed to confirm this hypothesis.

It continues to amaze me that we have little objective data as to which are the best treatments for hoof lesions. For example, for a white line infection should we remove all of the under run wall horn from sole to coronary band, or simply open the lesion and allow drainage? For a sole ulcer, should we remove protruding granulation tissue? Much more data are needed on the efficacy of different treatments, and one approach to this dilemma is to be discussed later in this Conference.

Concerns by consumers over the welfare of all food producing animals have become increasingly voiced, and we will in the future see more detailed monitoring of a range of animal based parameters, and a move towards the system of Real Welfare Outcomes currently being used in the pig industry. The merits of this will require careful discussion.

Finally in New Zealand there were some excellent presentations on human/animal relationships and the importance of gentle handling in terms of reducing lameness, improving animal health and increasing production. More work is needed in this area.

Conclusions

There is no doubt that this Conference has an excellent future. Despite 35 years of digit symposia, lameness remains one of the major conditions affecting the health, welfare and productivity of dairy cows. I would like to endorse Paul Greenough's suggestion that an electronic archive of these Symposia is established, including both presented papers and social photographs. Both Paul Greenough and David Weaver have contributed significantly to the establishment of the Symposia and to this presentation and it would be a fitting honour to the two of them if the archive was established.

Dates of the past symposia

1st	1976 Utrecht, April 4-9,
2nd	1978 Skara, Sweden
3rd	1980 Vienna, Austria
4th	1982 Alfort, Paris, France
	1984 – Greece (meeting abandoned)
(5^{th})	1986 Dublin, Ireland
5^{th}	1988 Majorca, Spain
6th	1990 Liverpool, UK
7^{th}	1992 Rebild, Denmark
8th	1994 Banff, Canada
9th	1996 Jerusalem, Israel
10th	1998 Lucerne, Switzerland
11th	2000 Parma, Italy
12th	2002 Orlando, Florida
13th	2004 Maribor, Slovenia
14th	2006 Colonia, Uruguay,
15th	2008 Kuopio, Finland,
16th	2011 Rotorua, New Zealand,
17^{th}	2013, Bristol, UK

Lameness and cow comfort on Canadian dairy farms

Karin Orsel, DVM, MSc, PhD, dipl. ECBHM
Dept. of Production Animal Health, Faculty of Veterinary Medicine, University of Calgary, Alberta, Canada
karin.orsel@ucalgary.ca

Alberta team members: Laura Solano, Guilherme Bond, HermanBarkema, Ed Pajor, Steve Mason.

Other Research Team leaders:
Canada lead and British Columbia: Anne-Marie de Passillé
Ontario: Derek Haley
Quebec: Doris Pellerin

Importance of Cow Longevity, Lameness and Cow Comfort
In recent years, the dairy industry has focused on increasing longevity to increase cows' productivity. Longevity can be defined as the length of a cow's productive life. Longevity can also be seen as an indicator for welfare; improvements in farm animal welfare will increase productivity and hence lead to a longer productive life.
Reduced cow comfort associated with farm-specific management practices as well as farm-specific barn designs are identified as important risk factors for a high prevalence of lameness and injuries. Lameness and injuries can markedly affect production and longevity, thereby reducing the overall efficiency of dairy production. Besides the reduced productivity, in Canada as well as world wide, lameness has now also been identified as the third most common reason for involuntary culling (CanWest DHI, 2011) and therefore a concern for animal welfare.

The Present
The Canadian Longevity and Lameness Project
Dairy Farmers of Canada (DFC) has recently developed a Code of Practice for the Care and Handling of Dairy Cattle, which is based on scientific knowledge on cow comfort and welfare (National Farm Animal Care Council (NFACC) 2009). There is a need to ensure the uptake of this knowledge and the implementation of the recommendations on individual farms. With these aspects in mind, DFC and Agriculture and Agri-Food Canada have funded a cow longevity study across Canada with the Faculty of Veterinary Medicine from the University of Calgary taking the lead in the province of Alberta (AB). Until now, there were limited data on lameness or injury prevalence available and no information on management practices and housing features associated with lameness and cow comfort.
On each farm, in two farm visits, information was collected in 3 main areas:

- Cow measures: a subgroup of cows was selected and measurements on hock, knee and neck injuries, lying time,
- Environment: information on stall base, bedding, stall and pen measurements, type of flooring, slipperiness, stocking density and other barn design features.
- Management: a questionnaire captured information on management practices related to cleanliness and bedding routine, treatment and procedures related to lameness and hoof trimming, and footbath routine.

At the end of the second visit, farm specific results along with a hard copy report were presented and discussed with the producers, which they were encouraged to discuss with experts (veterinarians, nutritionists, hoof trimmers etc.).

Longevity and Lameness Project in Alberta
Through the support of Alberta Milk, the Alberta Livestock and Meat Agency and The Alberta Dairy Hoof Health Project (www.hoofhealth.ca; Mason 2009), Alberta has added a research component to the project, focusing on lameness and claw lesions. Through collaboration with 7 specially trained hoof trimmers, data were collected on all animals trimmed. The lesions were recorded with the Hoof Supervisor® lesion recording system. The first farm visit of the research team was scheduled within 2 weeks before the hoof trimmers' visit, to be able to link the presence of lesions to the gait scoring outcomes.
Ontario also has implemented a hoof health project (the Ontario Dairy Hoof Health Project) collecting hoof trimming data as well as aiming to develop biosecurity protocols for controlling bovine digital dermatitis and subsequent lameness in Ontario dairy farms.

Some preliminary results of the Canadian study in Free stall barns
From January 2011 to July 2012, a total of 240 dairy farms (141 free stalls; 99 tie stalls) were visited, covering the provinces of AB, ON and QC. A total of 5,500free stall housed Holstein-Friesian cows were

included in the study. Herd size ranged from 65 to 400 cows and only herds that were CanWest DHI participants were included in the study.
In our study we found that on average 20% (range 0 to 66%) of cows within a herd were lame based on gait scoring.
In AB, 51% of the trimmed cows (total of 20,644), had visible foot lesions

Table 1. Most common lesions observed by hoof trimmers in AB (March 2013)

Type of Lesion	(%)
Digital dermatitis (DD)	43
Sole ulcer (SU)	17
White line (WL)	16
Sole hemorrhage (SH)	6
Others	17

In our questionnaire, DD was also perceived as a concerning issue by the dairy farmers, but 85% of the producers had good compliance to lameness management on farm.
In ON, 38% of the trimmed cows (total of 24,045), had visible foot lesions

Table 2. Most common lesions observed by hoof trimmers in ON (March 2013)

Type of Lesion	(%)
Digital dermatitis (DD)	35
Sole ulcer (SU)	13
White line (WL)	9
Sole hemorrhage (SH)	22
Others	30

And in British Columbia 60% of the trimmed cows (total of 15,930), had visiblefoot lesions

Table 3. Most common lesions observed by hoof trimmers in BC (March 2013)

Type of Lesion	(%)
Digital dermatitis (DD)	38
Sole ulcer (SU)	15
White line (WL)	14
Sole hemorrhage (SH)	7
Others	26

On free-stall farms the mean herd-level prevalence of hock, knee and neck injuries was 47% (0 to 95%), 24% (0 to 91%) and 9% (0 to 65%) respectively. Overall proportions of hock, knee and neck scores assigned as 0, 1, 2 or 3 were calculated using all observations of the cow can be found in table 4.

Table 4. Individual animal observations of the highest injury score on the three major regions of the cow (ZaffinoHeyerhoff et al *submitted*)

Injury	Score 0 (%)	Score 1 (%)	Score 2 (%)	Score 3 (%)
Hock	38	15	44	3
Knee	63	13	22	2
Neck	84	7	9	n/a

Overall, the prevalence of hock, knee and neck injuries was relatively high, but the wide range allows for identification of major risk factors in the Canadian dairy industry and potential for optimization under Canadian circumstances.
The average lying time of cows was 10.36 h/d (range 8.0;13.12h/d). For the Alberta data, with increasing lying time the odds for lameness was OR 1.2 (1.11 - 1.22), confounded by parity, pen floor and stall base. A limited number of farms met the requirements as listed in the Dairy Code of Practice for stall width (0%) or

stall length (53%) and a striking 53% of the farms has an obstruction in the lunge space in front of the cows. Flooring type varied widely across the country, with approximately 50% of the farms having floor types that prevented slips or falls when cows were moved. Importantly, cleaning routines are carefully implemented.

A wide variety was observed in on-farm practices related to footbath management. Only 2.8% of the farms in AB met all scientific recommendations on footbath dimensions. There was no consistency in the frequency of use and replenishment of solutions or the type and concentration of the products. Twenty-two different product combinations were recorded, with a range of one to four products used per farm in a frequency of zero to seven days per week. Ninety-five percent of the farms in AB used a footbath regularly; nevertheless, no two farms had the exact same protocol. There is a clear need to provide dairy farmers with practical, science-based recommendations for footbath management, and this trial is planned in AB for fall/winter 2013.

Results have been communicated with the dairy farmers in several ways. During the second farm visit a report was presented and discussed with the producers on farm-specific findings. At the end of the study, all the producers received a benchmarking report to the Canadian average. In spring 2013, Alberta Milk seminars (sponsored by the 'Growing Forward' program) attracted 200 participants in AB. During three sessions, they were introduced to methodology of the study, practiced some scoring methods and finally worked with four scenarios identifying strengths and weaknesses and prioritizing areas that affect cow longevity and lameness most.

Future Directions

Follow up projects identified from this research are focusing on two components

1. The presented benchmark reports and farm specific reports seemed very effective in communicating the current status of a farm. A potential follow up study will look at the usefulness of repeated measures after significant management changes and whether these reports will be sensitive enough to reflect the impact on cow longevity and lameness
2. With digital dermatitis being the most prevalent infectious cause of foot lesions, the University of Calgary is currently pursuing two trials with a focus on footbath protocols and optimizing on-farm implementation of scientific recommendations.

References

CanWest DHI. 2011. Western Herd Management Report.
http://www.canwestdhi.com/pdf_files/western report web version.pdf

National Farm Animal Care Council (NFACC) 2009. Code of Practice for the care and handling of dairy cattle. pp.65.

Mason B 2009. The Alberta Hoof Health Project.http://www.hoofhealth.ca.

ZaffinoHeyerhoff JC, LeBlanc SJ, DeVriesTJ, Nash CGR, Gibbons J, Orsel K, BarkemaHW, SolanoL, RushenJ, de Passillé AM, Haley DB.Factors associated with dairy cow injuries in Canada; Prevalence of, and factors associated with, hock, knee, and neck injuries on dairy cows in free-stall housing in Canada (submitted May 2013)

Lameness on New Zealand dairy farms: Perception and reality

R.A. Laven
IVABS, Massey University, Palmerston North
r.laven@massey.ac.nz

Introduction

Worldwide, lameness is considered to be the third most costly animal health problem after infertility and mastitis. Most research on lameness has focused on the housed cow – this is logical as housing tends to increase the prevalence of lameness and, particularly in the US, Canada and parts of Europe, more cows are being housed permanently and access to pasture is being reduced in those cows which are not housed all-year-round.

Extrapolation of such data to pasture-based systems, such as those which predominate in New Zealand, may not be warranted, as many of the risk factors which have been associated with lameness in Northern Hemisphere cattle are not present on most New Zealand dairy farms – this includes such obvious factors as poor cubicle design, and less obvious factors such as higher proportion of cows in good to fat body condition. Even pasture-based research may not be directly relevant – Barker et al (2010) reported that cattle grazing pasture also grazed by sheep had a higher risk of lameness, but mixed grazing of commercial sheep flocks and dairy herds is extremely unusual in New Zealand.

Furthermore the difference between systems means that the impact of lameness may be different. Dairy herds in New Zealand are normally seasonally-calving (usually late winter/early spring) – and therefore have a short breeding season (of about 12 weeks). This means that if lameness occurs before breeding and reduces fertility, it may result in significantly greater costs as a cow is culled for being non-pregnant rather than being able to conceive at a later date. However if lameness occurs after the breeding season then its impact on fertility may be negligible. So when cows are lame can have a significant effect on the impact of lameness.

Differences in management of lame cows could also affect the impact of lameness – on most New Zealand dairy farms lame cows are routinely separated from the main herd and milked once daily. The effects of this have not been properly evaluated but it could affect fertility both positively (by improving energy status) and negatively (cattle in smaller groups may show less oestrus behaviour).

New Zealand-based data is therefore essential if we are to properly understand, manage and control lameness in New Zealand. Such data will also be useful for other systems where pasture is still a major part of the dairy cow's environment. For example, Chesterton et al (1989), which identified the key risk factors for lameness at pasture, has been cited over 40 times in the non-antipodean literature and is a key part of the research used in developing the UK healthy foot programme.

This paper outlines the data that we have and the data that we need in order to identify properly the level of lameness on the NZ dairy industry and to see whether the perception of lameness on New Zealand farms actually matches reality.

How many lame cows are there*?*

Lameness incidence in NZ is poorly characterised. Two recent large scale studies reported that annual lameness incidence much lower than generally reported in Europe and North America; Chawala et al. (2013) reported an incidence of 6.3% while Brownlie (2013) reported an incidence of 3.7%. However these estimates were based on computerised records which required farmers to record lameness and upload it to a computerised system. So, clearly, these figures are a gross underestimate of true lameness incidence.

A recent survey of 59 dairy herds (27 in the SI and the 33 in the North Island [NI]) recorded the farmer-reported incidence of lameness (Fabian, 2012). Mean incidence on the NI was 8.6% per year, and on the SI 15.7%. This was a retrospective study and based on farmer estimates as useful paper or computer records were absent on most farms, so will again be an underestimate.

The only recent prospective study is that by Gibbs (2010). In this study of 43 farms on the South Island (SI) of New Zealand, each farm was provided with a recording diary and measures were taken to ensure that recording was satisfactory to minimise underestimation of incidence. The mean incidence of farmer-diagnosed lameness was 26.2% per year, with individual farm figures ranging from 4.3 to 64.4%. No similar data are available from the NI; the most commonly referenced data is that of Tranter and Morris (1991) but that study included only three herds with annual incidence rates of 38, 22 and 2%.

Farmer perception of lameness is a significant barrier to lameness control (Leach et al 2013). Previous research has shown that locomotion scoring can identify between 2.5 to 5 times the number of lame cows identified by farm staff (Wells et al. 1993; Sárová et al. 2011), but all of this data came from housed cattle. Pasture-based cattle have to regularly walk from the field to the parlour to be milked, so it is possible that this provides an increased opportunity to detect lame cows even if they are not being actively looked for.

Fabian (2012) tested this hypothesis on 59 dairy farms throughout New Zealand. Farms were selected on the basis of nomination by local veterinarians, visited at the expected peak for clinical lameness; i.e. October / November in the NI (Lawrence et al., 2011) and January/ February in the SI (Gibbs, 2010), and the whole herd locomotion scored, using the 4-point (0-3 score) DairyCo mobility scoring system (Barker et al., 2010), after morning or afternoon milking.
Overall, a total of 23,949 cows were locomotion scored (9,684 on the NI and 14,265 on the SI).
Mean herd prevalence of lame cows (those with a mobility score of ≥2 [LPR])was 8.3% (median 6.7%; range 1.2 to 36%), with 21% of lame cows having a mobility score of 3. Mean prevalence of cows with a mobility score of 3 (LPS) was 1.8% (median 1.0%; range 0 to 20.2%). Lameness prevalence as identified by farmers (FPR) was 2.3% (median 1.4%; range 0 to 20%). Fig. 1 shows for each farm the FPR/LPR expressed as a percentage.

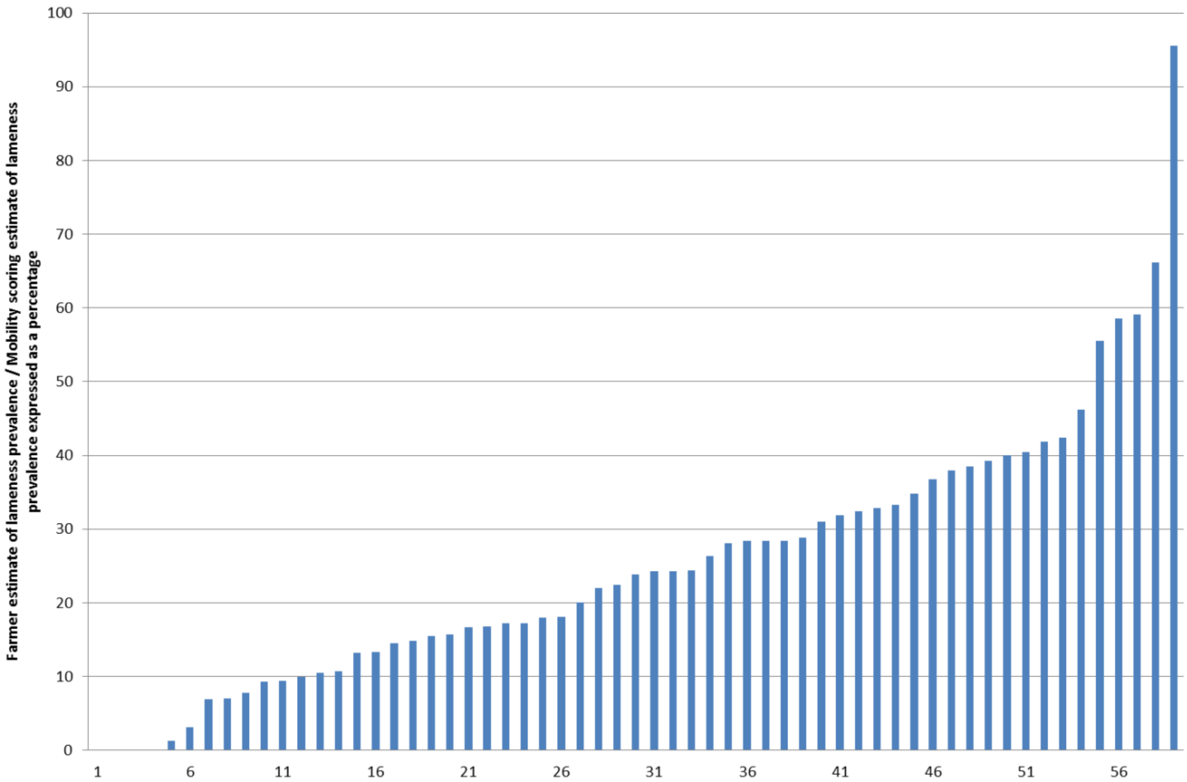
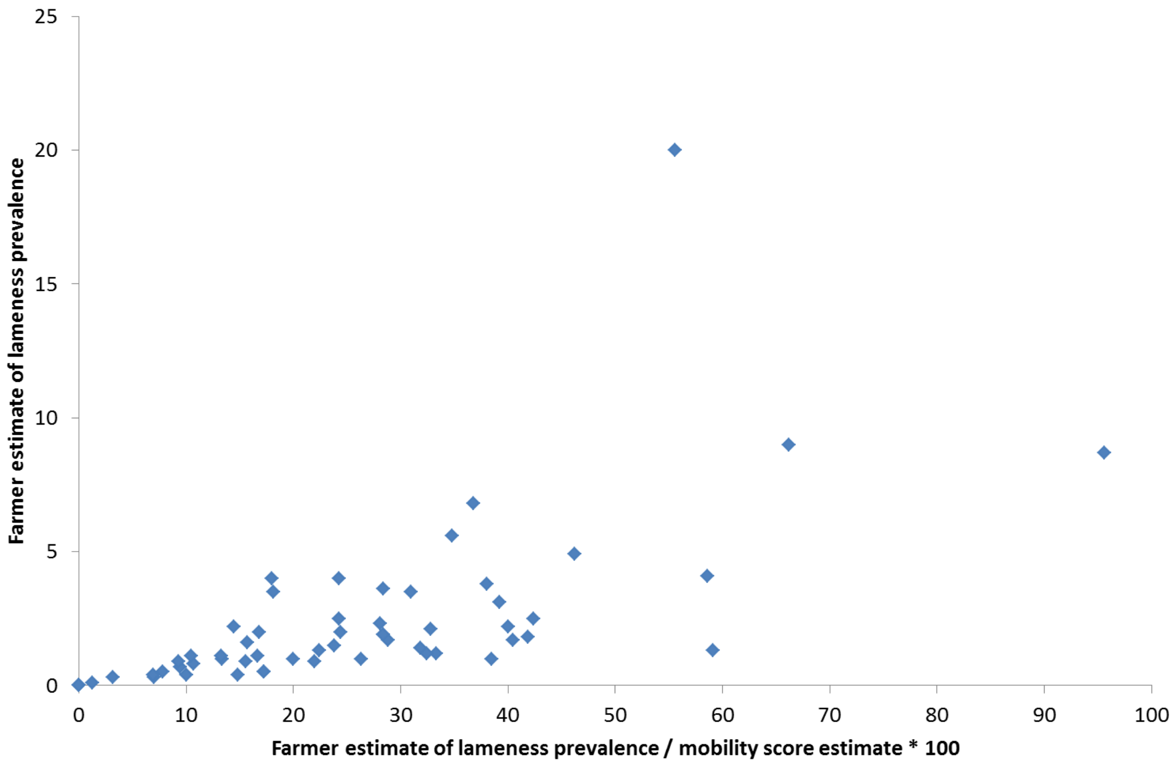


Figure 1. Distribution of the proportion of lame cows identified by farmer estimates in pasture-based cows in 59 herds across both the North and South Islands of New Zealand

On individual farms, FPR/ LPR ranged from 0 to 95% (mean 25%). There was no relationship between that percentage and LPR (ρ = 0.11, P=0.42); the relationship between FPR/ LPR and LPS was almost significant at the 5% level (ρ = 0.23, P=0.084), with a tendency for farms with a higher LPS cows to have a higher FPR/ LPR. There was a clear and significant association between FPR and FPR/ LPR, i.e. as FPR increased FPR/ LPR increased (ρ = 0.79, P<0.001; Fig. 2).



There was no significant association between either herd size and herd average milk yield and either FPR or LPR (P> 0.35). In contrast to the data on farmer-reported lameness incidence which showed that lameness incidence was higher on the SI, there were no significant differences between islands in lameness prevalence.

The study by Fabian (2012) shows that, although both the farmer reported incidence and prevalence of lameness was much lower than that recorded in most similar studies performed in the US and Europe, the proportion of lame cows recognised on these farms (1-in-4) was similar to that reported in previous studies. This suggests that the New Zealand system doesn't increase the detection of lame cows and that locomotion scoring is still required to properly evaluate lameness prevalence. Furthermore it shows that decreased lameness prevalence doesn't necessarily increase lameness recognition, i.e. that on farms with high lameness prevalence lack of recognition is not due to owner fatigue where the number of severely lame cows is so high that moderately lame cows are ignored.

Fabian (2012) showed that FPR were much more similar to LPS than LPR. This could be the result of farmers being better at recognising more severely lame cows. However FPR was more strongly correlated with LPR than LPS (ρ =0.63 vs. 0.45), which suggests that it is not as simple as this and that farmers are missing both severely and moderately lame cows – consistent with the findings of a single farm study by Alawneh et al. (2012) that approximately 15% of severely lame cows were treated >6 weeks after first being recorded as severely lame (using locomotion scoring).

These data clearly show that there is room for improvement in the recognition of lame cows under New Zealand conditions, and also the recording of lameness. The prevalence figures reported by Fabian (2012) were higher than the incidence figures reported by Chawala et al (2013), even though the latter were initially presented as accurately reflecting lameness incidence. So even though lameness prevalence and incidence is relatively low in New Zealand, there is still a significant problem of under-recording of lameness and under estimation of its importance. This has importance at the farm level, where lack of recognition of lameness can be a barrier to control, and also at the industry level, where under-estimation of the importance of lameness can mean it is ignored or only limited resources applied to developing and improving control strategies

Acknowledgements
Jessica Fabian for all the mobility scoring and the veterinarians who supported her, particularly Neil Chesterton and Mark Bryan

Searching for the evidence base: What do we know about treating claw horn lesions?

JN Huxley[1], SC Archer[1], OCD Atkinson[2], NJ Bell[3], EA Berry[4], N Bollard[1], RS Dean[1], DCJ Main[5], C Mason[6], O Maxwell[1], G Miguel Pacheco[1], SL Potterton[7], J Remnant[1], P Sleeman[1], HR Whay[5]
[1]University Of Nottingham, School of Veterinary Medicine and Science, Sutton Bonington Campus, Leicestershire, LE12 5RD, UK.[2]Dairy Veterinary Consultancy Ltd, Cheshire, UK. [3]The Royal Veterinary College, Hawkshead Lane, North Mymms, Hatfield, Hertfordshire, AL9 7TA, UK.[4]DairyCo, Stoneleigh Park, Kenilworth, Warwickshire, CV8 2TL, UK. [5]Department of Clinical Veterinary Science, University of Bristol, Langford House, Langford, Bristol, BS40 5DU, UK.[6]Scotlands Rural College, Dairy Research Centre, Hestan House, The Crichton, Dumfries, DG1 4TA, UK.[7]University of Nottingham, School of Biosciences, Sutton Bonington Campus, Leicestershire, LE12 5RD, UK.
jon.huxley@nottingham.ac.uk

Introduction

The levels of lameness in cattle, particularly dairy cows, in the UK and worldwide, are unacceptably high. Controlling lameness is thus one of the greatest challenges facing the dairy industry. Reducing disease and achieving sustainable reductions in the prevalence of lameness in cattle, requires a combination of two approaches. Firstly early identification and prompt and effective treatment of clinical cases to reduce the duration of time over which animals are lame and secondly, the implementation of effective farm-specific prevention strategies to decrease the rate at which new cases develop. These approaches require firm evidence for the best and most appropriate cost effective on-farm control strategies and treatment protocols (Potterton, et al. 2012).

Research in the lameness field has lagged behind that of similar endemic disease such as mastitis and infertility. Much of what we think we understand is actually received wisdom unsubstantiated by experimental research. In many areas of individual disease aetiology, treatment and prevention, once you scratch beneath the surface it can be surprising just how limited our scientific understanding actually is (Huxley 2012). This paper will review the current evidence base on the treatment of claw horn lesions and in particular discuss two recent pieces of work the author and colleagues have conducted in this area.

Materials and Methods – Study 1

The overall aim of this study was to collate and review the peer and non-peer reviewed English language literature on the treatment and prevention of lameness in cattle published since January 2000. The study aimed to identify deficits in knowledge and areas of disparity between what is recommended in the field by veterinarians, foot trimmers and advisors and what has been substantiated experimentally. Peer reviewed literature containing original work was gathered by searching three databases; papers were categorised and reviewed if they contained material on treatment or prevention. Non-peer reviewed clinical materials were collated from a range of sources; the materials were reviewed and categorised based on whether they recommended a range of possible treatment or prevention measures(Potterton, et al. 2012).

Results – Study 1

Only results which cover the treatment of claw horn lesions will be reported here. In the peer reviewed literature, of the 1364 papers published since 2000, on the treatment and prevention of lameness, no papers were identified which contained information on the treatment of white line disease (WLD) and only 3 contained information on the treatment of sole ulcer (SU). Of these papers, two described the treatment and outcomes of cases (Durmus 2005, Nguhiu-Mwangi, et al. 2008), neither of which contained information which could be translated into clinical decision making, and the third described a small clinical trial assessing the efficacy of Biotin supplementation as an addition to standard treatments, on clinical outcome (Lischer, et al. 2002).

Forty six sources of non-peer reviewed literature were identified and included in the review; 23 text books, 6 lameness control plans and 17 'other' sources. The degree of agreement between sources on the treatment of lameness was moderate and varied between treatments and lesions. The only treatment advocated by 100% of sources was a therapeutic trim in the case of SU and WLD (Potterton, et al. 2012).

Materials and Methods – Study 2

The aim of the study was to test treatments for claw horn lesions in newly lame cows, in an RCT. Approximately 1100 cows on five commercial dairy farms in central England were mobility scored fortnightly over a 12 month period using a 6 point scale. New case of lameness (two non-lame scores followed by a lame score), which met the enrolment criteria were randomly allocated to receive one of four treatment protocols, selected for use in the trial following industry consultation. Cows in all four treatment groups received a standard 5-step therapeutic foot trim. Animals in treatment group 1 received no additional treatment and acted as the positive control group. Treatment group 2 consisted of a trim and the application of a foot block to the sound claw. Treatment group 3 consisted of a trim and a three day course of non-steroidal anti-inflammatory drug (NSAID). Cows in treatment group 4 received a trim, a foot block and a course of NSAIDs. Treatment allocation was blocked by diagnosis:sole haemorrhage / sole ulcer (SH/U), WLD or 'Other' (usually a combination of both SH/U and WLD lesions) and farm. Primary outcome was assessed by a mobility score at 35 days post treatment completed by an observer, blind to the treatment administered. Secondary outcomes included milk production data and body condition score.

Provisional Results – Study 2

One hundred and eighty one animals met the enrolment criteria and were randomly assigned for treatment. Provisional univariate analysis indicates that there are significant differences in recovery rate across the four treatment groups.

Discussion

The most striking shortfall identified in study 1 was the lack of well controlled papers on the treatment of the claw horn lesions (WLD and SU); there was an almost complete deficiency in this area. The search identified only three papers, all on the treatment of SU. An extended review into the peer-reviewed literature published before 2000 has identified that the last decade is not unique; only a tiny number of papers have ever been published in this area (Potterton, et al. 2012).

The RCT described in study 2 was very challenging to conduct. In order to get around some of the difficulties identified during the study design process, the methodology was complex and time consuming to implement. These difficulties are discussed by Thomas et al at this conference and may in part explain why so few such studies have been conducted previously.

WLD and SU represent two of the most important causes of lameness. Thousands of cattle around the world are treated for these diseases every week by a range of farmers, paraprofessionals and vets who currently acquire their knowledge and training from a wide range of different sources including their peers, text books, courses and other sources of information. The information these sources contain represents the received wisdom and clinical experience of a small number of key opinion leaders in the field who write or contribute to clinical text books and other widely distributed material. This does not mean to say that these treatments are incorrect, rather that they have never been tested in randomised controlled trials (RCT) to assess the most efficacious treatments. In the absence of, or until better quality evidence exists, this approach remains clinically justified but may not lead to animals being treated using the most appropriate methods (Potterton, et al. 2012). Further work is urgently needed to fill this deficit in our current understanding of the most appropriate treatments for claw horn lesions.

Acknowledgments

The author would like to acknowledge and thank all the co-authors and colleagues with whom he collaborates and the farms that have taken part in studies over the last few years.

References

Durmus AS 2005 Management of sole ulcer in cattle. *Indian Veterinary Journal***82:** 1096-1097.

Huxley JN 2012 Lameness in cattle: An ongoing concern. *The Veterinary Journal***193:** 610-611.

Lischer CJ, Koller U, Geyer H, Mulling C, Schulze J, and Ossent P 2002 Effect of therapeutic dietary biotin on the healing of uncomplicated sole ulcers in dairy cattle - a double blinded controlled study. *Veterinary Journal***163:** 51-60.

Nguhiu-Mwangi J, Mbithi PMF, Wabacha JK, and Mbuthia PG 2008 Retrospective study of foot conditions in dairy cows in urban and periurban areas of Kenya. *Israel Journal of Veterinary Medicine***63:** 40-45.

Potterton SL, Bell NJ, Whay HR, Berry EA, Atkinson OCD, Dean RS, Main DCJ, and Huxley JN 2012 A descriptive review of the peer and non-peer reviewed literature on the treatment and prevention of foot lameness in cattle published between 2000 and 2011. *The Veterinary Journal***193:** 612-616.

Digital dermatitis of cattle and sheep - laboratory pointers to treatment and prevention

NJ Evans[1,2], RD Murray[2], R Birtles[3], R Blowey[4], CA Hart[1], SD Carter[1,2]
[1]Department of Infection Biology, Institute of Infection and Global Health & [2]School of Veterinary Science, University of Liverpool, L69 7ZJ, UK. [3]University of Salford, Salford, M5 4WT, UK. [4]Wood Veterinary Group, 125 Bristol Road, Gloucester GL2 4NB, UK.
evansnj@liverpool.ac.uk

Introduction
Bovine digital dermatitis (DD) was first reported in the UK in 1987 where it is now considered to be endemic, occurring in nearly all dairy herds. Worldwide, the infectious nature of DD makes it a major problem in all countries with dairy cattle. The ensuing lameness is an important animal health concern and is an important worldwide food security issue as it results in reduction in milk yield and reproductive performance and has significant treatment costs. An effective prevention/treatment that completely eliminates bovine DD has yet to be identified. Threateningly, this infection has now also emerged in sheep causing contagious ovine digital dermatitis and the bacteria considered causal have also been associated with newly described, very destructive, non healing hoof lesions in cattle suggesting an even greater economic and animal welfare cost of this infection.
Spirochetes and more specifically treponemes have been implicated as important in the aetiology of DD. This report describes work carried out at the University of Liverpool to further characterise the digital dermatitis treponemes of cattle and sheep and how this work may point to future treatments.

Materials and Methods
Isolation and genotypic and phenotypic characterisations of spirochetes were carried out as described (Evans, et al. 2008, Evans, et al. 2011b). Molecular detection of treponemes in lesions and various host tissues and environment samples used specific PCR assays as described (Evans, et al. 2009c). Antimicrobial susceptibility testing was carried out as described (Evans, et al. 2009a). Quantitative reverse transcriptase PCR (qRT-PCR) analyses of bovine keratinocytes and fibroblasts were carried out according to standard methods.

Results
Optimised isolation methods initially allowed for genotyping and phenotyping of 23 bovine DD treponemes and division into three groups/phylotypes (Evans, et al. 2008) and subsequently, the number of strains isolated has increased (~80). Following additional characterisations we were able to designate one BDD treponeme phylotype as a new species, *Treponema pedis* (Evans, et al. 2009b). We have developed an *in vitro* antimicrobial susceptibility testing method for bovine DD treponemes and identified the most effective antibiotics for use against these bacteria as penicillin, penicillin derivatives and specific macrolides (Evans, et al. 2009a, Evans, et al. 2012a). To investigate the molecular epidemiology of the DD spirochetes we developed PCR assays specific for the different bovine DD treponeme phylotypes and identified the presence of all three phylotypes as together in 74.5% of BDD lesions surveyed (Evans, et al. 2009c). Immunohistochemistry studies identified hair follicles in foot skin as likely entry routes for the treponemes, contributing to understanding treponeme host invasion. The specific PCR assays were used to identify the presence of DD treponemes in sheep DD lesions (Sayers, et al. 2009) and new 'non-healing' manifestations of other bovine foot diseases (Evans, et al. 2011a). Inflammatory host response studies using qRT-PCR assays for relevant bovine genes demonstrated that skin fibroblasts and not keratinocytes are most responsive to BDD treponemes, producing macrophage elastase and RANTES, potentially important inflammatory mediators (paper submitted). Successful experiments to isolate, analyse and compare commensal bovine GI tract treponemes with BDD treponemes identified these micro-organisms as belonging to two large separate phylogenetic clusters, differing in serum dependence and in the presence of a gene encoding tissue attachment machinery (Evans, et al. 2011b). We have also surveyed large numbers of oral and rectal tissues for BDD treponemes which identified occasional colonisation by BDD treponemes (Evans, et al. 2012b).

Discussion
All the aforementioned studies need to be considered to try and understand how to best prevent or treat cattle and sheep DD. Immunohistochemistry and the identification of multiple treponeme phylotypes together in bovine DD lesions identified the disease as polytreponemal rather than more broadly polymicrobial. This is in agreement with other molecular studies carried out in other countries. This suggests treponeme targeted antibiotics, vaccines or transmission blocking may allow for eradication of this disease. We have identified

similarities between cattle and sheep DD suggesting similar prevention/treatment methods should work. Potentially best antibiotic choices from the *in vitro* methods described here can be made for *in vivo* use although considerations with regards to antibiotic usage for specific animal types and environmental damage need to be considered. The upregulation of RANTES and macrophage elastase expression is a similar inflammatory signature to human psoriasis suggesting that treatments for the human skin condition might be worth considering for DD.
Whilst the flora of ruminant GI tracts appears to contain different treponemes to those associated with DD we have found occasional presence of DD treponemes in oral and rectal tissues and further pinpointing may allow for better understanding transmission routes. Future and ongoing studies at Liverpool include more comprehensive infection reservoir investigations and transmission studies. Genomics and proteomics studies are needed to further clarify vaccine studies and are currently underway. In the future hopefully we may be able to finally prevent this disease in cattle and sheep by using a mixture of vaccines, good farm practice and effective treatment.

Acknowledgments
Research was funded from a Department for Environment, Food and Rural Affairs Grant (AW1010) and a Biotechnology and Biological Sciences Research Council Research Grant (BBE0189201).

References
Evans NJ, Blowey RW, Timofte D, Isherwood DR, Brown JM, Murray R, Paton RJ, and Carter SD 2011a Association between bovine digital dermatitis treponemes and a range of 'non-healing' bovine hoof disorders. *The Veterinary record* 168**:** 214.
Evans NJ, Brown JM, Demirkan I, Birtles R, Hart CA, and Carter SD 2009a *In vitro* susceptibility of bovine digital dermatitis associated spirochaetes to antimicrobial agents. *Veterinary Microbiology* 136**:** 115-120.
Evans NJ, Brown JM, Demirkan I, Murray RD, Birtles RJ, Hart CA, and Carter SD 2009b *Treponema pedis* sp. nov., a spirochaete isolated from bovine digital dermatitis lesions. *International journal of systematic and evolutionary microbiology* 59**:** 987-991.
Evans NJ, Brown JM, Demirkan I, Murray RD, Vink WD, Blowey RW, Hart CA, and Carter SD 2008 Three unique groups of spirochetes isolated from digital dermatitis lesions in UK cattle. *Veterinary Microbiology* 130**:** 141-150.
Evans NJ, Brown JM, Demirkan I, Singh P, Getty B, Timofte D, Vink WD, Murray RD, Blowey RW, Birtles RJ, Hart CA, and Carter SD 2009c The association of unique, isolated treponemes with bovine digital dermatitis lesions. *Journal of clinical microbiology* 47**:** 689-696.
Evans NJ, Brown JM, Hartley C, Smith RF, and Carter SD 2012a Antimicrobial susceptibility testing of bovine digital dermatitis treponemes identifies macrolides for *in vivo* efficacy testing. *Veterinary Microbiology* 160**:** 496-500.
Evans NJ, Brown JM, Murray RD, Getty B, Birtles RJ, Hart CA, and Carter SD 2011b Characterization of novel bovine gastrointestinal tract *Treponema* isolates and comparison with bovine digital dermatitis treponemes. *Applied and Environmental Microbiology* 77**:** 138-147.
Evans NJ, Timofte D, Isherwood DR, Brown JM, Williams JM, Sherlock K, Lehane MJ, Murray RD, Birtles RJ, Anthony Hart C, and Carter SD 2012b Host and environmental reservoirs of infection for bovine digital dermatitis treponemes. *Veterinary Microbiology* 156**:** 102-109.
Sayers G, Marques PX, Evans NJ, O'Grady L, Doherty ML, Carter SD, and Nally JE 2009 Identification of spirochetes associated with contagious ovine digital dermatitis. *Journal of clinical microbiology* 47**:** 1199-1201.

How can we help the busy dairy farmer control digital dermatitis?

Peter T. Thomsen
Aarhus University, Department of Animal Science, P. O. Box 50, DK-8830 Tjele, Denmark
PeterT.Thomsen@agrsci.dk

Recent studies of the productivity in Danish dairy herds have shown that the amount of milk produced per man hour range from approximately 200 to 600 kg. This means that an average Danish dairy farmer has less than 10 seconds to produce 1 kg milk. Leach et al. (2010) found that lack of time and labour were considered the most important barriers to lameness control by UK dairy farmers and Relun et al. (2013) reported that time and labour were seen as major challenges in relation to treatment and prevention of digital dermatitis by French dairy farmers. Dairy farmers are indeed very busy people!

Digital dermatitis is a major problem in dairy production in many countries worldwide. In Denmark, the prevalence of digital dermatitis is approximately 25%. In other words, at any given time one out of four cows has digital dermatitis.

Combining the two problems – the busy dairy farmer and a high prevalence of digital dermatitis – results in a very big challenge: Too many cows with digital dermatitis and too little time to deal with it. How to handle this dilemma has been the focus of research done at Aarhus University during the last 5-10 years.

If I can't find the lame cow, I can't treat her

In order to be able to handle a lame cow, the farmer must be able to identify the lame cow. This may sound obvious. However, previous research has shown that generally farmers are only able to identify 25-40% of the truly lame cows in their herd (Wells et al., 1993; Whay et al., 2003; Espejo et al., 2006; Leach et al., 2010).

The first step in controlling lameness – or more specifically digital dermatitis – therefore must be to identify the lame/diseased cows. This is necessary in order to get an overview of the magnitude of the problem in the herd and to be able to identify individual cows for treatment. If the farmer can't find the lame cow, he/she can't treat her!

Even though not all cows with digital dermatitis show obvious signs of lameness (Tadich et al., 2010), an evaluation of lameness may be a first step towards identifying cows with digital dermatitis.

A traditional locomotion scoring of a cow can be done in less than 1 minute and can be done by the dairy farmer after a limited amount of training. However, in an average Danish dairy herd with approximately 160 cows, this means that a 'screening' for lameness would last 2-3 hours. Very few farmers would have the time (and be willing) to do this on a regular basis. Therefore, there is a need for alternative methods for rapid identification of lame cows. At Aarhus University, we have been working with two alternative strategies: 1) a simple screening of lameness based on the arching of the back in standing cows and 2) the use of automatic recording of lying behaviour to identify lame cows and cows with specific hoof lesions.

Low tech approach to finding the lame cow

Many locomotion scoring systems use the arching of the back as one of several clinical signs indicating that a cow is lame. A cow with an arched back when standing is generally considered to be more lame than a cow with an arched back only when walking (Sprecher et al., 1997). We tested the hypothesis that a clinically lame cow could be identified using only the arching of the back in standing cows. Arching of the back was recorded in 454 standing cows and compared to a locomotion scoring of the same cows. We found that the method had a sensitivity of 0.50 and a specificity of 0.86. In other words, the method found half of all truly lame cows and when a cow was classified as lame based on the arching of the back, the probability that she was truly lame was high. The method is a significant improvement compared to the situation where many dairy farmers are only able to identify one out of every four truly lame cows in their herd. The method is much easier and quicker to use compared to a traditional locomotion scoring and can be used to get an overview of the lameness status in the herd (Thomsen, 2009).

High tech: even less labour, but costly

Automated methods for the identification of lame cows and cows with hoof lesions may require even less labour. On the other hand, the technical equipment needed often is quite expensive. In a recent study, we evaluated the use of locomotion scores and lying behaviour as indicators of hoof lesions in dairy cows. Based on locomotion scoring and automatic recordings of lying behaviour in 1,340 cows from 42 herds, we found that locomotion scores and the duration of individual lying bouts could be used as indicators of hoof lesions. Interestingly, we found that long lying bouts was a specific indicator for cows with digital dermatitis. In contrast, cows with hoof horn lesions (e.g. sole ulcers) did not have significantly longer lying bouts (Thomsen et al., 2012a).

Easy scoring of digital dermatitis
Looking more specifically at digital dermatitis, several recent studies have demonstrated that scoring of digital dermatitis during milking is an interesting alternative to scoring in a hoof trimming chute (Thomsen et al., 2008; Relun et al., 2011; Stokes et al., 2012). Scoring during milking can be done much easier and is not dependent on the availability of a hoof trimming chute. Due to the dynamic nature of digital dermatitis lesions (Nielsen et al., 2012), frequent scorings are needed in order to quantify the presence of digital dermatitis in a herd.
Overall, simple manual screening methods and automated methods as exemplified above allows the busy dairy farmer to identify lame cows and cows with digital dermatitis without the use of too much extra work. The choice of a specific methodology in the individual herd will naturally depend on an individual evaluation of the preferences of the farmer, the availability of skilled labour and financial constraints.

Knowledge about risk factors: Is it helpful?
Knowledge about risk factors may be seen as an important tool in the prevention of digital dermatitis. However, risk factors for digital dermatitis have been studied intensively and in many cases the effects across studies are not very consistent. Some studies e.g. find grazing to be associated with a lower risk of digital dermatitis, other studies with a higher risk and yet other studies find no significant association between digital dermatitis and grazing. Secondly, many of the risk factors for digital dermatitis can't easily be changed by the farmer. As an example, the risk of digital dermatitis has been shown to be lower in older cows. However, the farmer naturally can't have a herd with only parity 3 or older cows. Other risk factors (e.g. floor type) can only be changed at very high costs. In conclusion, this means that prevention based on the knowledge of risk factors for digital dermatitis may not be the best way forward.

Automatic washing of hooves
Systematic washing of hooves has been suggested as a means to control digital dermatitis. Anecdotal evidence from some Danish dairy farmers has indicated that manual washing of hooves may decrease the prevalence of digital dermatitis. However, manual washing is time consuming and the quality of the cleaning may vary. Therefore, Aarhus University in cooperation with two commercial companies developed and tested a system for automatic washing of hooves. An automatic hoof washer was developed and installed in 6 commercial dairy herds. The effect of washing the hooves with water and soap was evaluated using the cow as her own control; only left legs were washed leaving the right legs unwashed as a within cow control. Automatic washing of hooves with water and soap decreased the prevalence of digital dermatitis: The odds ratio of having digital dermatitis was 1.48 ($p=0.02$) in the control side compared to the washed side. Automatic washing of hooves was shown to be effective without the use of antibiotics or other adverse chemicals and required only a minimum of labour (Thomsen et al., 2012b). Automatic washing of hooves must not be seen as a 'stand alone' solution, but may be a help for the busy dairy farmer in the fight against digital dermatitis.

Two problems – and suggestions for solutions
I have presented two major problems in modern dairy production: Too many cows with digital dermatitis and too little time to deal with it. New methods for time efficient identification of lame cows and cows with digital dermatitis may have the potential to help the busy dairy farmer quantify the problem at the herd level and identify individual cows for treatment. Finally, automatic washing of hooves may have the potential to reduce the prevalence of digital dermatitis with the use of only a minimum of labour.

References
Espejo,LA, Endres MI, Salfer JA 2006 Prevalence of lameness in high-producing Holstein cows in freestall barns in Minnesota. Journal of Dairy Science 89, 3052-3058
Leach KA, Whay HR, Maggs CM, Barker ZE, Paul ES, Bell AK, Main DCJ 2010 Working towards a reduction in cattle lameness: 1. Understanding barriers to lameness control on dairy farms. Research in Veterinary Science 89, 311-317
Nielsen BH, Thomsen PT, Green LE, Kaler J 2012 A study of the dynamics of digital dermatitis in 742 lactating dairy cows. Preventive Veterinary Medicine 104, 44-52
Relun A, Guatteo R, Roussel P, Bareille N 2011 A simple method to score digital dermatitis in dairy cows in the milking parlor. Journal of Dairy Science 94, 5424-5434
Relun A, Guatteo R, Auzanneau M M, Bareille N 2013. Farmers' practices, motivators and barriers for adoption of treatments of digital dermatitis in dairy farms. Animal, doi: 10.1017/S1751731113000803.
Sprecher DJ, Hoesteler DE, Kaneene JB 1997 A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 47, 1179-1187

Stokes JE, Leach KA, Main DCJ, Whay HR 2012 The reliability of detecting digital dermatitis in the milking parlour. The Veterinary Journal 193, 679-684
Tadich N, Flor E, L Green 2010 Associations between hoof lesions and locomotion score in 1098 unsound dairy cows. The Veterinary Journal 184, 60-65
Thomsen PT 2009 Rapid screening method for lameness in dairy cows. Veterinary Record 164, 689-690.
Thomsen PT, Klaas IC, Bach K 2008 Scoring of digital dermatitis during milking as an alternative to scoring in a hoof trimming chute. Journal of Dairy Science 91, 4679-4682
Thomsen PT, Munksgaard L, Sørensen JT 2012a Locomotion scores and lying behaviour are indicators of hoof lesions in dairy cows. The Veterinary Journal 193, 644-647
Thomsen PT, Ersbøll AK, Sørensen JT 2012b Automatic washing of hooves can help control digital dermatitis in dairy cows. Journal of Dairy Science 95, 7195-7199
Wells SJ, Trent AM, Marsh WE, Robinson RA 1993 Prevalence and severity of lameness in lactating dairy-cows in a sample of Minnesota and Wisconsin herds. Journal of the American Veterinary Medical Association 202, 78-82
Whay HR, Main DCJ, Green LE, Webster AJF 2003 Assessment of the welfare of dairy cattle using animal-based measurements: direct observations and investigation of farm records. Veterinary Record 153, 197-202

Dairy farmers and shepherds: Motivations and barriers for tackling lameness

HR Whay[1], SV Horseman[1], LE Green[2], EM King[2]
[1]University of Bristol, School of Veterinary Sciences, Langford, Bristol, UK [2]University of Warwick, School of Life Sciences, Coventry, UK
Bec.Whay@bristol.ac.uk

Introduction

Lameness continues to present many problems for ruminant livestock and farmers alike with most research attention directed towards dairy cattle and then sheep in the UK. There are both points of commonality and notable differences in the challenges that these two livestock sectors face in controlling lameness. By looking across the two industries there is the potential that workers in each sector can learn from the experiences of the other.

The most recent estimate of lameness in UK dairy cattle (Barker et al 2010) reports a mean prevalence of 36.8% (range 0 to 79.2%) across 205 farms (see Table 1 for definition of mobility scores). This contrasts with sheep where King (2013) reported a median 12 month period prevalence of 5.0% across 388 farms (range 0 to 25%) (see Table 2 for definition of locomotion scores). The most common causes of lameness in UK sheep are infections foot lesions; interdigital dermatitis (ID), footrot (FR) and contagious ovine digital dermatitis (CODD) with ID and FR the cause of 90% of lameness in English flocks (Kaler and Green 2009). In UK dairy cattle, an infectious disease, bovine digital dermatitis (BDD) is a major contributor to lameness but the non-infectious claw lesions sole ulcer, sole bruising and white line disease are common causes of lameness. In 1996 sole ulcer and white line disease were the most frequently identified lesions associated with episodes of lameness (Murray et al 1996), BDD is also now a commonly identified lesion (Barker et al 2009).

Species differences and the fact that dairy cows produce milk whilst sheep mainly rear meat lambs result in different production and management systems. The dairy industry has steadily intensified, increasing the number of animals per herd from a handful of cows in a byre at the end of World War II to the herds of one - two hundred cows or more that we see today. Housing, particularly concrete flooring, has become a key component of dairy cattle management along with a drive to substantially increase the amount of milk produced per animal per lactation. Each dairy cow in the herd is uniquely identified, can usually be sorted and caught for individual attention and has a high frequency of human contact compared with sheep. The current average flock size is 210 ewes, with most sheep farmers having several enterprises, sheep being just one of these enterprises. Dairy cattle are inspected at least twice a day during milking compared to sheep which are commonly inspected once per day when on pasture. This may limit the familiarity of sheep with human contact and reduces the potential time available for observing and checking the flock.

Two aspects of lameness management considered pivotal for successful disease control are 1) farmer identification of lame animals and 2) prompt delivery of lameness treatment. Here we look at some evidence for what influences the success or otherwise of achieving these management goals on UK sheep and dairy farms.

Table 1 Definition of Dairy Co Mobility Score for dairy cattle (DairyCo 2011)*

Score	**Description of Cow Behaviour**	**Suggested Action**
0 - Good Mobility	Walks with even weight bearing and rhythm on all four feet, with flat back. Long, fluid strides possible.	-No action needed. -Routine (preventative) foot trimming when / if required. -Record mobility at next scoring session.
1- Imperfect Mobility	Steps uneven (rhythm or weight bearing) or strides shortened; affected limb or limbs not immediately identifiable.	-Could benefit from routine (preventative) foot trimming when/if required. -Further observation recommended.
2 – Impaired Mobility	Uneven weight bearing on a limb that is immediately identifiable and/or obviously shortened strides (usually with an arch to the centre of the back).	-Lame and likely to benefit from treatment. -Foot should be lifted to establish the cause of lameness before treatment. -Should be attended to as soon as practically possible.
3 – Severely Impaired Mobility	Unable to walk as fast as a brisk human pace (cannot keep up with the healthy herd) and signs of score 2	-Very lame. -Cow will benefit from treatment. -Cow requires urgent attention, nursing and further professional advice. -Cow should not be made to walk far and kept on a straw yard or at grass. -In the most severe cases, culling may be the only possible solution.

Table 2 Definition of locomotion score for sheep (Kaler et al 2009)*

Score	0	1	2	3	4	5	6
Posture and Locomotion							
Bears weight evenly on all four feet							
Uneven posture, but no clear shortening of stride							
Short stride on one leg compared with others							
Visible nodding of head in time with short stride							
Excessive flicking of head, more than nodding, in time with short stride							
Not weight bearing on affected limb when standing							
Discomfort when moving							
Not weight bearing on affected limb when moving							
Extreme difficulty rising							
Reluctant to move once standing							
More than one limb affected							
Will not stand or move							

*The manner in which sheep and cattle bear weight on their limbs is very different and this affects detection of lameness.

Identification of lameness by dairy farmers and shepherds

The nature of the two industries described above indicate that dairy cattle receive greater individual attention and are observed and checked more frequently than sheep. Consequently it would seem intuitive to assume that lameness in dairy cattle would be detected more accurately than in sheep. However, research evidence suggests that the opposite is true. King and Green (2011) reported that estimates of the lameness prevalence of sheep by farmers were consistently and closely correlated with that of a researcher's estimate of lameness prevalence (median 5.4% cf. 7.9% across 5 lowland farms). Underestimates were greatest by farmers with higher prevalences of lameness (>9%). In contrast, Leach et al (2010) reported a very poor correlation between the prevalence of dairy cattle lameness reported by dairy farmers (mean 6.9 % across 222 farms) and that recorded by a researcher (mean 36% across same 222 farms), with most farmers substantially under estimating (or at least under reporting) the number of lame cows on their farm.

It is unclear what lies behind this startling difference in the accuracy of sheep and dairy cattle farmer identification of lameness. Certainly, the overall prevalence of lameness in sheep is lower so the absolute count of number of animals to be identified as lame is lower in sheep than dairy cattle and this may make the identification task a little easier. It may also be the case that when faced with large numbers of lame animals, as is the case on some dairy farms, farmers become desensitised to observing lameness or under recognise lameness as a coping strategy. Some farmers may also be unwilling to report levels of lameness above a certain threshold where this conflicts with farm assurance or cross compliance requirements. In both sheep and dairy cattle there is evidence that farmers' underestimation of lameness increases as the true prevalence of lameness increases (King and Green, 2011; Leach et al 2010). In dairy cattle, there is also some evidence that farmers use a different 'definition' of what constitutes a lame cow to that used by researchers, even employing a language that downgrades moderate lameness to '*a little bit impaired in how mobile they are'*, '*walking a little light*', '*they walk funny*', reserving the term lame for what researchers would describe as severe lameness (mobility score 3; Dairy Co 2011) (Horseman 2012). Whereas sheep farmers are in much more substantial agreement with a researcher as to the locomotion score (locomotion score 2; Kaler et al 2009; see Table 2 for score descriptors) at which a sheep is defined as lame and also have internal consistency, being more likely to identify sheep as lame as severity of lameness increased (Kaler and Green 2008; King and Green 2011).

Identification of lameness and delivery of treatment

Identification is key to the treatment of lameness, after all if a farmer does not know that an animal is lame it will definitely not get treated. However, as already alluded to, the identification of lameness by farmers is less straight forward than the 'early identification argument' accounts for. As discussed above, the degree of change in locomotion at which an animal is defined as lame is certainly one aspect and this appears to be more problematic in dairy cattle than in sheep. Another aspect is farmers' decision making about when to treat a lame animal. Treatment of lameness in both dairy cattle and sheep has both herd level (footbathing) and individual (lifting feet and examining them) components; here only individual treatment is discussed. The work of Kaler and Green (2008) and King and Green (2011) provides evidence of a discrepancy between the locomotion score at which sheep farmers identified sheep as lame (score 2) and the locomotion score which prompts them to catch and inspect lame sheep. All 35 farmers in the King and Green (2011) study recognised locomotion score 2 sheep as lame, although three farmers would not have included sheep lame at this score in a report such as a postal survey. Eighteen of the 35 sheep farmers included in the King and Green (2011) study said that they would catch and inspect sheep once their locomotion score reached 2 or above (see Table 2), the remaining 50% would wait until sheep were score 3; so on many farms treatment is delayed until a higher severity of lameness is observed. Beliefs that locomotion score 2 sheep will recover, difficulty in catching the sheep and the perception that they are not 'very' lame all underpin the decision to delay treatment. This delay in treatment is of particular importance because in the case of an infectious cause of lameness, as is most commonly seen in sheep, a delay in treatment allows spread of the disease as well as delaying recovery

In a study of the effect of early treatment of hindlimb lameness in dairy cattle (Leach et al 2012) a treatment group was established and all cows allocated to this group were treated by the researchers within two days of being recorded as lame, based on fortnightly mobility scoring. A control group was also established in which cows identified as lame and requiring treatment (mobility score 2; see Table 1) were allocated to receive treatment according to the farms normal lameness treatment routines; the farmers attention was not drawn to these cows, they were specifically left to be identified and treated by the farmers in the usual manner. One hundred and one cows were identified as lame and eligible for treatment by the researcher and then allocated to the control group. Of these 101 cows only 12 were treated by the farmer, and median days to treatment for these cows was 65 days. It appears that under-identification and under-treatment of lame cows occurred on the study farms. However, there is no direct evidence that the cows were not identified as lame only that they were not treated. Dairy farmers report that they prioritise the treatment of severely lame (score 3) cows suggesting a tendency towards under treatment rather than under recognition. Interestingly, the study also reported that thirty percent of cows in the control group that were not treated returned to soundness for at least four weeks. It is increasingly recognised that not all lame cows remain constantly lame once they first start limping, this moving in and out of lameness is likely to reinforce farmers decisions to delay treatment and may explain expressions farmers use such as 'she's not properly lame'.

Horseman (2012) highlighted that the delivery of treatment to lame dairy cattle is also influenced by the wider context of the farm. Considerations such as whether treatment of lame cattle was in competition with other priority jobs such as cutting silage or spreading manure, whether staff were sufficiently skill and confident to treat lame cattle and whether the cattle handling facilities leant themselves easily to lifting up cows feet all influenced the likelihood of a delay between detection and treatment of lameness. This is similar to the findings of King (2013) who highlighted that the delivery of prompt treatment to mildly lame sheep is also influenced by the wider context of the farm. The availability of labour, job prioritisation against other farm enterprises, and the distance of the flock to appropriate handling facilities; with sheep with lambs at foot or more severely lame likely to be given increased priority.

Dairy farmers and shepherds

Dairy cattle and sheep farmers work under very different conditions but both are challenged by the on-going problem of lameness. In terms of identification of lameness it seems there is potential for dairy farmers to learn from the strategies employed by shepherds. While shepherds have less contact time with their animals than dairy farmers, it seems that they use this time effectively to spot lame animals and recognise changes in locomotion at an earlier stage. In addition, lameness in sheep is more obvious, making identification easier for farmers.

Prompt delivery of treatment to lame individuals appears to be more problematic for both sheep and dairy farmers, with delays in treatment inherent in both systems. Here a greater understanding of what underpins these delays is needed in order to address them; early evidence from both Horseman (2012, dairy cattle) and King (2013; sheep) indicates that it is a complex mix of opportunity, availability of resources, beliefs and traditions balanced against other demands placed on farmers' time; animals don't die of lameness. By better understanding these barriers to treatment and the counterbalancing motivations that trigger treatment activity we might be better able to work with sheep and dairy farmers to find solutions that lead to earlier and more effective treatment of lameness.

Acknowledgements

The authors would like to thank all farmers who have participated in the studies of lameness in dairy cattle and sheep described here. Sue Horseman was funded by Dairy Co and Elizabeth King by a Biotechnology and Biological Sciences Research Council (BBSRC) industrial CASE studentship with Pfizer, with additional thanks to EBLEX for the provision of farmer address lists.

References

Barker ZE, Amory JR, Wright JL, Mason SA, Blowey RW, Green LE 2009 Risk factors for increased rates of sole ulcers, white line disease, and digital dermatitis in dairy cattle from twenty-seven farms in England and Wales Journal of Dairy Science 92 (5): 1971 – 1978

Barker ZE, Leach KA, Whay HR, Bell NJ, Main DCJ 2010 Assessment of lameness prevalence and associated risk factors in dairy herds in England and Wales. Journal of Dairy Science 93: 932 – 941

DairyCo 2011 http://www.dairyco.org.uk/resources-library/technical-information/health-welfare/mobility-score-instructions/ (accessed12 July 2013)

Horseman 2012 Current on-farm practice in the treatment of sole ulcer and white line disease and the barriers and motivating factors associated with treatment of all lame cows. MSc (R) Thesis, University of Bristol

Kaler J, Green LE 2008 Recognition of lameness and decisions to catch for inspection among sheep farmers and specialists in GB BMC Veterinary Research (4): 41

Kaler J, Green LE 2009 Farmers' practices and factors associated with the prevalence of all lameness and lameness attributed to interdigital dermatitis and footrot in sheep flocks in England in 2004 Preventive Veterinary Medicine 92 (1-2): 52 – 59

Kaler J, Wassink GJ, Green LE 2009 The inter- and intra-observer reliability of a locomotion scoring scale for sheep Veterinary Journal 180 (2): 189 – 194

King EM, Green LE 2011 Assessment of farmer recognition and reporting of lameness in adults in 35 lowland sheep flocks in England Animal Welfare 20 (3): 321 - 328

King EM 2013 Lameness in lowland English sheep flocks: farmers' perspectives and behaviour. PhD Thesis, University of Warwick

Leach KA, Whay HR, Maggs CM, Barker ZE, Paul ES, Bell AK, Main DCJ 2010 Working towards a reduction in cattle lameness: 1. Understanding barriers to lameness control on dairy farms. Research in Veterinary Science 89, 311-317

Leach KA, Tisdall DA, Bell NJ, Main DCJ, Green LE 2012 The effects of early treatment for hindlimb lameness in dairy cows on four commercial UK farms

Murray RD, Downham DY, Clarkson MJ, Faull WB, Hughes JW, Manson FJ, Merritt JB, Russell WB, Sutherst JE, Ward WR 1996 Epidemiology of lameness in dairy cattle: description and analysis of foot lesions. Veterinary Record 138, 586-591

Sponsored Evening Lectures - Accompanying Papers

Bovine Digital Dermatitis – The Tedious Reality of an Endemic Claw Disease

Dörte Döpfer, Dr. *med. vet.*, MSc, PhD, Assistant Professor
Food Animal Production Medicine Section, School of Veterinary Medicine, UW-Madison, 2015 Linden Drive, Wisconsin 53706, USA, phone: +1(608)2361186
dopferd@vetmed.wisc.edu

Abstract
Bovine Digital dermatitis (DD) has proven to be hard if not impossible to eliminate from cattle farms. The reality of preventing and controlling DD to the "Manageable State of Disease" is associated with arduous early detection and recording of lesions, tedious but prompt individual topical treatments, chronicity and recurrence of DD lesions and long-term, expensive group interventions using hoof baths with on occasionsenvironmentally and health-wise questionable chemicals. This has resulted in a major animal welfare problem without solution.

While numerous field trials are being conducted using new or alternative agents for topical and group prevention and control measures, test chemicals are not routinely tested for their in vitro effect upon the bacteria that are the best candidates for causing DD, i.e. treponemes.

The presentation will be about integrated prevention and control measures for DD from heifers to lactating cows and dry cows. It will describe in vitro tests as pre-screening tests before exposure of cows and how these tests play a role during decision making processes together with modeling approaches for analyzing the data sets that result from studies aimed at preventing and controlling DD.

Session 1

Levels of Lameness and Disease

1. A retrospective analysis of field data to investigate the prevalence of foot lesions in dairy cows in Somerset and Dorset. A comparison of 2008 and 2012

MC Burnell[a], JD Reader[a]
[a]Synergy Farm Health, Dorset
jon.reader@synergyfarmhealth.com

Introduction

Synergy Farm Health employs six veterinary technicians/paraprofessionals as part of a vet led team that provide a comprehensive foot health package to farmers in the form of foot trimming and mobility scoring in the South West of England. Each foot trimmer uses a ruggedized laptop to enable reliable data capture on farm. These laptops are equipped with the Herdkeeper ™ software (Stellasoft). This allows fast accurate recording of both foot trimming data and mobility scoring in the field. Data is uploaded as soon as Internet access is available. The system allows immediate reporting of results to farmers as well as access to data for veterinary surgeons and advisers for individual sessions or for summaries carried out regularly. These can be used to facilitate risk assessment s as well as benchmarking between farms.

A summary of 3 years (2006-2008) foot trimming records were presented in poster format at the CLC 2009 (Burnell and Reader, 2009). This poster updates this information with 2012 data but also compares the prevalence of lesions in these 2 periods.

Materials and Methods

All foot trimming records for 2012 that had been uploaded by the six foot trimmers working for Synergy Farm Health were analysed. These were compared to the prevalence of lesions that were analysed from the 2006/2008 data.

Results

	2012 Total
No Farms	**120**
Total No sessions	**945**
No Cows Seen	**21186**
Cows with all feet seen	**14762**
Cows with back feet seen	**20668**
Cows with only front feet seen	**538**
Cows with Lesions	**11294**

Figure 1 Prevalence of lesions recorded at foot trimming 2012

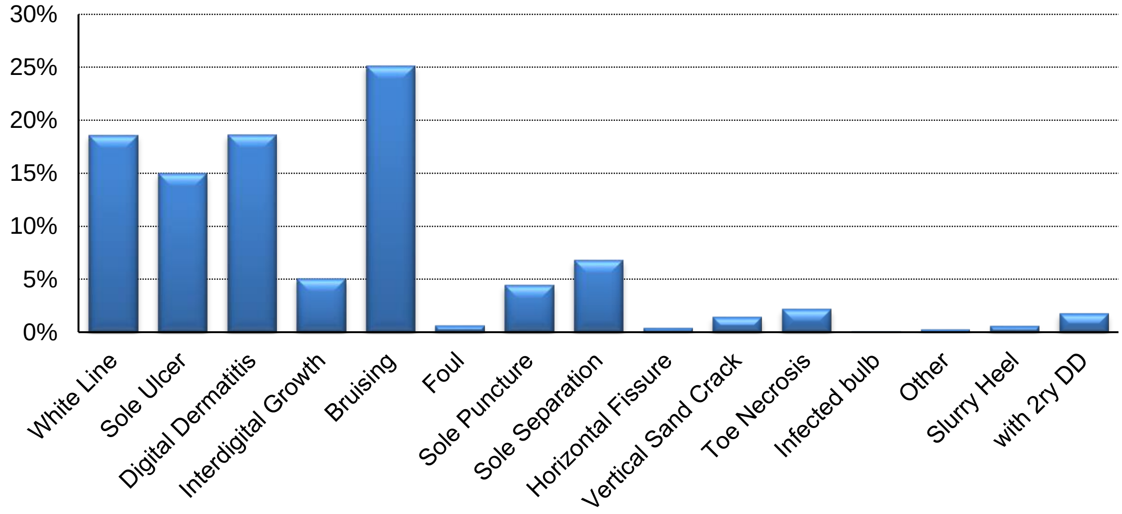
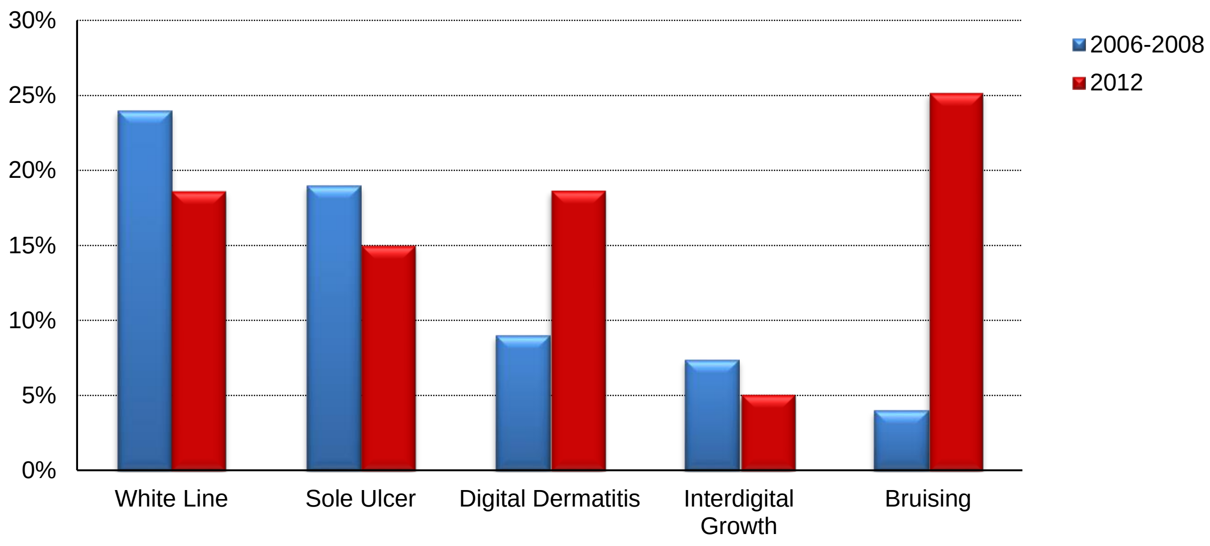


Figure 2 Comparison of prevalence of lesions recorded at foot trimming for 2012 and 2008



86% of all lesions recorded were on the hindlimbs and 14% of all lesions were on the forelimb. 86% of claw lesions on the hindlimb were on the lateral claw. 69% of claw lesions on the forelimb were recorded on the medial claw. 73% of all claw lesions were on the lateral claw of the hindlimb.

Discussion

Few studies are published of prevalence of lesions found at foot trimming. Barker (2007) reported incidence levels from farmer records of 29% for sole ulcer, 22% for white line disease (WLD) and 15% for digital dermatitis. In both our surveys (2006-8 and 2012) WLD was the predominant lesion and not sole ulcer. It is also important to note that the foot trimming survey analyses lesions and these are not necessarily causing lameness.

Both Barker (2007) and our foot trimming surveys do not report levels of heel ulcer. There is a feeling that this is an underdiagnosed condition because of its similarity to sole ulcers. Burgi (personal communication) reports that in his opinion the majority of ulceration seen on the medial claw of the back foot can be described as heel ulcer. If sole ulcers were to be recategorised in this way then rather than 15% sole ulcers reported we can report 11% sole ulcers and 4% heel ulcers.

There has been a marked increase in the prevalence of bruising reported by the foot trimmers. This may be partly down to an increase in ongoing training that they have received and the understanding that this is an important part of the aeteology of claw horn lesions. Also the use of computerized records has made recording of lesions and observations simpler and therefore all lesions are likely to be reported. This warrants further study.

The authors conclude that recording of lameness and foot trimming data is not straight forward. Primary lesions need to be separated from secondary lesions and further work and training is required to standardize lesion recognition and recording.

Acknowledgements

The authors would like to thank the foot trimmers for their ongoing support and their acceptance of the introduction of new technology and to Yvonne Critchell for her ongoing data analysis.

References

Barker ZE 2007 Epidemiology of lameness in dairy cows. PhD Thesis, University of Warwick.

Burnell MC and Reader 2009 A Retrospective Analysis Of Field Data To Investigate The Prevalence Of Foot Lesions In Dairy Cows In Somerset And Dorset 2006-2008. Proceedings of 1st Cattle Lameness Conference 2009.

2. Dairy Cow Well-Being on Wisconsin's Large, High Producing Dairy Herds

RL Brotzman[1], DD Döpfer[1], MR Foy[1], JP Hess[1], KV Nordlund[1], TB Bennett[1], and NB Cook[1]
[1]School of Veterinary Medicine, University of Wisconsin, Madison, WI
rbrotzman@wisc.edu

Introduction
The emergence of confinement-housed facilities for large herds of dairy cattle has been associated with increasing concerns for animal welfare from consumer groups and animal activists. The School of Veterinary Medicine, University of Wisconsin-Madison, has been researching and working alongside Wisconsin dairy producers for over a decade to help build and remodel dairy cattle facilities that promote excellent health, welfare and productivity. The Dairyland Initiative (www.thedairylandinitiative.vetmed.wisc.edu) was developed to facilitate these efforts. This study tests the hypothesis that "large, high producing dairy herds have excellent standards of animal well-being" by auditing herds for select measures of physical well-being, housing and management characteristics.

Materials and Methods
Dairy Herd Improvement data for year 2011 was obtained for 557 Upper Midwest herds with test-day mean ≥ 200 cows. Twenty-two variables were selected and reduced to 16 through principle component analysis (PCA). Farms were divided into six groups by cluster analysis (CA) using PCA-selected variables. Groups 1, 2 and 6 had higher mean performances in selected variables than Groups 3, 4 and 5. Twenty-two herds from each of Groups 1, 2, and 6 were visited from June to August 2012. Farms were randomly and proportionately selected from Wisconsin counties where the majority of the 557 herds resided. Data were collected regarding welfare, housing and management practices. Objective welfare indicators were assessed in the highest production, mature cow group on each farm, including hock and carpal scores; prevalence of back, hook and pin injuries (BACK); and locomotion scores (1 -5 scale). Findings from the survey of 66 herds equally representing Groups 1, 2, and 6 were summarized overall and by group.

Results
Preliminary analysis showed mean prevalence of clinical lameness (score 3-5) [mean±SD] was 13.2±7.3%, and prevalence of severe lameness (score 4-5) was 2.5±2.7 %. Sand herds were numerically lower than mat and mattress herds combined (clinical lameness 11.2±5.8% on sand and 17.4±9.0% on mats and mattresses, severe lameness 2.1±2.3% on sand and 3.5±3.5% on mats and mattresses). Mean prevalence of hair loss over the hock was 38.2±19.3% (29.5±16.8% in sand-bedded herds, 53.2±14.0% in mat/mattress herds), and mean prevalence of swollen or ulcerated hocks was 12.2±15.3% (4.03±3.73% in sand herds, 29.4±17.3% in mat/mattress herds). Carpal injuries of swelling or ulceration were present in 6.2±5.5% of cows on average among study herds (5.19±3.17% in sand herds, 8.27±8.44% in mat/mattress herds). BACK injuries were uncommon (mean prevalence 3.62±3.4%). Future work will model measureable well-being outcomes against housing and management characteristics to identify which practices should be promoted for improved dairy cow well-being.

Discussion
While clinical lameness prevalence on large, high producing farms was low in this study, hock and carpal injuries were relatively commonplace in some systems (mats/mattresses) and may indicate areas for improvement in stall design. In comparison, a recent survey of mature, high producing multiparous cows on large dairies found the prevalence of clinical lameness to be 31% in California and 55% in the Northeast US (von Keyserlingk et al 2012). Research and outreach messages on facility and stall design, and management for the benefit of cattle and producers that manage them are being heard and implemented in the study region.

References
Von Keyserlingk MAG, Barrientos A, Ito K, Galo E, Weary DM 2012 Benchmarking cow comfort on North American freestall dairies: Lameness, leg injuries, lying time, facility design, and management for high-producing Holstein dairy cows. Journal of Dairy Science 95:7399–7408

3. Contagious Ovine Digital Dermatitis – a questionnaire survey of 511 sheep farms in Wales

JW Angell[1], D Grove-White[1], JS Duncan[1]
[1]School of Veterinary Science, University of Liverpool, Leahurst, Neston, CH64 7TE, United Kingdom,
[2]Institute of Global Health, School of Veterinary Science, University of Liverpool, Liverpool, United Kingdom
jwa@liv.ac.uk

Introduction
Contagious Ovine Digital Dermatitis (CODD) is a new and emerging disease of the ovine foot, first reported in the U.K. in 1997 (Harwood et al 1997). The disease causes severe damage to the ovine foot and is a significant welfare concern (Davies 1999). Since its emergence, the disease has not been extensively studied. *Treponeme* spp. associated with Bovine Digital Dermatits (Dawhi et al 2005) have been isolated from CODD lesions as have other bacterial species such as *Dichelobacter nodosus* and *Fusobacterium necrophorum*.

Materials and Methods
In 2012 a postal questionnaire was sent to 2000 sheep farms in Wales. The 511 respondents answered questions on lameness in general, infectious foot disease, and associated management practices. Questions were also included to investigate farmers' current attitudes to the management of lame sheep.

Results
The current prevalence of CODD across Welsh sheep farms is estimated to be 35.0 %, with a median on farm prevalence of 2.0%. Risk factors associated with CODD on farms include geographical location, farm size, the presence of digital dermatitis in cattle on the farm, concurrent foot disease - in particular Footrot and Interdigital Dermatitis - and foot trimming.
Farmers view winter to be the season when CODD is at its worst and they report their breeding ewes to be the group most severely affected.
Farmers also treat all lame sheep the same, regardless of the diagnosis and rarely involve their vet in diagnosis, treatment or management of ovine foot disease.

Discussion
The proportion of farms affected by CODD has increased over estimates from previous surveys (Wassink et al 2003 and Kaler and Green 2008). However, the on farm prevalence remains low. The association of CODD with the presence of digital dermatitis in cattle on the farm corroborates earlier hypotheses of a link between these two diseases. The association of CODD with concurrent foot disease warrants further investigation as to the role of other pathogenic organisms.
The lack of involvement of veterinarians with lame sheep is of concern, and is reflected in the generalised approach farmers have to diagnosis and treatment. It is unclear as to the nature of the specific barriers to veterinary involvement and investigation of these issues is warranted in order to improve animal welfare.

Acknowledgements
This study was funded by a grant from The British Veterinary Association Animal Welfare Foundation, Norman Hayward Fund.

References
Davies IH, Naylor RD and Martin PK 1999. Severe ovine foot disease. In: The Veterinary Record 145(22):646.
Dhawi A, Hart CA, Demiarkan I, Davies IH and Carter SD 2005. Bovine Digital dermatitis and severe virulent ovine foot rot: A common spirochaetal pathogenesis. In: The Veterinary Journal 169:232-241.
Harwood DG, Cattell JH and Lewis CJ 1997 Virulent foot rot in sheep. In: The Veterinary Record 140(26):687.
Kaler J and Green LE 2008 Naming and recognition of six foot lesions of sheep using written and pictorial information: A study of 809 English sheep farmers. In: Preventive Veterinary Medicine 83:52-64.
Wassink GJ, Moore LJ, Grogono-Thomas R and Green LE 2003 Exploratory findings on the prevalence of contagious ovine digital dermatitis in sheep in England and Wales during 1999 to 2000. In: The Veterinary Record 152:504–506

4. Observation of footrot incidence in a controlled challenge experiment with Katahdin and F_1 crossbred rams

T Wuliji[1], S Azarpajouh[1], W Lamberson[2], J Caldwell[1], B Shanks[1], A Bax[1]
[1]Lincoln University, Jefferson City, Missouri; [2]University of Missouri, Columbia, Missouri, USA
wulijit@linconu.edu

Introduction

The North Central part of US is an endemic prevalence area for footrot in ruminants, including sheep and goats. Sheep and goats are popular diversified small farm enterprises in the region; therefore, footrot control is becoming significant to the small ruminant industry. Although native or hair sheep breeds, such as Katahdin, are reputed as having better footrot disease resistance but there were no validated information available for footrot disease challenge in these breeds.

Materials and Methods

Weaned Katahdin and F_1 crossbred ram lambs were stratified based on body weight, breeds, and footrot marker test scores, and were evenly divided into control and challenge groups, with 28 animals in each group respectively. The trial (IACUC # 2010) was conducted during a dry and cold season. To simulate a wet and warm micro environment, the left front foot of each animal was fitted with a sock and a plastic sheep boot. A quarantine pasture block with a high fence and locked gate was set up as a housing facility. Animals were adapted to pen feeding and boot conditions for two weeks prior to the start of the trial. Two strains of Dichelobacter nodosus (ATCC 25549 and ATCC 31545) were obtained from ATCC (ATCC, VA) and cultured on Blood Agar media for 3 - 4 days anaerobically to harvest inoculation bacteria stocks. The inoculation site in the interdigital space of the animal foot was prepared by cleaning, scrubbing, and making a small scalpel incision (1 cm long). A number of colonies from one quarter section of a culture plate surface were wiped with a cotton pad moistened in PBS solution and placed on the scalpel wound. The cotton pad was secured with medical gauze and vet wrap. Animals that received foot inoculation remained booted for the entire experimental period. Control animals had boots removed after the two week adaptation period. Inoculation pads were collected from each animal on the 5^{th} day following the procedure. Animals were blood sampled, observed, and had footrot scores (0-4) and other clinical symptoms recorded weekly for 8 weeks. Animals were subjected to 2 week post trial footrot preventive treatments and held in the quarantine area for 4 more weeks before disposal. Blood specimens were analyzed for hematocrit, white and red blood cell counts, white blood cell types, mineral contents, and IgG profiles. Data were analyzed by the mixed procedures of SAS.

Results

There were 16 of 28 rams from the footrot bacteria challenged group that recorded a footrot score of 1 or 2 compared to 0 in the control group. There were no severe clinical footrot symptoms recorded in any of the challenged animals. Blood cell counts, white blood cell types, and cell type ratio demonstrated that small differences were found for HEM ($P < 0.05$), N/L ratio ($P < 0.05$) and EOS ($P < 0.01$; Table 1).

Table 1. Blood cell counts, white blood cell types, and cell type ratios by breeds and groups

	HEM	NEU	LYM	N /L	EOS	MON	BAS	WBC	RBC
	%	%	%	Ratio	%	%	%	ml	ml
Katahdin	30.51	53.30	41.70	1.32	3.01	1.01	0.96	5948	10403047
K x D	32.48	52.44	42.42	1.26	3.04	1.07	1.02	5839	10808873
SE	0.28*	0.39	0.39	0.02	0.11	0.03	0.03	99	192533
Control	31.07	52.75	42.60	1.25	2.65	1.04	0.95	5911	10402929
Treat.	31.92	52.99	41.51	1.32	3.40	1.04	1.04	5876	10808991
SE	0.32*	0.39	0.39	0.02*	0.11**	0.03	0.03	98	190202

Small differences ($P < 0.05$ / $P < 0.01$) were also found for P, Fe, and Zn by breeds and Ca, S, Zn, and Cu by groups (Table 2).

Table 2. Serum macro and micro mineral contents by breeds and groups

	Macro Minerals mg/L						Micro Minerals mg/L		
	Na	K	Ca	P	Mg	S	Fe	Zn	Cu
Katahdin	175.97	10.28	4.63	3.37	1.05	3.41	0.095	0.039	0.036
K x D	178.23	10.74	4.76	3.65	1.07	3.25	0.111	0.036	0.034
SE	1.63	0.43	0.05	0.05**	0.01	0.06	0.002**	0.001*	0.001
Control	175.37	10.65	4.58	3.58	1.05	3.46	0.103	0.035	0.030
Treat.	178.83	10.37	4.81	3.44	1.08	3.20	0.103	0.041	0.040
SE	1.59	0.42	0.05**	0.05	0.01	0.06**	0.002	0.001**	0.001**

Discussion

The results suggest that Katahdin and F1 cross bred rams are not likely to be readily susceptible or prone to an artificial infection by D. nodosus cultures in this experiment. However, whether there is a higher footrot resistance or a poor infectious potency of bacteria cultures involved in this experiment warrant further investigation.

.

P1(a). Prevalence of lameness in 548 bulls and the type of claw lesion in 29 lame bulls from 23 dairy herds in southern Chile

J Borkert
Borkert y Cía. Ltda., **Hoof Trimming Company, Osorno, Chile**
jborkert@cuidatuvaca.com

Introduction
Lameness causes pain, deterioration of animal welfare and economic losses. Lameness is caused because of multifactorial disorders, where feeding practices, environment, infectious processes, genetics and behavior are involved. There are few studies in Chile about the prevalence of lameness in dairy cows but there are not studies about bulls. Some dairy herds in southern Chile use bulls after use artificial insemination as a reproductive protocol.

Objective
Determine the prevalence of lameness in 548 bulls and the type of claw lesions in 29 lame bulls from 23 dairy farms in southern Chile.

Material and Methods
The bulls of 23 Dairy farms in the X region of Chile were put together in one farm after breeding seasons. This farm was visited in June of 2011. A Veterinary Doctor attended and collected the data from 29 lame bulls to determinate the prevalence of type of the lesions. In lame bulls all four feet were examined.

Results
The average prevalence of lameness was 16.4%. The four most frequent lesions were white line disease (55.2%), ulceration of the sole (34.5%), double sole (17.2%) and digital dermatitis (13.8%) (Figure 1). The fore limbs was the most affected in 75.8% of the bulls and the most affected claw was the medial fore claw in 55.2%.

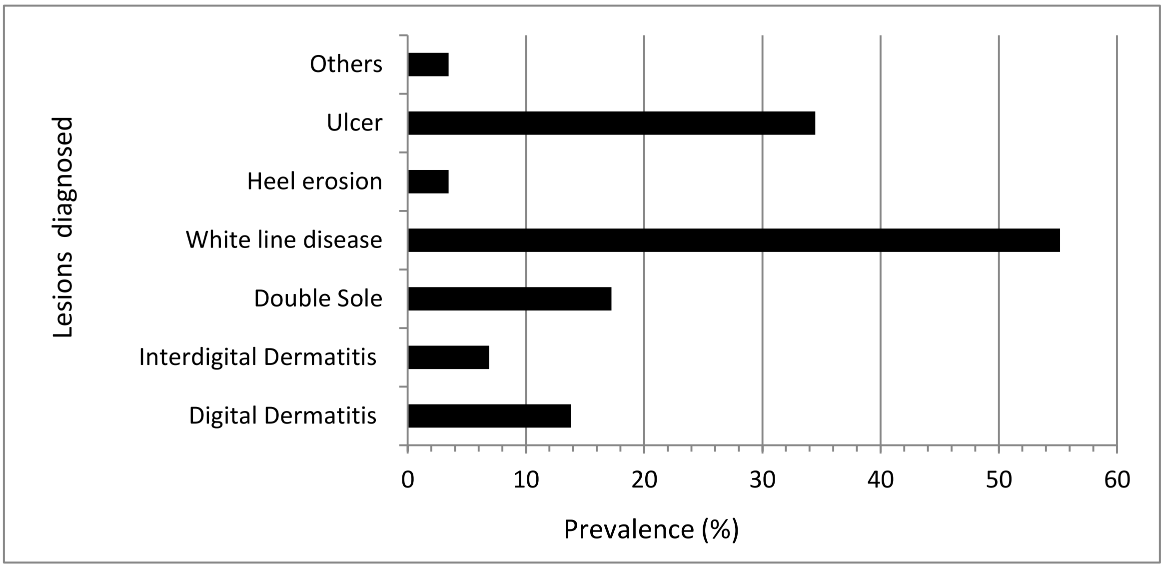


Figure 1. Prevalence of lesions in 29 lame bulls from the 23 dairy farms in the X region of Chile.

Discussion
The average prevalence of lameness is similar to recent studies in dairy cows in Chile. But the fore limbs are most affected in these bulls maybe for the jump in hard surfaces like concrete in the parlor.

P1(b). Lameness in Breeding Beef Bulls

L Petrie
Department of Large Animal Clinical Sciences, Western College of Veterinary Medicine, Saskatoon
lyall.petrie@usask.ca

Introduction

There is limited information available on lameness in breeding bulls, and that which is published is mainly on arthropathies and skeletal abnormalities (Dutra et al 1999). This paper reviews the causes of clinical lameness in breeding beef bulls admitted to the Large Animal Clinic of the Western College of Veterinary Medicine (WCVM) over a 10 year period

Materials and Methods

Case records of 191 beef bulls, one year old and greater, admitted to the WCVM for the ten year period from January 1, 2002 to December 31, 2011 with lameness as the presenting complaint were reviewed. The diagnoses were made principally on clinical examination.

Results

The bulls were predominantly Simmental (39), Aberdeen Angus (35), Red Angus (30), Charolais (29), Hereford (21) and Limousin (15). The mean age was 4.3 years (range 1-11 years). The clinical diagnoses for the 220 episodes of lameness are presented in Table 1. Sole abscesses associated with either white line disease or infected vertical fissures were the predominant lesions. Of the lesions proximal to the foot, 24 (10.9%) were diagnosed as joint conditions or fractures. No firm diagnosis was made in 9 cases; these bulls probably had upper limb lesions. Eighty one percent of all lameness occurred in the foot, predominantly the fore feet with 17.6%, 15.7%, 14.6% and 17.6% of claw lesions occurring in the left fore lateral, left fore medial, right fore medial and right fore lateral claws respectively. In the hind feet 13.9%, 4.2%, 4.2% and 12% of claw lesions occurred in the left hind lateral, left hind medial, right hind medial and right hind lateral claws respectively. Of the 107 bulls where the information had been recorded in the case file, 62 (58%) had been treated prior to admission, almost exclusively with a long acting oxytetracycline antibiotic preparation.

Table 1 Lameness in 191 Beef Bulls (220 Episodes)

	n	%
White line disease - sole abscess	69	31.4
Infected vertical fissures – sole abscess	27	12.3
Infected vertical fissures	10	4.5
Lesions above the foot, including injuries, hock, stifle and hip lesions	32	14.5
Septic Arthritis P2-P3	12	5.5
Toe ulcer, Thimble toe	24	10.9
Foot rot	9	4.1
Sole ulcer	8	3.6
Interdigital fibroma	5	2.7
Digital dermatitis, Interdigital dermatitis	4	1.8
Other lesions	11	5
No firm diagnosis	9	4.1

Discussion

The breed distribution reflects the local beef bull population. The low mean age (4.3 years) probably indicates the limited breeding life-span of beef bulls before in-breeding occurs. Although skeletal abnormalities and arthropathies are often held to be responsible for most of the lameness in breeding bulls (Dutra et al 1999), the foot was the most common site of lameness in this study with 81% of all lesions occurring in the foot, predominantly the fore feet with the lesions equally distributed among the four front claws. In addition to white line disease sole abscesses were also associated with infected vertical fissures in which infection dissected distally to the toe and under the sole. Many of the bulls in this study had vertical fissures which were not associated with lameness. Two bulls had digital dermatitis which has been recognised previously in beef bulls in this region (Borgmann et al 1996).

References

Borgmann IE, Bailey J &Clark EG 1996 Spirochete-associated bovine digital dermatitis. *Canadian Veterinary Journal 37*: 35-37.

Dutra F, Carlsten J & Ekman S 1999 Hind limb skeletal lesions in 12-month-old bulls of beef breeds. *Journal of Veterinary Medicine Series A46:* 489-508.

P2(a). Non-healing white-line lesions: prevalence, causing organisms and risk factors

M Holzhauer[1], M Gongrijp[1], E van Engelen[1], G van Schaik[2], M van Bostelen[2], A Velthuis[1]
[1] GD, (Dutch Animal Health Service), Deventer, The Netherlands; [2] Private Claw Trimmer, Appingedam, The Netherlands
m.holzhauer@gddeventer.com

Introduction
In dairy cows, lameness is, as result of the pain and the long lasting character of most lesions, an important cause of impaired animal welfare and a primary reason for preliminary culling (Bruijnis et al., 2010; Ettema et al., 2010). Since 2000 dairy farmers are dealing with a non-healing variant of the white-line disease (NHWLD). The condition is presented as a white line disorder, which does not heal despite intensive treatment (Holzhauer, 2008, Burgi and Cook, 2008). Hence, the etiologic background, the herd- and cow prevalence and the currently used therapies at Dutch dairy farms are unknown. The aim of this study was to elucidate these aspects.

Material and Methods
The etiologic background was studied by using bacteriological culturing of lesion swabs of cows with and without NHWLD. In three NHWLD positive herds, six cows with and six cows without typical horn lesions (e.g. ulcers) were selected per herd. In these cows, both cows with NHWLD and non-NHWLD lesions were sampled and investigated using bacteriological culturing. In addition, in three NHWLD negative herds, six cows with non-NHWLD were sampled. All samples were cultivated (under aerobic and anaerobic circumstances) and typed. Additionally, the samples were tested for *Dichelobacter nodosus (D. nodosus)* using a PCR.
The herd and cow prevalence was estimated using data on claw trimming diagnosis and the risk factors were identified using information from claw-trimming sessions and a survey. Information from 185 dairy herds, provided by 8 claw trimming organisations, distributed over the country, with regular preventive-claw trimming information were approached randomly to participate. In addition, by using a survey, information was collected about 1) characteristics of the herds (e.g. production level, type of flooring), 2) general management (pasturing or permanent housing, feeding and cleaning) and 3) claw management (use of footbaths, NHWLD treatments and frequency of claw trimming). The relationship with other claw lesions was analysed with a multilevel logistic regression model. The relation with possible risk factors was analysed with a negative binomial regression model. All analyses were carried out in STATA 12.

Results and discussion
In cultivation, 29 different types of bacteria could be identified. The positive clusters of bacteria belonged mainly to the genus *Prevotella* and Porphyromonas. The analysis showed a significant association between NHWLD and the presence of *Fusobacterium*, *Bacteroides* and *Prevotella*. A positive or dubious result in the *Dich. nodosus* PCR was positively correlated with NHWLD.
The herd prevalence was estimated around 74% (95% CI 64-78%). The median of the cow prevalence was 3% (95% CI 0-24%) and 4% (95% CI 0-20%) in 2011 and 2012 respectively. Cows with interdigital dermatitis were more often affected with NHWLD and cows with digital dermatitis less often. Risk factors were regions, a recent BVDV introduction, permanent housing, and irregular claw trimming. Hence, manually cleaning of the floors was associated with less NHWLD.
Treatment of the lesion with tetracyclin spray and Novaderma® under a bandage (5 days) seemed to result in the highest cure rate of NHWLD.

References
Bruijnis MR, Hogeveen H and Stassen EN 2010 Assessing economic consequences of foot disorders in dairy cattle using a dynamic stochastic simulation model. Journal of Dairy Science 93: 2419-32.
Burgi K, Cook N 2008 "Hairy Attack": a new lesion affecting the corium of the white line - a case report. Proceedings 15th International Symposium & 7th Conference on lameness in ruminants, Kuopio, Finland 9 - 13 June
Ettema J, Østergaard S, Kristensen AR 2010 Modelling the economic impact of three lameness causing diseases using herd and cow level evidence. Preventive Veterinary Medicine 95:64-73.
Holzhauer M 2008 Non-Healing white line disorders, a new clinical presentation. Proceedings 15th International Symposium & 7th Conference on lameness in ruminants, Kuopio, Finland 9 - 13 June.

Keyserlingk MAG von, Barrientos A, Ito K, Galo E, Weary DM 2012 Benchmarking cow comfort on North American freestall dairies: Lameness, leg injuries, lying time, facility design, and management for high-producing Holstein dairy cows. Journal of Dairy Science 95: 7399-7408.
Zurbrigg K, Kelton D, Anderson N, Millman S 2005 Stall dimensions and the prevalence of lameness, injury, and cleanliness on 317 tie-stall dairy farms in Ontario. Canadian Veterinary Journal 46: 902-909.

P2(b). Prevalence of lameness in 2370 cows and the type of claw lesion in 511 lame cows from 4 dairy herds in central area of Chile

F Galleguillos, J Borkert
Borkert y Cía Ltda. Osorno, Chile.
fgalleguillos@cuidatuvaca.com

Introduction

There are few studies in Chile about the prevalence of lameness in dairy cows in the south area. Some authors have reported prevalence between 9.1 and 46.6%. The prevalence of lameness found in other countries (including Israel, New Zealand and USA) vary from 3.8% to 30%. There are no studies that report in Chile about the prevalence of lameness in dairy cows in the central area of the country, in this area of Chile the cows are maintained in barns and have a high level production.

Objective

Determine the prevalence of lameness in 2370 cows and the type of claw lesions in 511 lame cows from 4 dairy farms in central area of Chile.

Material and Methods

4 dairy farms in the metropolitan, V and VI regions (central area) of Chile were visited in March of 2013. A Veterinary doctor attended and collected the data from 511 lame cows to determinate the prevalence of type of the lesions. In lame cows all four feet were examined.

Results

The average prevalence of lameness in 2370 cows was 21.6%. The five most frequent lesions were overgrowth of the horn (47%), digital dermatitis (31%), ulcer (20%), interdigital dermatitis (12%) and white line disease (12%) (Figure 1). The hind foot was the most affected in 73%. A 20% of the lame cows needed a block (rubber) and a 56% of the lame cows needed a cohesive bandage. In a 27% of the cows it were only needed a corrective trim. In a 2% of cows the elimination was recommended due to the severity of the lesions.

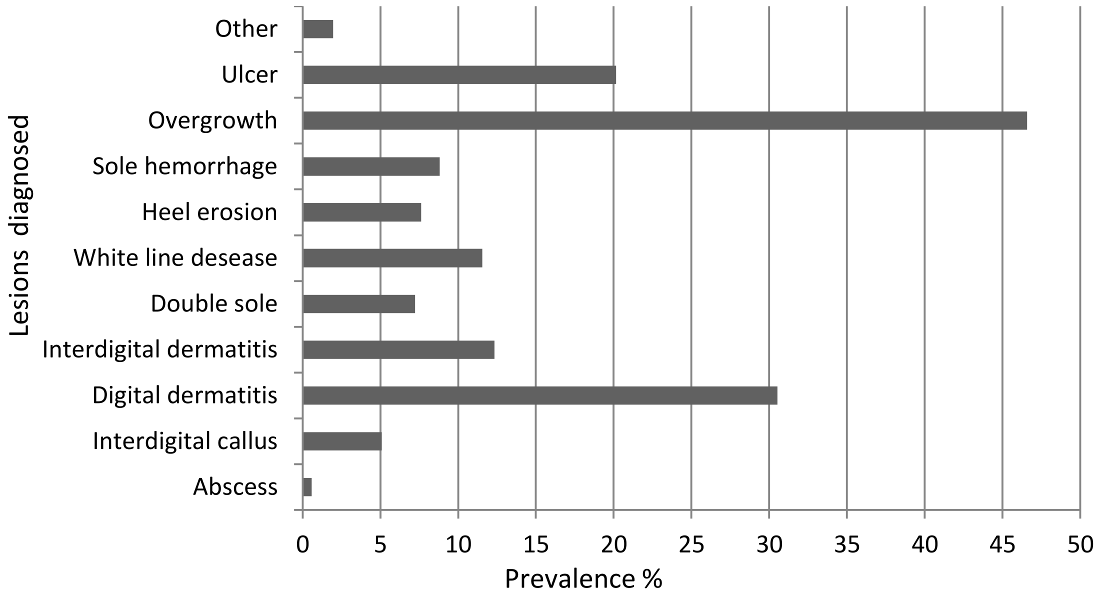


Figure 1. Prevalence of lesions in 511 lame cows from 4 dairy farms in the central region of Chile.

Conclusion

The average prevalence of lameness is similar to recent studies in southern Chile. The overgrowth and digital dermatitis was the most common lesion; this is different from the result found in southern Chile where the most common lesion was white line disease. This may be explained in part because in the central area of Chile the cow are maintained in barns and not in pastures and in the most of the farms of the central area there is not a establish trimming routine.

P3(a). Bovine Digital Dermatitis in New Zealand – the past the present and the future

RN Chesterton[a]
[a] Inglewood Veterinary Services
chesterton@inspire.net.nz

Introduction

In New Zealand up until the end of 2012, Bovine Digital Dermatitis (BDD) had been reported only as sporadic cases. The first confirmed case of BDD in New Zealand was in 2004 (Vermunt & Hill, 2004). Since there was little experience of the disease in New Zealand and because of its expression as sporadic and isolated cases, no testing had been done prior to the 2004 case. In 2011, five suspect cases were reported by laboratories from different parts of the country (van Andel et al, 2012). In all cases except one, only individual animals in the herds were involved.

In 2012 an awareness campaign was begun by the author in New Zealand and as a result more farmers and vets are reporting the sporadic occurrence of single or a few cases in outdoor grazing farms. We asked the question whether these cases were truly individual cases or represented a bigger problem.

This paper reports a follow up on three dairy farms that had reported a case of a BDD-like classical lesion. Multiple cases of non lame cows with early and healing lesions were found. This finding raises the question of whether individual isolated cases in herds in fact indicate the “tip of an iceberg” and if so what does the future hold for NZ concerning BDD and its possible spread.

Materials and Methods

Three dairy herds with isolated suspect cases of classical BDD were investigated. The herds were visited during milking and the rear feet examined for BDD. A number of the lesions were sampled for histology and silver stain.

Results

Table 1

Farm #	Date of visit	# cows	# visually confirmed BDD	% of herd	Date cases first observed by farmer
1	28/12/12	217	19	8.8%	1991
2	11/01/13	230	17	7.4%	7/01/13
3	05/04/13	550	9	1.6%	01/11/12

In all herds multiple cases of classical BDD were identified.
All the samples confirmed the diagnosis of BDD.

Discussion

Dairy and beef farming in NZ is predominantly grass based. Compared to housed systems the feet are relatively free of contamination from slurry and it was thought that the relatively clean environment accounted for a history apparently free of BDD.

Identifying multiple cases in three herds in Taranaki raises some questions:

> ‘Have these herds had multiple cases of (mild) BDD for many years that don’t cause significant lameness?
> Or is this the first finding of multiple cases and evidence of an evolution of the disease from sporadic incidence to now being more infectious?’

This work was done at the beginning of an awareness campaign re BDD in New Zealand. We have only begun to collect reports of cases of BDD and indeed farmers and vets have only recently been encouraged to look for them. Whether this represents the tip of an iceberg still remains to be seen.

We have now recommended that where there are sporadic cases of BDD that the entire herd be checked.

References

Döpfer D, Koopmans A, Meijer FA, Szakall I, Schukken YH, Klee W, Bosma RB, Cornelisse JL, van Asten AJAM, ter Huurne AA 1997 Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. Veterinary Record 140 (24):620-3.

Vermunt JJ, Hill FI 2004 Papillomatous digital dermatitis in a Holstein-Friesian bull. New Zealand Veterinary Journal 52:2, 99-101

Van Andel M, Rawdon T, Thompson K, Vink WD 2012 Review of Recent Bovine digital Dermatitis-like lesions in Cattle. Surveillance 39 (2) 2012

P3(b). Prevalence and severity of claw disorders in female calves and young dairy cows

B Brummelman[1], M Holzhauer[2]
[1]Private practitioner,Wolvega,The Netherlands; [2]GD Animal Health Service, Deventer, The Netherlands
berend.brummelman@gmail.com

Introduction

A longitudinal study (Holzhauer et al., 2012) established that the prevalence of digital dermatitis (DD), interdigital dermatitis/heel horn erosion (IDHE) and sole hemorrhages (SH) increased with age. Grazing, season of observation and age class were estimated risk factors for these claw disorders. If DD and IDHE occurred once, there was increased risk of persistence/reoccurrence in a higher age class. Prevalence was estimated with all severity stages of the different claw disorders as being positive. In some other studies prevalence was estimated as the less severe stage of a disorder being negative (Capion et al., 2008; Manske et al., 2002).
The aim in this paper is to consider the same dataset (Holzhauer et al., 2012), regarding the more severe stages of disorders.

Material and Methods

In 10 dairy herds in the northern region of The Netherlands, 40 female youngstock, aged 2 months – 2 years, were randomly selected. Hind claw observations were performed at 3 monthly intervals (May 2008-February 2010). Seven claw disorders were recorded, differentiated into infectious: digital dermatitis (DD), interdigital dermatitis/heel horn erosion (IDHE), interdigital hyperplasia (IH) and interdigital necrobacillosis (IN), and non-infectious: sole hemorrhages (SH), white line lesion (WLL) and sole ulcer (SU). The main 3 disorders (DD, IDHE and SH) were recorded in severity classes: DD 4 classes (Döpfer et al., 1997) and IDHE and SH 3 classes (Somers et al., 2003). The other 4 (IH, IN, WLL and SU) as present/absent. Observations were carried out at leg level.
Descriptive analysis was carried out to evaluate the changes in prevalence over time. Only data of animals observed at least five times were included in the analyses (366 animals with 2731 observations). Unit of analysis was the animal. To estimate prevalence of IDHE and SH, severity classes 0 and 1 were reclassified as negative and 2 and 3 positive. For DD we focused at class 2, because class 1 is a pre-clinic stage and 3 and 4 healing stages.

Results and discussion

Effect of age on DD, IDHE and SH is presented in Figure 1, 2 and 3 respectively. Prevalence curves of severe scores of these disorders follow more or less the same track as the curves of all the positive scores, however on a lower level. In Figure 1 the curve of DD=2 shows, after a summit at 30 months of age, a decreasing prevalence of DD in first lactation and an increase again after second calving (36 months). In Figure 3 the curve of SH=2+3 shows markedly an increase after first calving and again after second calving. The high prevalence of SH=1+2+3 at the age of 12-15 months was not found in the curve of SH=2+3 and is not known in literature: the origin is of score SH=1 and needs further investigation.
Prevalence of IH, IN, WLL and SU were too low for further evaluation.

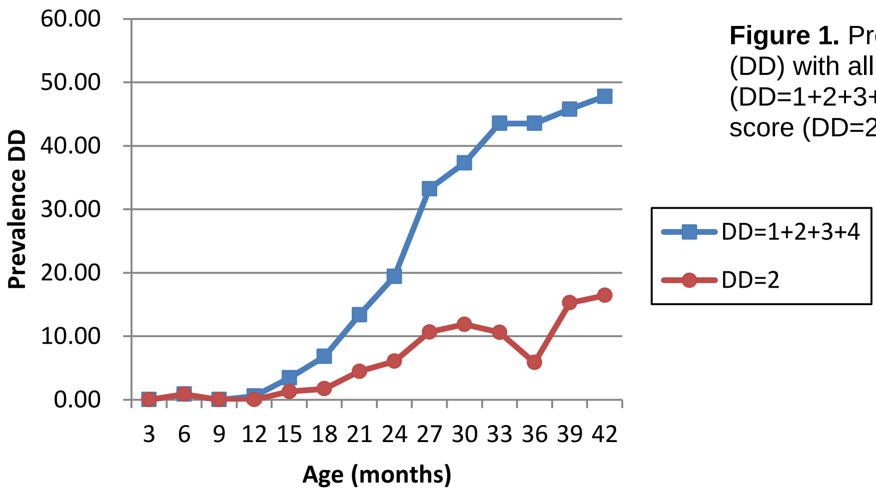


Figure 1. Prevalence of digital dermatitis (DD) with all positive scores (DD=1+2+3+4) and the severe clinical score (DD=2).

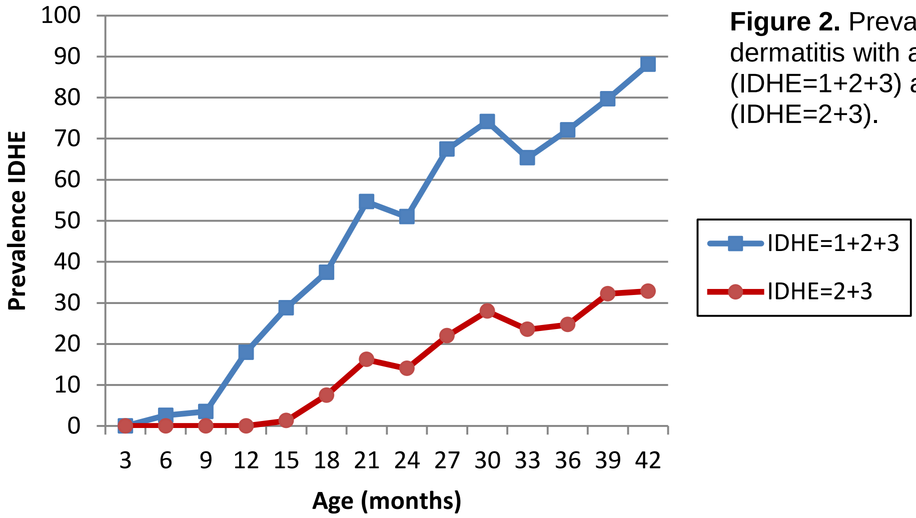


Figure 2. Prevalence of interdigital dermatitis with all positive scores (IDHE=1+2+3) and severe scores (IDHE=2+3).

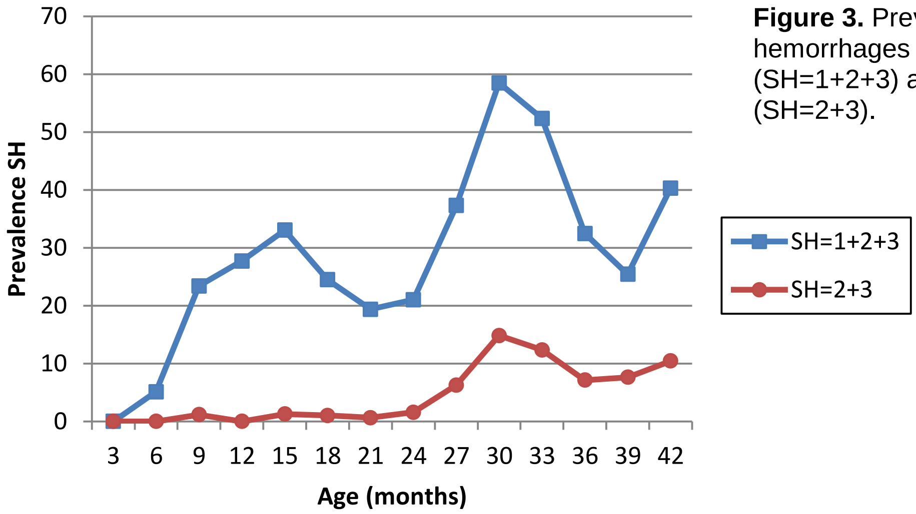


Figure 3. Prevalence of sole hemorrhages with all positive scores (SH=1+2+3) and severe scores (SH=2+3).

Conclusions

Severe scores of DD and SH look more indicative for marked points in age and lactation stages, compared with all positive scores.

References

Capion N Thamsborg SM, Enevoldsen C 2009 Prevalence of foot lesions in Danish Holstein cows. The Veterinary Record 163: 80-86.

Döpfer D Koopmans A Meijer FA Szakáll I Schukken YH Klee W Bosma RB Cornelisse JL van Asten AJ, ter Huurne AA 1997 Histological and bacteriological evaluation of digital dermatitis in cattle with special reference to spirochaetes and *Campylobacter faecalis.* The Veterinary Record 140: 620-623.

Holzhauer M Brummelman B Frankena K, Lam TJGM 2012 A longitudinal study into the effect of grazing on claw disorders in female calves and young dairy cows. The Veterinary Journal 193: 633-638.

Manske T Hultgren J Bergsten C 2002 Prevalence and interrelationships of hoof lesions and lameness in Swedish dairy cows. Preventive Veterinary Medicine 54: 247-63.

Somers JGCJ Frankena K Noordhuizen-Stassen EN Metz and JHM 2003 Prevalence of claw disorders in Dutch dairy cows exposed to several floor systems. Journal of Dairy Science 86: 2082-2093.

P4(a). Interdigital dermatitis, heel horn erosion and digital dermatitis in 14 Norwegian dairy herds

M Knappe-Poindecker[1], M Gilhuus[2], TK Jensen[3], K Klitgaard[3], RB Larssen[1], T Fjeldaas[1]
[1]Norwegian School of Veterinary Science, PO Box 8146, 0033 Oslo, Norway [2]Norwegian Veterinary Institute, PO Box 750, 0106 Oslo, Norway [3]National Veterinary Institute, Technical University of Denmark, 1870 Frederiksberg, Denmark
maren.knappe-poindecker@nvh.no

Introduction
The aim of this study was to assess infectious foot diseases including identification and characterization of the causal bacteria in problem herds struggling with interdigital dermatitis (ID) and heel horn erosion (E), and in control herds expected to have few such problems.

Materials and Methods
Fourteen herds with 633 cows altogether, from which eight herds were problem herds and six were control herds, were included in the study. All cows were scored for lameness and infectious foot diseases, and the cleanness of the claws was recorded. In each herd seven cows with symptoms of ID, E or DD and three cows with no symptoms of these diseases were selected for bacterial sampling. Swabs were analysed for identification and characterization of *Dichelobacter nodosus* by PCR, culturing, virulence-testing and serotyping. Biopsies were analysed by fluorescent *in situ* hybridization regarding histopathology, identification and characterization of *Treponema* spp.

Results
Interdigital dermatitis was the most frequent claw disease with a prevalence of 51% in problem herds and 27% in control herds, followed by E with a prevalence of 35% and 22%, respectively. Characteristic DD lesions were recorded in only 1.4% of the 633 cows and 3.1% of the cows had a LocS ≥3. Bacteriological samples were taken from 34 cows with ID, 11 with E, 40 with both ID and E, eight with DD and from 47 cows with healthy feet. All *D. nodosus* serogroups except F and M were detected, and all isolates were defined as benign by the gelatin gel test. Only six previously described treponemal phylotypes were detected (PT1, PT2, PT3, PT6, PT13 and PT15). One new phylotype (PT19) was identified. Cows with ID had large histopathological changes in the epidermis, but minor changes in the dermis. There was a strong association between ID and *D. nodosus* (p= <0.001).

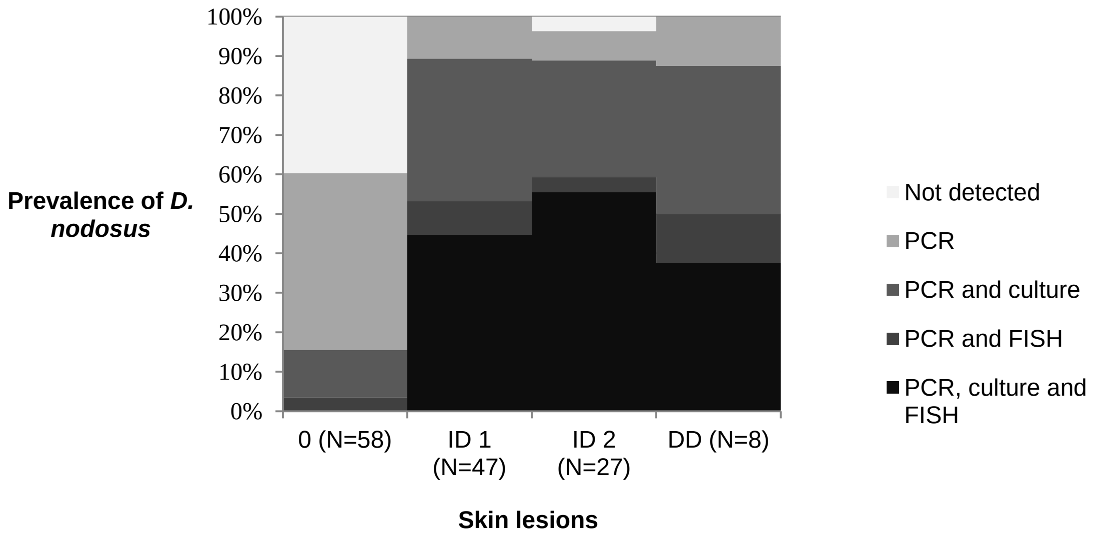


Figure 1. Prevalence of *D. nodosus* detected by different methods among cows with healthy claws, cows with ID score 1 and 2 and cows with DD

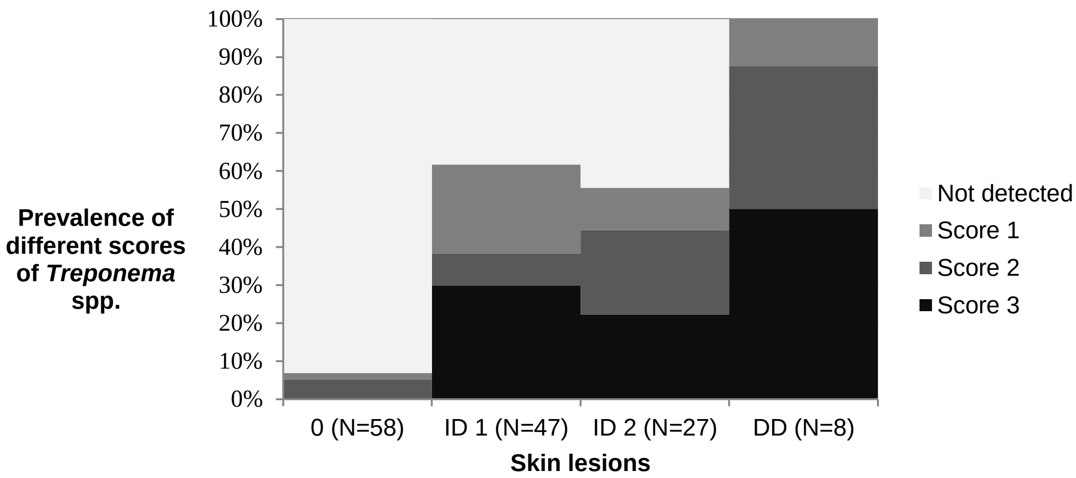


Figure 2. Prevalence of different scores of *Treponema* spp. diagnosed by fluorescent *in situ* hybridization among cows with healthy claws and cows with ID and DD

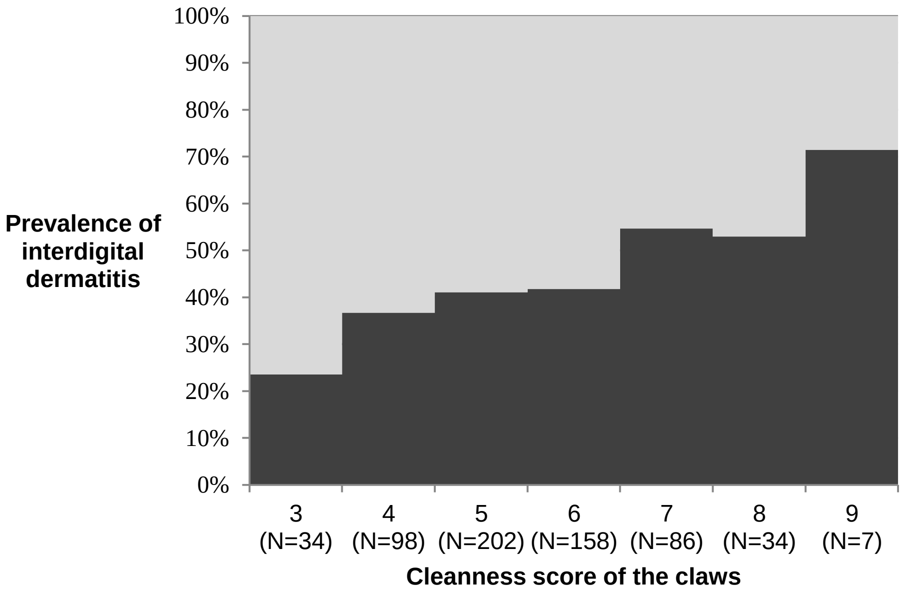


Figure 3. The association between interdigital dermatitis and cleanness score of the claws

Discussion

The high prevalence of ID combined with few cows with characteristic DD lesions explains the low prevalence of lameness compared to foreign studies (Read and Walker 1998). *Treponema* spp. was, however, frequently detected but with few phylotypes. In contrast to *D. nodosus*, the bacterium was hardly detected in clinically healthy cows.

This study indicates that *D. nodosus*, *Treponema* spp. and hygiene were involved in the pathogenesis of ID in these herds. The study also indicates that ID is far more frequent than DD in Norwegian dairy cows, which is different than in other European countries (Rasmussen et al 2012)

References

Read DH and Walker RL1998 Papillomatous digital dermatitis (footwarts) in California dairy cattle: clinical and gross pathologic findings. Journal of Veterinary Diagnostic Investigation 10:67-76

Rasmussen M Capion N Klitgaard K Rogdo T Fjeldaas T Boye M Jensen TK 2012 Bovine digital dermatitis: Possible pathogenic consortium consisting of Dichelobacter nodosus and multiple Treponema species. Veterinary Microbiology 160: 151-61

P4(b). Outbreaks of interdigital phlegmon in Finland

RE Junni[1], MR Kontturi[1], ER Seuna[2], MJ Kujala[1], HK Simojoki[1], ES Malinen[2], KK Pekkanen[2], MS Pelkonen[2], TT Soveri[1]
[1]Faculty of Veterinary Medicine, University of Helsinki, Finland, [2] Finnish Food Safety Authority Evira, Helsinki, Finland
miia.kontturi@helsinki.fi

Introduction
During the last couple of years, several acute outbreaks of interdigital phlegmon (IP) have occurred mainly in new loose house stalls. These outbreaks have led to economic losses in individual farms. Simultaneously with IP, other infectious hoof diseases such as digital dermatitis (DD) and interdigital dermatitis (IDD) have been frequently detected. A research project of infectious hoof diseases is in progress. Two outbreaks of a pilot study are described here.

Materials and Methods
Observations were made during numerous farm visits, including herd size, floor material and type, ventilation system, cleanness of the barn and recent changes in herd management or diet. Lameness of the cows was observed. The feet of all cows were inspected in a trimming chute. The findings were registered and individual cows were treated with parenteral or local antibiotics and hoof trimming according to diagnosis. A hoof healthcare plan was made for both herds. If swelling or an open wound existed between the claws, IP was suspected. Swab samples were taken from different types of hoof lesions for the bacteriological examination, with special emphasis on the presence of fusobacteria.

Results
Farm 1 was a dairy herd of 60 cows. During a period of one month, 22 cows suffered from acute or incipient IP. About half of the cows had severe heel horn erosion, six cases of DD and four white line abscesses were detected. Six cows did not recover and were retreated. One cow was culled. The barn was >10 years old, and the narrow alleys made the barn too crowded. The cleanness of the barn was moderate. Feeding had changed two weeks before the outbreak. The consistence of the feces was runnier which made the barn dirtier. Well managed hoof trimming did not exist in the herd.
Farm 2 was a dairy herd of 110 cows. Before the first farm visit already 30 cows had been treated because of IP. Nine of these did not recover. On a farm visit 34 cows more were diagnosed as IP. Several interdigital fibromas were also detected. Concurrently, calf diphtheria was also found. In this farm the recovery of the cows were slow. Barn house was modern, about one year old and tidy. Environmental or management risk factors were not identified but new cows were purchased to the farm about two months earlier. In both outbreaks, *Fusobacterium necrophorum* was frequently isolated from IP samples, but also from DD and abscesses. Both *F. necrophorum* subspecies *necrophorum* and *funduliforme* were frequently isolated in same lesion.

Discussion
On farm 1, several predisposing factors occurred: inadequate hygiene, crowded conditions and a lack of proper hoof trimming. Additionally, the outbreak was preceded by a feeding disorder, which may have caused subclinical ruminal acidosis. The environmental conditions on farm 2 were very good. Animal trade could be regarded as predisposing factor for the outbreak. *F. necrophorum* is regarded as an important etiological agent in IP. In the two outbreaks, it was commonly found in all types of infectious claw disorders. *F. necrophorum* seems to be capable of causing IP despite of good hygiene and well management.

Acknowledgments
The Ministry of Agriculture and Forestry and Valio Ltd are acknowledged for the funding of the research. We also thank The University of Helsinki and Evira for the travel grants.

Session 2

Lameness and Genetics

and

Animal Behaviour and Lameness

5. Breeding for better claw health – the Nordic experience

E Telezhenko[1], K Johansson[2]
[1] VikingGenetics, Box 64, SE-532 21, Skara, Sweden, [2] Växa Sverige, P.O. Box 7023, SE-75007, Uppsala, Sweden
evgenij.telezhenko@vikinggenetics.com

Introduction

The official breeding values for hoof health have been available in Nordic countries (Denmark, Finland and Sweden) since 2011. Hence it is possible to retrospectively assess changes in genetic potential for hoof health. Breeding programme for Holsteins in Nordic countries has combined selection for milk production (which is unfavourably associated with hoof health) and selection for several health traits (which are positively associated with hoof health) for several decades (Buch et al., 2011). The purpose of the study was to assess genetic trends for hoof health in Nordic population of Holstein sires and in Holstein sires imported to the Nordic countries.

Materials and Methods

In the study estimated breeding values were used for indexes of hoof health, production and resistance to mastitis of 675 Nordic and 239 imported progeny tested Holstein bulls born 1993 – 2008 with the reliability for hoof health index higher than 70%. Imported sires were mainly from USA (46%), The Netherlands (14%), Canada (14%) and Germany (12%). The breeding values were estimated by Nordic Cattle Genetic Evaluation 1st February 2013. The breeding values were presented as a relative deviation from the rolling base (cows 3-5 year) with average equals 100 and standard deviation equals 10. Hoof health index, based on records of hoof trimmers, included the following lesion groups: dermatitis, limax, heel horn erosion, corkscrew claw, double sole, white line disease, sole hemorrhage and sole ulcer (Johansson et al., 2011). Sole ulcer had the highest relative economic weight in the index (45%) as the most costly lesion. For the analysis the averages of breeding values per year of the sire birth (weighted on number of sires from each year) were used. The linear regression model (JMP 4) included the nationality of the sires (df=1, DFS or imported) as a fixed factor, and birth year of the sires as a continuous factor nested within sires' nationality (df=2).

Results

The results showed that bulls from the united Nordic Holstein population did not show either a significant negative or positive trend (estimate= 0.06, SE=0.14, P=0.69) for hoof health index (Figure 1), while imported sires had a weak tendency for declining the hoof health (estimate =-0.40, SE= 0.25, P=0.12). Nordic sires also showed significantly better values for hoof health (P< 0.001) than the imported sires.

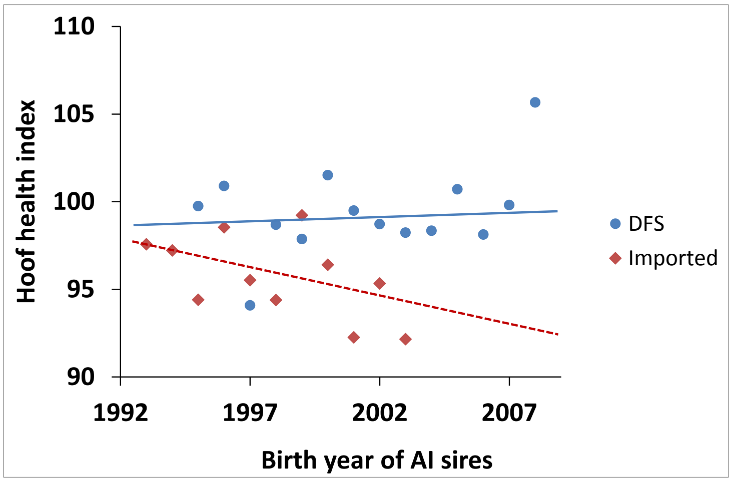


Figure 1. Genetic trends for hoof health index in Nordic (DFS countries) and imported Holstein sires

There were strong positive trends for increased protein yield in both Nordic and imported sires (Figure 2). Even though imported sires apparently showed higher protein yield there was no significant difference between the groups (P=0.21).

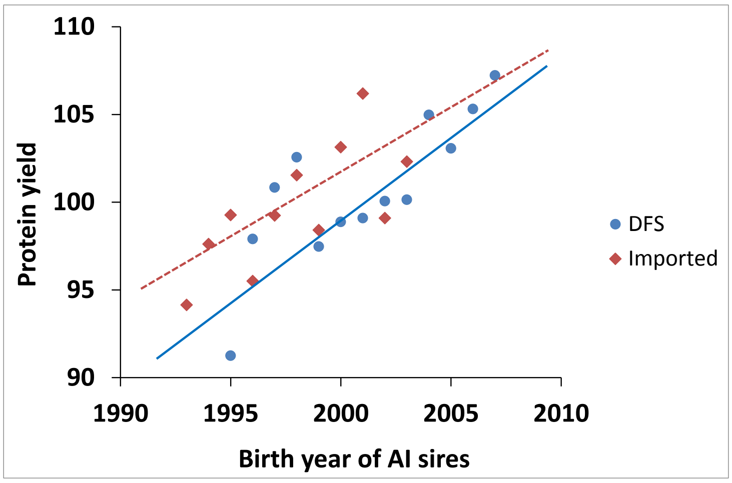


Figure 2. Genetic trends for protein yield in Nordic (DFS countries) and imported Holstein sires

The studied population of Nordic bulls had significant positive genetic trends for resistance to mastitis (P=0.02) while for the imported population this trend was not obvious (P=0.83). Hoof health index correlates positively with resistance to mastitis and other diseases (Buch et al., 2011). Thus, the deterioration of hoof health due to increased production was probably counteracted by controlling correlated health traits.

Conclusion

In the Nordic Holstein population, increased production did not cause declining hoof health, despite the generally observed antagonistic relationship. This could be explained by correlated positive effect of long term improvement of the other health traits in Nordic Holsteins.

References

Buch LH, Sørensen AC, Lassen J, Berg P, Eriksson J-Å, Jakobsen JH and Sørensen MK 2011 Hygiene-related and feed-related hoof diseases show different patterns of genetic correlations to clinical mastitis and female fertility. Journal of Dairy Science 94:1540-1551.

Johansson K, Eriksson J-Å, Sander Nielsen U, Pösö J and Pedersen Aamand G 2011 Genetic Evaluation of Claw Health in Denmark, Finland and Sweden. Interbull Bulletin 43.

6. Claw disorder genetics and the effect of preselecting cows for trimming

D van der Spek[1], J van Arendonk[1], A Vallée[2], H Bovenhuis[1]
[1]Animal Breeding and Genomics Centre, Wageningen University, PO 338, 6700 AH, Wageningen, the Netherlands, [2]Gènes Diffusion, 3595 Route de Tournai, 59501 Douai, France
dianne.vanderspek@wur.nl

Introduction

Claw problems are from an economical and welfare point of view important traits to consider in dairy cattle breeding (Enting et al 1997). Selection for reduced claw problems can be based on hoof trimmer records. Typically, not all cows in a herd are trimmed. Our objectives were to estimate heritabilities and genetic correlations for claw disorders and investigate effects of selecting cows for trimming.

Materials and Methods

The dataset contained 50.238 Holstein Friesian cows, of which 20.474 cows had at least one claw trimming record, with a total of 29.994 records from 2007 to 2012. Six claw disorders had a frequency ≥5% (Table 1) and were analysed: (inter-)digital dermatitis or heel erosion or any combination (DER), double sole (DS), interdigital hyperplasia (IH), sole haemorrhage (SH), sole ulcer (SU), white line separation (WLS), and a combined trait. Of the cows scored, 55% had at least one claw disorder.

Table 1. Claw disorder frequencies

Claw disorder	Frequency
DER	23.8
DS	11.3
IH	8.7
SH	13.9
SU	8.7
WLS	17.8
Combined	54.8

Results and Discussion

Heritability ranged from 0.05 (SH) to 0.43 (LI) in trimmed cows (Table 2). Genetic correlations between laminitis-related claw disorders were moderate to high and the same was found for hygiene-related claw disorders.

Table 2. Claw disorder heritabilities (h^2) for trimmed cows, trimmed and untrimmed (assumed without claw disorders) cows, and subgroups of different percentages of cows in the herd trimmed.

	Trimmed	Trimmed & untrimmed	Percentage of cows trimmed per herd per year		
			<35%	35-70%	≥70%
Claw disorder	h^2	h^2	h^2	h^2	h^2
DER	0.07	0.07	0.12	0.04	0.02
DS	0.06	0.06	0.06	0.08	0.03
IH	0.43	0.39	0.46	0.20	0.17
SH	0.05	0.04	0.04	0.04	0.04
SU	0.11	0.08	0.26	0.12	0.10
WLS	0.09	0.07	0.10	0.11	0.09
Combined	0.08	0.08	0.12	0.06	0.06

The effect of selecting cows for trimming was firstly investigated by including untrimmed cows in the analyses and assuming they were not affected by claw disorders. Heritabilities showed only minor changes (Table 2), indicating a small effect of preselecting cows for trimming.

Secondly, different subsets of the data were created, based on the percentage of cows in the herd trimmed. Heritabilities for IH, DER, and SU tended to decrease when a higher percentage of cows in the herd was trimmed (Table 2). Selecting herds with a certain fraction of cows being trimmed influenced heritability.

Finally, a bivariate model with a claw disorder and the trait "trimming status" (being trimmed or not) was used. Heritabilities were similar as compared to claw disorder heritability in trimmed cows, indicating a negligible effect of preselecting cows.

Interestingly, trimming status has a relatively high heritability (0.09), when compared to heritabilities for claw disorders. The heritability for trimming status indicates a genetic background for cows to be trimmed. Cows that need more frequent claw trimming are not favoured. Genetic correlations estimated between trimming status and each claw disorder were generally positive indicating that cows which are more likely to be trimmed are also more likely to be affected by a claw disorder. Therefore, trimming status might be an interesting trait to be included in genetic evaluations.

References

Enting H, Kooij D, Dijkhuizen AA, Huirne RBM, Noordhuizen-Stassen EN 1997 Economic losses due to clinical lameness in dairy cattle. *Livestock Production Science 49:* 259-267.

7. Environmental effects and a genetic predisposition influence Interdigital Hyperplasia

R Pijl[1], H Alkhoder[2],HH Swalve[2]
[1] Fischershäuser 1, 26441 Jever, Germany, [2] Institute of Agricultural and Nutritional Sciences, University of Halle, 06099 Halle, Germany
r.pijl@t-online.de

Introduction

Interdigital Hyperplasia (IH) has been regarded as a relatively rare disease of the bovine hoof. The data base of the first author contains more than 100,000 records from around 32,000 individual cows with repeated trimmings. The assessment of disease status was conducted at time of hoof trimming within the regular work of the first author's professional hoof trimming practice. Here we report an analysis with respect to environmental and genetic effects that influence the disease status for IH.

Material and Methods

Data was collected at time of hoof trimming and recorded electronically. All disease status assessments were from years 2003 to 2012. Statistical analyses consisted of applying threshold models with appropriate fixed effects and a random permanent environmental term to account for repeated observations. Models for genetic analysis also included a random animal effect accounting for relationships among animals. Fixed effects seen as appropriate from previous analyses of the data were parity, stage of lactation (nested within parity), age at calving (nested within parity), farm, and date of visit within farm. For analyses of specific environmental factors such as allowance of grazing, these models were augmented by the respective effect.

Results and Discussion

Table 1 displays the prevalence for IH across the study years as found in the raw data. The prevalence of IH appears to be slightly increasing over the study period. Table 2 gives the prevalence for parity as a result from the statistical model. Prevalence is clearly increasing with parity.

Table 1. Prevalence of IH for study years

Year	% I.H.
2003	9.40
2004	10.47
2005	10.94
2006	12.42
2007	11.94
2008	11.04
2009	11.40
2010	13.36
2011	12.38
2012	10.15

Table 2. Prevalence for parity (LSMeans)

Lactation Nr.	LSMeans	s.e.
1	4.18	0.15
2	7.69	0.22
3	10.85	0.32
4	12.79	0.38
5	13.95	0.51
6+	13.83	0.56

Table 3. Prevalence for allowance of grazing

Allowance of grazing	LSMeans (%)	s.e.
No grazing	18.24	0.6482
During the day	13.10	0.3187
Day and night	6.92	0.2122
A few hours daily	20.87	0.6072

In general, grazing seems to have a positive effect in decreasing the prevalence for IH. However, systems that allow grazing for a few hours only seem to be detrimental. A reason could be that the disadvantages of confinement in the barn are not offset by the few hours outside and rather the additional stress for moving in and out couples with the disadvantages of indoor housing. Differences in the prevalence of IH among farms were large. While on most farms a prevalence in the range of 1 to 20 % was found, farms with no occurrence of IH or a prevalence of > 20 %, and in some cases of > 30 % was observed. This may be taken as an indication that farm-specific environmental effects may contribute to the development of IH. The heritability of IH status was estimated as 0.297 ± 0.018. This figure of a heritability is comparatively high as most estimates for any disease in the bovine species are lower. Swalve et al. (2011) estimated heritabilities between 0.05 and 0.20 for other claw diseases, e.g. laminitis, dermatitis digitalis, dermatitis interdigitalis, sole ulcer and white line disease.

References

Swalve HH, Alkhoder H, Pijl R 2011 Genetic background of disorders of the bovine hoof from data collected at hoof trimming. 8th Conference on Lameness in Ruminants, New Zealand, 28 Feb – 03 Mar

8. The potential role of gene regulation in the control of bovine digital dermatitis

RA Scholey[1], NJ Evans[1], RW Blowey[2], JP Massey[3], RD Murray[1], RF Smith[1], WE Ollier[3] & SD Carter[1]
[1] Department of Infection Biology, Institute of Infection and Global Health, University of Liverpool, Liverpool Science Park IC2, 146 Brownlow Hill, Liverpool L3 5RF, UK; [2] Wood Veterinary Group, Quedgeley, Gloucester GL2 4NB, UK; [3] Centre for Integrated Genomic Medical Research, University of Manchester, Manchester M13 9PT UK
Rachel.Scholey@Manchester.ac.uk

Introduction
We used the next generation sequencing technology, RNA-Seq, to investigate the profile of gene expression in bovine foot skin affected by the treponeme disease bovine digital dermatitis (BDD) (Scholey et al, 2013). The implications are discussed.

Materials and Methods
Five healthy bovine foot skin samples and five BDD lesions were analysed for each of 16,235 gene transcripts, ie, how much of each gene was active, in healthy vs BDD skin. The 500 most significantly different transcripts, ie, those showing the greatest difference between healthy and BDD skin, were studied in more detail using gene pathways analysis.

Results
In BDD skin our study found the most significantly increased gene transcript was of the gene leading to the production of the protein alpha-2ML1. Additionally, BDD skin had higher levels of gene expression for cytokines that can suppress immune responses, including IL24 and IL19. Numerous keratin proteins were found to be down regulated in BDD.

Discussion
The increase in anti-inflammatory cytokine gene expression in BDD might help to explain why there are good levels of detectable circulating antibody to BDD, but a poor local immune response which appears to have little protective effect against development or persistence of lesions. Pathway analysis revealed genes could be placed in several gene networks of potential interest, including pathways containing alpha-2ML1 and various down regulated keratin genes. These pathways might reveal targets for therapeutic intervention or better understanding of the host response to treponeme infection.

Acknowledgments
This study was funded through DEFRA, HEFCE and the BBSRC.

References
Scholey RA., Evans NJ, Blowey RW, Massey JP, Murray RD, Smith RF, Ollier WE, Carter SD 2013 Identifying host pathogenic pathways in bovine digital dermatitis by RNA-Seq analysis. Veterinary Journal DOI:10.1016/j.tvjl.2013.03.008.

9. A designed field study based on records collected at time of hoof trimming reveals a strong association between an individual gene and laminitis in dairy cattle

HH Swalve[1], C Floren[2], M Wensch-Dorendorf[1], K Schöpke[1], R Pijl[3], K Wimmers[4], B Brenig[2]
[1] Institute of Agricultural and Nutritional Sciences, University of Halle, 06099 Halle, Germany; [2] Institute of Veterinary Medicine, University of Göttingen, Burckhardtweg 2, 37077 Göttingen, Germany; [3] Fischershäuser 1, 26441 Jever, Germany; [4] Research Unit of Molecular Biology, Leibniz Institute for Farm Animal Biology, Wilhelm-Stahl-Allee 2, 18196 Dummerstorf, Germany

Introduction
Feet and leg problems have a major impact on the well-being and lifespan of the dairy cow and thus are also economically important to the dairy farmer. Apart from approaches using genetic selection for classical traits from conformation scoring, attempts for genetic improvement also can be based either on records of individual disease cases or on records of disorder status at time of hoof trimming.

Material and Methods
In this study 1,962 first lactation cows were subjected to hoof trimming with an assessment of sub-clinical and clinical disorder status. Cows were from seven large commercial herds in Mecklenburg - Western Pomerania that had similar housing with cubicles, slatted flooring, little use of straw for bedding, and TMR feeding. Cows were trimmed and assessed once, focusing on the first half of the lactation. According to an earlier study by Pijl and Swalve (2006), the prevalence for laminitis is elevated in days 50 to 150 post partum. Herds were visited in intervals to enable recording of cohorts of similar stage of lactation. Each cohort or herd-visit comprised between 31 and 165 cows. The experiment is described in more detail in Schöpke et al. (2013). Additional measurements included weight, back fat thickness and body condition at time of trimming. DNA extracted from blood of 1,183 cows was used for analysis with a custom-made array of 384 single nucleotide polymorphisms (SNP). SNP had been selected according to results from the literature for effects in classical conformation traits, from biochemical pathway analysis, and from comparative analysis of putative candidate genes in cattle, pigs, and sheep. Selection of cohorts of cows for SNP chip analysis was such that cohorts with extreme frequencies of disorders and cohorts with slightly deviating housing system were excluded in this first step.

Results
The results from a mixed threshold model analysis with the genotype included as a fixed effect revealed a strong association of one SNP on BTA 21 with laminitis status. Back-transformed means of disorder status for the three genotypes were 0.37 (AA), 0.52 (AB), 0.56 (BB). Using the full data set of 1,962 cows including the less-suitable cohorts gave back-transformed means of 0.51 (AA), 0.58 (AB), 0.62 (BB).

Discussion
The results show that a genetic predisposition for laminitis can be traced back to the genomic level. Hence, genetic selection for an improved resistance to laminitis appears to be possible. However, the study also shows that, in general, careful planning of a field study is required if associations between genomic polymorphisms and diseases status is to be examined and that not all cohorts collected may be equally informative.

References
Pijl, R and Swalve HH 2006 An analysis of claw disorders diagnosed at claw trimming. In: Proceedings of the 14th Symposium and 6th Conference on Lameness in Ruminants, Uruguay, November 8 - 11. Avail. from www.ivis.org, Pages 34 - 36
Schöpke K, Weidling S, Pijl R and Swalve HH 2013 Relationships between bovine hoof disorders, body condition traits, and test-day yields. Journal of Dairy Science 96: 679–689

10. Resting to recover: Changes in lying behaviour caused by treatment for lameness

GG Miguel-Pacheco[1], H Thomas[1], JN Huxley[1], J Kaleer[1]
[1] School of Veterinary Science and Medicine, University of Nottingham, Loughborough, England, LE12 5RD. svxgm@nottingham.ac.uk

Introduction
Lying is very important in the behavioural repertoire of dairy cattle (Metz 1985). Cows need to lie down in order to rest and ruminate, making this behaviour very important for milk production (Cooper, et al. 2008). Dairy cattle in Automatic Milking Systems (AMS) have been observed to lie down for up to 11.2 h/d (DeVries, et al. 2011). Lying behaviour is mostly affected by lameness (Ito, et al. 2010). The present observational study aims to assess the effects of different treatments for claw horn lesions on lying behaviour.

Materials and Methods
The study was conducted in an Automatic Milking Systems (AMS) where 44 newly lame dairy cows were selected and randomly received one of four treatments for lameness as soon as they were identified as lame. In addition, 34 matched non-lame animals were enrolled as controls. Inmediately after treatment, an accelerometer (Onset Pendant G data loggers, Onset Computer Corporation Pocasset, MA) was attached following the methodology described by Gibbons et al. (2012). Lying data was collected for five days following treatment. Lying behaviour was averaged across the 5 observation days, creating 3 variables: total duration (min/d), number of bouts per day and average duration of bout (min/bout). Descriptive analysis has been conducted.

Results
All 3 variables were normally distributed and are presented in Table 1. No significant difference (P=0.15) was observed for total lying behaviour between newly lame treated cows (N: 44; Mean: 754.9 m/d; StDev: 171.0) and non-lame cows (N: 34; Mean 702.3 m/d; StDev: 135.5).

Table 1 Mean and standard deviation for three variables of lying behaviour collected over 5 days after treatment

	N	Total lying time (min/day)		Number of lying bouts per day		Average duration of lying bouts (min.)	
		Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
Non-lame cows	34	702.3	135.5	11.3	3.4	66.2	15.0
Newly lame treated cows:							
Treatment 1 (Trim only)	13	745.3	163.8	11.0	2.9	70.8	15.7
Treatment 2 (Trim+Block)	11	792.6	159.3	12.5	2.2	65.4	10.4
Treatment 3 (Trim+NSAID)	11	759.8	185.6	11.3	3.7	72.1	15.6
Treatment 4 (Trim+Block+NSAID)	9	716.8	195.8	10.6	2.8	70.9	13.6

Discussion
Preliminary results suggest that there is no difference in lying behaviour between newly lame cows and non-lame cows or between lame cows given different treatment. Prompt intervention may prevent the significant changes in lying behaviour observed in previous studies (e.g.Ito, et al. 2010).

Acknowledgements
Giuliana Miguel-Pacheco is funded by the University of Nottingham International Office Scholarship.

References
Cooper MD, Arney DR, and Phillips CJC 2008 The effect of temporary deprivation of lying and feeding on the behaviour and production of lactating dairy cows. Animal **2:** 275-283.

DeVries TJ, Deming JA, Rodenburg J, Seguin G, Leslie KE, and Barkema HW 2011 Association of standing and lying behavior patterns and incidence of intramammary infection in dairy cows milked with an automatic milking system. Journal of Dairy Science **94:** 3845-3855.
Gibbons J, Medrano-Galarza C, de Passille AM, and Rushen J 2012 Lying laterality and the effect of IceTag data loggers on lying behaviour of dairy cows. Applied Animal Behaviour Science **136:** 104-107.
Ito K, Von Keyserlingk MAG, LeBlanc SJ, and Weary DM 2010 Lying behavior as an indicator of lameness in dairy cows. Journal of Diary Science **93:** 3553-3560.
Metz JHM 1985 The reaction of cows to a short-term deprivation of lying. Applied Animal Behaviour Science **13:** 301-307.

11. The effect of lameness on behaviour and heart rate variability during acute stress in dairy cows

V. Jurkovich[1], J Tőzsér[2], L Kovács[2]
[1]Department of Animal Hygiene, Herd Health and Veterinary Ethology, Faculty of Veterinary Science, Szent István University, Budapest, Hungary [2]Institute of Animal Science, Department of Cattle and Sheep Breeding, Faculty of Agricultural and Environmental Science, Szent István University, Gödöllő, Hungary
jurkovich.viktor@aotk.szie.hu

Introduction
Lameness is one of the most important welfare issues due to the chronic pain and discomfort in dairy cattle. Chronic stress in lame cows compromises reproduction, decreases milk yield and possibly leads to other pathological conditions. Heart rate variability (HRV) is a non-invasive stress assessing method (von Borell et al 2007) reflecting the activity of the two branches of the autonomic nervous system. Our objective was to test the effect of lameness as a chronic stressor on HRV and behaviour responses during an acute stress situation (rectal palpation).

Materials and Methods
Measurements were carried out on a commercial large-scale dairy farm. Based on their locomotion score two groups of cows (non-lame: scores 1-2 [Sprecher et al 1997], N=28; lame: scores 3-5, N=24; age: 3.2±1.7 years; milk production: 34.7±7.8 kg/day; stage of lactation: 150±42 DIM) were formed. Transrectal palpation, as a routine husbandry procedure was performed 1 h after the morning milking for a duration of 4 min. Stepping rate (steps/4 min), restlessness behaviour (scores: 0-3) and vigilance (scores: 0-3) were observed during the procedure visually. During the different phases of the test period (5-min for baseline, without touching the animal, 4-min rectal palpation and 10-min calming down, without touching the animal) heart rate was recorded continuously with a Polar Equine RS800 CX monitoring system: HRV parameters were calculated in time- (rMSSD) and frequency-domains (HF, LF/HF) and with Poincaré plot (SD1, SD2 and SD2/SD1 ratio).

Results
Behavioural reactions were similar in lame and non-lame cows during rectalisation. No differences were found between groups in baseline HRV and during rectal palpation. During the first 5 min of the restitution period notable differences were found rMSSD, HF, LF/HF, SD1 and SD1/SD2 (Mann-Whitney U: P=0.047, P=0.039, P=0.039, P=0.047 and P=0.007, respectively). Between 6-10 min of restitution only HF, LF/HF and SD2/SD1 differed in the two groups (P=0.037, P=0.037 and P=0.048, respectively).

Discussion
Lame cows showed similar behavioural and cardiac responses to acute stress. However, in the first 5 min after rectalisation, lame cows showed higher parasympathetic activity (rMSSD↑, HF↑, SD2↑) than sound ones, parallel with decreased sympatho-parasympathetic measures (LF/HF↓ and SD2/SD1↓) reflecting a shift towards parasympathetic tone. The differences in parasympathetic measures after short-term stress were supposedly resulted by the higher compensatory activity of the autonomic nervous system in chronically stressed cows (Stewart et al 2010).

Acknowledgments
This work was partialy supported by National Development Agency, co-financed by the European Social Fund (Grant No.: TÁMOP-4.2.1.B-11/2/KMR-2011-0003 and TÁMOP-4.2.4.A/1-11-1-2012-0001).

References
von Borell E, J Langbein, G Després, S Hansen, C Leterrier, J Marchant-Forde, R Marchant-Forde, M Minero, E Mohr, A Prunier, D Valance & I Veissier 2007 Heart rate variability as a measure of autonomic regulation of cardiac activity for assessing stress and welfare in farm animals: a review. Physiol. Behav 92 293–316
Sprecher DJ, Hostetler DE & Kaneene JB 1997 A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 47 1179-1187
Stewart M, Webster JR, Stafford KJ, Schaefer AL & Verkerk GA 2010 Technical note: Effects of an epinephrine infusion on eye temperature and heart rate variability in bull calves. Journal of Dairy Science 93: 5252-5257

P5(a). The impact of reduced mobility score in the pre-breeding period on the fertility of dairy cattle in a seasonally breeding pasture-based system

F. Bosma[1], R.A. Laven[2]
[1]Faculty of Veterinary Medicine, Utrecht University; [2] IVABS, Massey University, Palmerston North
r.laven@massey.ac.nz

Introduction

Locomotion (mobility) scoring gives a better picture of the true level of lameness on a farm as it identifies lame cows earlier and, on some farms, may identify more lame cows. The DairyCo mobility score (Barker et al 2010) has just been adapted for the New Zealand (NZ) pasture-based situation and is currently being promoted as a useful technique for lameness management. In order to increase its use on NZ dairy farms, more data is needed on the impact of increased mobility score on productivity fertility.
The aim of this study was to evaluate the effect of decreased mobility on the fertility of cattle in an autumn-calving herd.

Materials and Methods

This was a prospective cohort study of 130 mixed age dairy cows that calved between March and June 2011 in a dairy herd in Palmerston North, New Zealand. The herd had a 9-week breeding season (first 6 weeks AI, last 3 natural mating) that started on 10 June 2011.
Prior to the start of mating, all cows were individually locomotion scored (LCS) by the first author twice weekly. Cows were scored using the DairyCo mobility score as they left the milking parlour after the afternoon milking.

Results

Of the 130 cows followed during the study, 88 (68%) became pregnant during the breeding season. The mean mobility score of the cattle which became pregnant during the breeding season was lower (P=0.001) than that of the cattle which did not become pregnant (0.6 ± 0.06 vs. 1.1 ± 0.11, respectively).
Of the 130 cows, 40 (31%) had 3 or more mobility scores ≥2. Such cattle were significantly more likely to be empty at the end of the breeding season than cattle with <3 such records (relative risk 1.8; 95% confidence interval = 1.15 to 3). Additionally they had a longer mean planned start of mating to conception interval (42.5 ± 4.9 vs. 50.5 ± 11.6), though this was not significant at the 5% level (P= 0.53)

Discussion

The proportion of the herd which was recorded as lame was significantly higher than in previous years and fertility was much worse. So the representativeness of this dataset, even for this farm may be limited. However it further adds to the evidence that cows with reduced mobility have reduced fertility even if the lameness may not be apparent to farm staff. This is the first such study under New Zealand conditions where cows are predominantly kept at pasture; further research on more cows on more farms is required to better establish the effect of increased mobility score on fertility in such cattle.

Acknowledgements

Thanks to Natalia Martin for assistance with the mobility score training.

References

Barker ZE, Leach KA, Whay HR, Bell NJ, Main DCJ 2010. Assessment of lameness prevalence and associated risk factors in dairy herds in England and Wales. Journal of Dairy Science 93: 932-941.

P5(b). Establishing a footrot resistant sheep flock by footrot gene marker test screening

T Wuliji[1], JGH Hickford[2], B Shanks[1], W Lamberson[3], H Zhou[2], S Azarpajouh[1]
[1]Lincoln University, Jefferson City, Missouri; [2]Lincoln University, Lincoln, New Zealand; [3]University of Missouri, Columbia, Missouri, USA
wulijit@linconu.edu

Introduction

Although selection of sheep based on disease resistance is effective, it is time consuming, healthy, resistant sheep have to be exposed to the disease, and there is a risk that susceptible sheep may be retained in breeding flocks. Lincoln University of New Zealand has identified extensive polymorphisms at the DQA2 and DQA2-like loci located within the Major Histocompatibility Complex (MHC; Hickford et al., 2004) and have subsequently developed a gene marker testing procedure based on evidence of links between these loci and footrot tolerance (Escayg et al. 1997). The North Central part of U.S. is an endemic prevalence area for footrot in sheep and goats. Hair sheep breeds are reputed to have better disease resistance, but no genotypic markers have been reported for footrot resistance.

Materials and Methods

The footrot gene-marker test reports five basic footrot scores (1, 2, 3, 4 and 5) corresponding to alleles of the MHC DQA2 and DQA2-like loci. This gives 15 possible score combinations (1,1; 1,2; 1,3; 1,4; 1,5; 2,2; 2,3; 2,4; 2,5; 3,3; 3,4; 3,5; 4,4; 4,5; 5,5), where 1,1 is claimed to have the highest tolerance and 5,5 the lowest tolerance to footrot infection.
Blood samples were collected from 600 mixed-age sheep, mostly representing hair sheep breeds: Katahdin, Dorper, and their crossbred lambs from the Lincoln University of Missouri farm and several private sheep producer's farms throughout Missouri. Blood specimens were collected on FTA blood DNA collection paper cards. DNA extraction and the gene marker test were performed at Lincoln University Gene Marker Laboratory in New Zealand. A chi-square test was used to test difference in variant alleles, animal genotypes, and score group distribution frequency.

Results

There were 583 sheep samples returned with gene marker test results. Figure 1 illustrates the distribution of the sheep into the 15 allele combination patterns. As footrot tolerance genes are assumed to exert a dominant effect, an expressed value for a pair of alleles was derived and animals were grouped into five categorical groups (1, 2, 3, 4, and 5). Variant allelic distribution in the five score groups were 10.0, 21.2, 45.3, 17.6, and 5.9 percent for allele 1, 2, 3, 4, and 5, respectively (Figure 2). Whereas, animals classed into the five score groups, were 18.5, 33.3, 42.0, 5.8, and 0.3 percent, respectively (Figure 3). Both allelic distribution and genotypic distributions were significantly ($P < 0.01$) different among the five score groups.

Figure 1. Animal distribution frequency in footrot marker genotypes (1,1 ... 5,5)

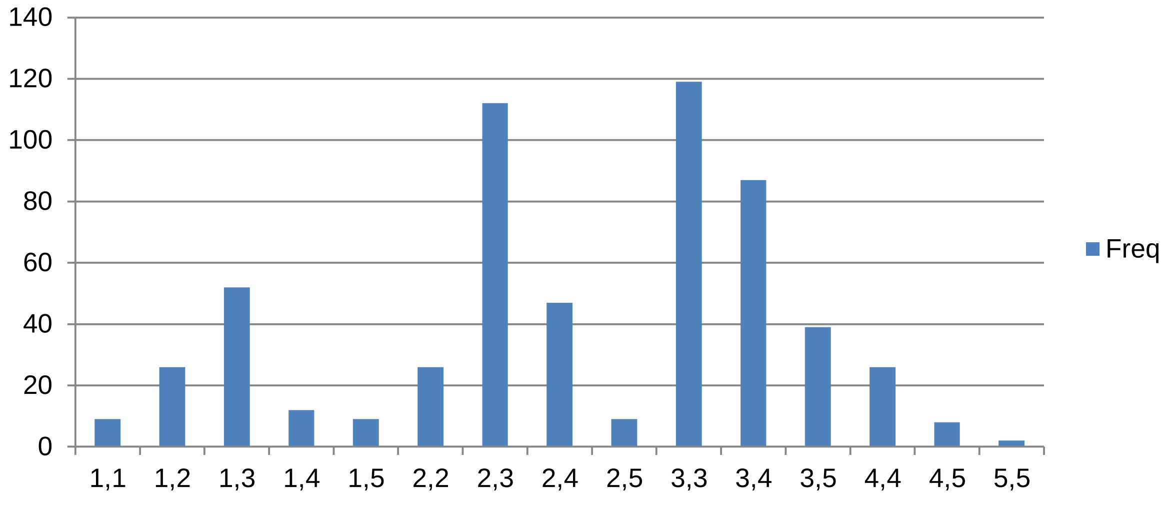


Figure 2. Allelic (score) distribution frequency in five groups (583 x 2 = 1166)

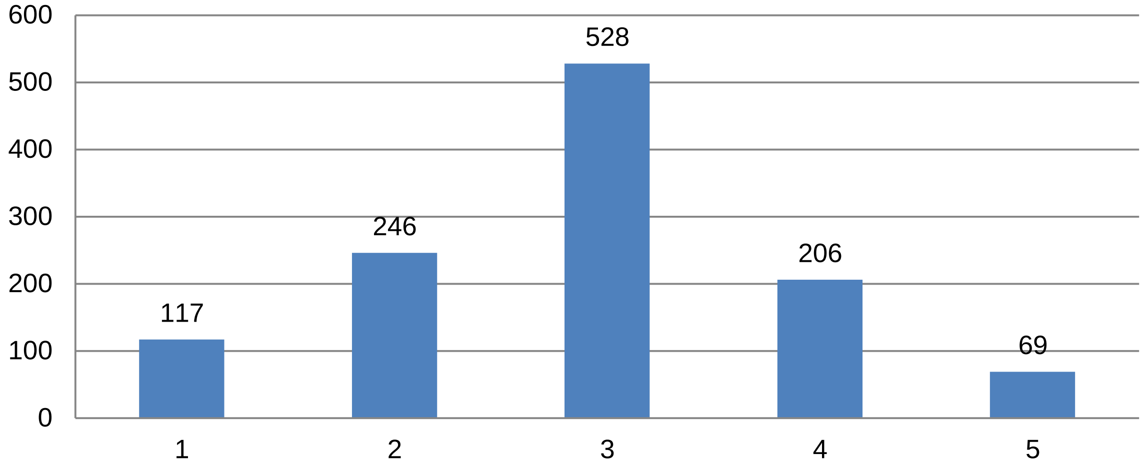
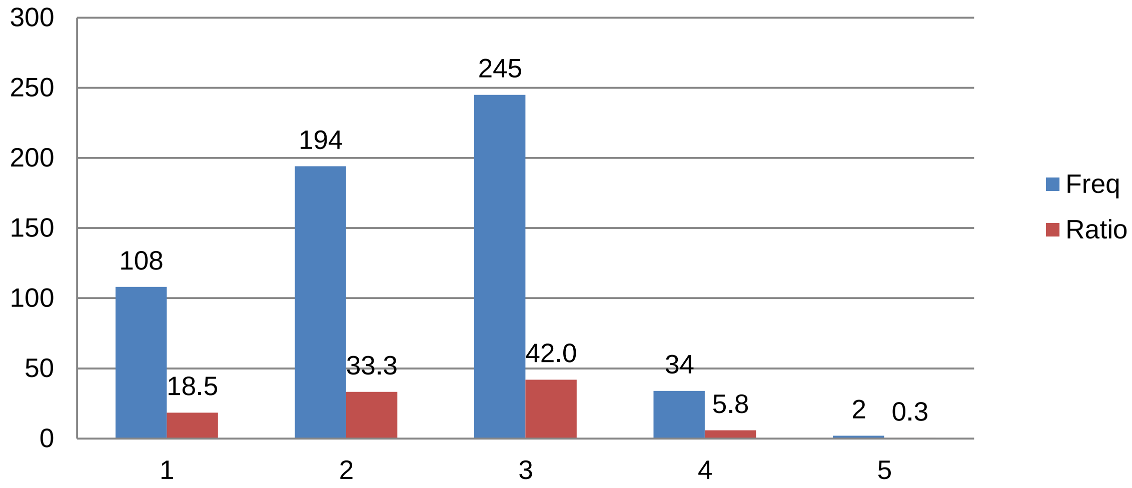


Figure 3. Number of animals (n = 583) and ratios in five footrot score groups



Discussion

The ratio of animals in the footrot tolerance score groups 1 and 2 combined to be the larger portion of the flock at 52 %. Animals with the moderate score of 3 were 42 % and animals with susceptible scores of 4 and 5 were 6 % of the flock. The combined allelic distribution of scores 4 and 5 is 23.6% in the flock, which can be considered as “culling alleles”. By using the footrot marker test screening, it may be possible that a high footrot tolerant sheep flock can be established within three to four breeding seasons.

Acknowledgements

Authors thank Dr. Freeman Fang, Lincoln University, New Zealand for marker tests and Ms. Amy Bax and Mr. Luke Wilbers for sample collection and recording at Lincoln University, Missouri.

References

Escayg AP, Hickford JGH, Bullock DW. 1997. Associations between alleles of the ovine major histocompatibility complex and resistance to footrot. Research in Veterinary Science 63: 283-287.

Hickford JGH, Zhou H, Slow S, Fang Q. 2004. Diversity of the ovine DQA2 gene. Journal of Animal Sciences 82:1553-1563.

P6(a). To go or not to go: Impact of lameness in dairy cows on visits to an Automatic Milking System

GG Miguel-Pacheco[1], J Huxley[1], J Kaler[1]
[1] School of Veterinary Science and Medicine, University of Nottingham, Loughborough, England, LE12 5RD
svxgm@nottingham.ac.uk

Introduction
There is a tendency worldwide for the automation of farms; this includes the introduction of automatic milking systems (AMS). It is known that half of the dairy population per year in the UK suffer from lameness and it has been recognised as a painful condition. Affected cows show behavioural signs of being ill and in pain such as reduction in mobility, therefore feeding is reduced and attendance to the AMS can also be compromised; these factors potentially affect not only animal welfare, but also farm profitability. The aim of our study was to identify the impact of lameness on milking behaviour.

Materials and Methods
Thirty eight pairs of Holstein-Friesian cows (case and control) were enrolled onto the study, these were selected using matching criterion that include mobility score, parity, days in milk (DIM) and milk production, and block by pen. Animals had free access to the AMS and feed. Data collected included number of AMS visits in the last 24 hours and time of the visit. Descriptive analysis and logistic regression modelling were performed.

Results
Preliminary results show a significant difference in milking visits between the control and case cows ($z = -2.71$, $p<0.001$); control cows visited the robot more frequently (Mean: 3.2 visits/24hr) than the case animals (Mean 2.8 visit/24hr). Differences between control and case cows at each time period were explored.

Discussion
Our findings suggested that lame cows visited the AMS less frequently than non-lame cows. Lame cows are often the last to enter the milking unit (Hassall, et al. 1993), tend to walk more slowly (Chapinal, et al. 2010) and lie longer than their sound herd mates (Juarez, et al. 2003) in conventional parlours. Pain and discomfort (Whay, et al. 1997) caused by lameness may have had an impact on the cow's willingness to attend the AMS as frequently as non-lame animals. Less frequent visits to the AMS may lead to higher udder fullness due to milk accumulation that can cause discomfort (Gleeson, et al. 2007). Reduction in milking frequency may not only affect milk production and increase farm management cost, because animals need to be fetched to the AMS, but also lame cows may experience higher levels of stress when fetched.

Acknowledgements
Giuliana Miguel-Pacheco is funded by the University of Nottingham International Office Scholarship.

References
Chapinal N, De Passillé AM, Rushen J, and Wagner S 2010 Automated methods for detecting lameness and measuring analgesia in dairy cattle. Journal of Diary Science **93:** 2007-2013.
Gleeson DE, O'Brien B, Boyle L, and Earley B 2007 Effect of milking frequency and nutritional level on aspects of the health and welfare of dairy cows. Animal **1:** 125-132.
Hassall SA, Ward WR, and Murray RD 1993 Effects of lameness on the behaviour of cows during the summer. Veterinary Record **132:** 578-580.
Juarez ST, Robinson PH, DePeters EJ, and Price EO 2003 Impact of lameness on behavior and productivity of lactating Holstein cows. Applied Animal Behaviour Science **83:** 1-14.
Whay HR, Waterman AE, and Webster AJF 1997 Associations between locomotion, claw lesions and nociceptive threshold in dairy heifers during the peri-partum period. Veterinary Journal **154:** 155-161.

P6(b). Association between lameness, heart rate and heart rate variability during different activities of dairy cows

L. Kovács[1], J. Tőzsér[1], V. Jurkovich[2]
[1] Institute of Animal Science, Department of Cattle and Sheep Breeding, Faculty of Agricultural and Environmental Science, Szent István University, Gödöllő, Hungary [2] Department of Animal Hygiene, Herd Health and Veterinary Ethology, Faculty of Veterinary Science, Szent István University, Budapest, Hungary
kovacs.levente@mkk.szie.hu

Introduction
Pain associated with lameness decreases the welfare of cows (O'Callaghan 2002). Lame cows tend to be less active (O'Callaghan et al., 2003), spending more time lying and less time feeding (Galindo and Broom 2002). A lame cow is less able to cope with her environment, as pain might seriously affect walking and other movements. The aim of our work was to test the hypothesis that lameness has an effect on the activity of the autonomic nervous system by comparing heart rate (HR) and heart rate variability (HRV) of lame and non-lame cows during different activities.

Materials and Methods
Focal cows (age: 3.2±1.7 years; milk production: 34.7±7.8 kg/day; stage of lactation: 150±42 DIM) were divided into two groups based on their locomotion scores (non-lame: scores 1–2, N=28; lame: scores 3–5, N=24 [Sprecher et al. 1997]) on a large scale dairy farm. Heart rate was recorded between 10:00 h and 20:00 h with a Polar Equine RS800 CX monitoring system. Cows were observed visually for the duration of lying, standing and feeding bouts. Heart rate variability parameters were calculated in 5-min time windows following recommendations by Mohr et al. (2002) in time-, frequency- and non-linear domains. For the comparison of HRV values between the groups the Mann–Whitney test was used.

Results
No differences were found in HRV between groups during standing. During feeding parasympathetic measures were higher (RMSSD, HF, SD1), while sympathetic measure SD2 and sympatho-parasympathetic indices (LF/HF and SD2/SD1) were lower in lame cows (P=0.001, P=0.017, P=0.001 and P=0.019, P=0.017, P=0.004, respectively). Heart rate was lower during lying in lame cows compared with sound ones (P=0.05).

Discussion
Considerable differences during feeding probably derived from the lower level of aggression in lame cows at the feeding bunk (Jurkovich et al., 2013) evidenced by higher parasympathetic tone than none-lame ones. Lower HR during lying corresponds to a human study reported of decreased HR in chronically stressed individuals (Lucini et al., 2005). Further investigations are needed to find the exact reasons of these results.

Acknowledgments
This work was supported by National Development Agency and co-financed by the European Social Fund (Grant No.: TÁMOP-4.2.1.B-11/2/KMR-2011-0003 and TÁMOP-4.2.4.A/1-11-1-2012-0001)

References
Galindo F & Broom D M 2002 The effects of lameness on social and individual behaviour of dairy cows. Journal of Applied Animal Welfare Science 5 193-201
Jurkovich V, Tőzsér J, Kézér L, & Kovács L 2013 The effect of aggressive behaviour on HRV parameters of lame and non-lame cows during feeding. World Veterinary Congress, 17-20 September (accepted)
O'Callaghan KA 2002 Lameness and associated pain in cattle – challenging traditional perceptions. In Practice 24 212-219
O'Callaghan KA, Cripps P J, Downham DY & Murray RD 2003 Subjective and objective assessment of pain and discomfort due to lameness in dairy cattle. Animal Welfare 12: 605-610
Lucini D, Di Fede G, Parati G & Pagani M 2005 Impact of chronic psychosocial stress on autonomic cardiovascular regulation in otherwise healthy subjects. Hypertension 46: 1201-1206
Mohr E, Langbein J & Nürnberg G 2002 Heart rate variability: A noninvasive approach to measure stress in calves and cows. Physiology and Behavior 75: 251-259.
Sprecher DJ, Hostetler DE & Kanneene JB 1997 A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 47: 1179-1187

P7(a). Changes in cow flow following installation of rubber matting in the milking parlour

N Kayes[1], H Bishop[2], NJ Bell[1]
[1]The Royal Veterinary College, Stinsford Farmhouse, Kingston Maurward College, Stinsford, Dorchester DT2 8PY; [2] AHVLA, 66 Ty Glas Road, Llanishen, Cardiff CF14 5ZB
njbell@rvc.ac.uk

Introduction
Rubber matting is a popular addition to the milking parlour but few papers describe the effect on cow behaviour in the parlour (Bell & Huxley 2009, Gudaj, et al. 2009). The aim of this study was to assess how the installation of rubber matting (Walkway Mat; EasyFix™, Ireland) into a 16:16 Herringbone milking parlour at Higher Dairy, Kingston Maurward College affected cow flow through the parlour.

Materials and Methods
Ninety milking cows were observed at morning and afternoon milking. The median time taken for a row of cows to enter and exit the parlour was determined during four phases of data collection; the pre-installation phase (all concrete), phase one (left-hand side concrete, right-hand side rubber matting), phase two and the long term follow-up (both all rubber matting). Cows were analysed in three groups; the whole herd, main and special needs management groups. Wilcoxon Signed Rank Test was used to test for significance ($p<0.05$).

Results
A significant improvement in cow flow into the milking parlour was observed following the rubber matting intervention. The whole herd were quicker entering the parlour during the long term follow-up (Table 1). The whole herd and main group demonstrated an overall decrease in exit time on rubber matting, although this study found no statistically significant differences. The results for the special needs management group were less clear and further studies are required to determine the response of vulnerable cows to rubber matting.

Table 1. Median (minimum - maximum) time for a complete row of 8 cows to enter and exit the milking parlour during the pre-installation, phase 2 and long term follow-up study periods for the whole herd, main group and special needs group.

	Mean Entry Time (seconds)			Mean Exit Time (seconds)		
	Pre-Installation (concrete)	**Phase 2** (rubber matting)	**Long Term** (rubber matting)	**Pre-Installation** (concrete)	**Phase 2** (rubber matting)	**Long Term** (rubber matting)
Whole Herd	66.00 (26.00–300.00)	45.00 (24.00–106.00)	36.00** (18.00–89.00)	61.00 (27.00–639.00)	64.00 (23.00–190.00)	52.00 (22.00–413.00)
Main Group	66.00 (26.00–300.00)	42.50* (24.00–106.00)	32.50* (18.00–78.00)	60.00 (27.00–285.00)	51.50 (23.00–167.00)	48.00 (22.00–165.00)
Special Needs Group	63.50 (31.00–105.00)	76.50 (65.00–100.00)	59.00 (44.00–89.00)	89.00 (46.00–639.00)	78.50 (35.00–190.00)	82.00 (38.00–413.00)

Key: *$p<0.05$, **$p<0.001$

Discussion
It was concluded that the installation of rubber matting into the milking parlour can improve cow flow, particularly on entry to, and potentially, during exit from the milking parlour and help improve milking efficiency. Reducing standing time and improving cow flow is likely to improve foot health, although it was not feasible to demonstrate this within the time-frame of this study.

Acknowledgements
Nigel Allen, Herd Manager at Kingston Maurward College dairy, for allowing me access to the milking parlour for data collection. The rubber matting for this study was kindly provided by EasyFix^{TM} Rubber Products Ltd.

References
Bell NJ, Huxley JN 2009 The use of rubber floor matting on dairy units: a critical review. *Cattle Practice*.
Gudaj R, Blackie N, Bleach E, Scaife JR, Amory J 2009 The behaviour of cows in response to rubber mats in milking parlour stalls *Proceedings of the* Proceedings of the British Society of Animal Science p 94.

P7(b). Effect of lameness on milk production of dairy cows from eight herds in southern Chile

J Borkert[1], N Tadich[2]
[1]Borkert y Cía Ltda, Hoof Trimming Company, Osorno, [2]Faculty of Veterinary Science, University Austral of Chile, Valdivia, Chile.
jborkert@cuidatuvaca.com

Introduction
Cows that have an obvious lameness must necessarily pass through a progression to this condition. Also, after treatment recovery will be gradual. It seems likely that the progression of lameness to the point where it is treated and the subsequent recovery phase will be reflected in milk production.

Objective
To determine the effect of lameness on milk production in cows from one or more calving, three months before the cow becomes lame and three months after the event occurred in relation to their non lame contemporaries.

Material and Methods
We used eight dairy farms in the province of Valdivia, X Region, Chile with a milk production ≥ 1,000,000 liters per year and an average of 337 (±) 101 lactating Holstein Friesian cows for each farm. The farms were visited between April 2005 and May 2006. The farms had control official milk monthly, of which production data were obtained. Each farm was provided with a form for recording lame cows. To determine the effect of lameness on milk production records were analyzed for the three months before the cow appeared lame, and the three months after the event occurred in relation to their non lame contemporaries. The difference in production was analyzed using a Student t test for paired samples. The analysis was performed using SAS programs (Statistical Analysis System) V9.0 (SAS Institute Inc., 2005).

Results
Milk production in lame cows decreased by 1.7±5.3 litres per day in the period spanning one month before to one month after lameness treatment in comparison to non lame cows, a total loss of approximately 51 litres over the period. Milk production in the period spanning two months before lameness treatment and two months after showed a decrease of 3.4±4.7 litres, equivalent to a loss of 306 litres. Finally if we take into account three checks before and three after diagnosis we see that the difference became 4.8±5.1 litres less for lame cows, approximately 720 litres for this period.

Discussion
The production of milk decreased by 51, 306 and 720 liters in lame cows in comparison to non lame cows, two and three controls before or after the diagnosis of lameness respectively. This suggests that the effects of lameness progression and recovery are reflected in milk production.

P8(a). Weekly changes in locomotion score and milk yield in dairy cows

MA Palmer[1,2], NE O'Connell[1]
[1]Institute for Global Food Security, School of Biological Sciences, Queen's University Belfast, N. Ireland;
[2]Agri-Food and Biosciences Institute, Large Park, Hillsborough, N. Ireland
mpalmer06@qub.ac.uk

Introduction
Lameness has been associated with a reduction in milk yield in dairy cows (Hernandez et al., 2005), demonstrating an economic, in addition to a welfare, cost to this problem. It has been shown that the loss in milk yield can begin months before the animal is diagnosed as clinically lame (Green et al., 2002). This implies that there may be small, gradual changes in locomotion and milk yield before a diagnosis of clinical lameness is made. The aim of this study was to determine whether small changes in locomotion score were associated with changes in milk yield over a short period of time (one week).

Materials and Methods
The study used 222 dairy cows of parity 1 to 7 which were kept in cubicle housing and milked twice daily. Daily milk yields were automatically recorded for each animal and weekly average milk yields were calculated. All animals were locomotion scored once per week as they left the milking parlour using a modified version of the scale described by Manson and Leaver (1988) ranging from 1.0 (sound) to 4.5 (difficulty walking) in gradations of 0.5.
Records were examined to identify changes in locomotion score of 0.5 units from week to week and simultaneous changes in milk yield. Only the first suitable locomotion score change was used for each animal. No data were included from before day 56 post partum or from animals that had recently been treated for an illness. Data were analysed using a restricted maximum likelihood (REML) procedure in Genstat (VSN International) with change in milk yield as the response variate.

Results
Sufficient data were not available to examine all changes in locomotion score. For those that were examined, the mean change in milk yield for each category of increase and decrease in locomotion score is shown in Table 1. No relationship was found between category of change in locomotion score and change in milk yield ($p = 0.723$).

Table 1 The mean (± se) change in milk yield for different changes in locomotion score from week to week

Increases in locomotion score			Decreases in locomotion score		
	N	Mean (±se)		N	Mean (±se)
2.0 - 2.5	18	0.858 (±0.87)	**2.5 – 2.0**	31	-0.036 (±0.76)
2.5 – 3.0	82	-0.172 (±0.62)	**3.0 - 2.5**	40	0.495 (±0.67)
3.0 - 3.5	21	-0.022 (±0.75)	**3.5 – 3.0**	16	-0.310 (±0.74)
3.5 – 4.0	9	-0.331 (±0.99)	**4.0 - 3.5**	5	0.381 (±1.22)

Discussion
No relationship was seen between small changes in locomotion score and changes in milk yield during this short time scale. It may be that there is a time lag between a change in locomotion score and change in milk yield, and that a week is too short a time scale in which to examine this relationship.

Acknowledgements
The authors thank Alan Gordon for assistance in the design of the statistical analysis and the staff of the Dairy Unit for assistance with data collection. M. Palmer acknowledges the Department for Agriculture and Rural Development (NI) for receipt of a Postgraduate Studentship.

References
Green LE, Hedges VJ, Schukken YH, Blowey RW and Packington AJ, 2002 The impact of clinical lameness on the milk yield of dairy cows. Journal of Dairy Science 85: 2250-2256
Hernandez JA, Garbarino E J, Shearer JK, Risco C A and Thatcher WW 2005 Comparison of milk yield in dairy cows with different degrees of lameness. Journal of the American Veterinary Medical Association 227: 1292-1296
Manson FJ and Leaver JD 1988 The influence of concentrate amount on locomotion and clinical lameness in dairy cattle. Animal Production 47: 185-190

P8(b). Use of GPS to assess walking behaviour of lame cows in Chilean grazing dairy herds

P. Levet[1], J.P. Smulder[2], N. Tadich[2]
[1]Master Degree Student, Faculty of Veterinary Science, Universidad Austral de Chile.
[2]Faculty of Veterinary Science, Universidad Austral de Chile, Valdivia, Chile.
ntadich@uach.cl

Introduction

Lameness is a common disease in dairy cows worldwide. In Chile, Flor and Tadich (2008) reported a mean prevalence of clinical lameness (locomotion score (LS) ≥3, Sprecher et al 1997) of 16.7% in 91 dairy herds. Lame cows are in pain, produce less milk, are less likely to become pregnant and are more likely to be culled involuntarily. The aim of this work was to determine and compare the area and distance travelled by lame and non lame cows kept on pasture in the south of Chile, using GPS.

Material and Methods

This study evaluated the mobility of the lame cows and normal cows using a GPS motion recorder (Garmin ®). Fifty one lame cows (LS 3, Sprecher et al 1997) and 51 sound cows, from five dairy farms that kept their lame and non lame cows grazing together, were used. The GPS was installed in a harness in the head of the cow, and recorded data during 24 hours, with an interval of 10 minutes. The recorded data were: area and distance travelled on paddocks, and distance travelled on the tracks, mean walking speed on paddock and mean walking speed on the tracks. An analysis of variance was carried out to determine differences between groups of cows.

Results

The distance travelled on the paddocks was the only variable significantly different between lame and sound cows ($P \leq 0.05$). The distance travelled in the paddocks by the lame cows was of 1810 m and the distance travelled by sound cows was of 2347 m. The area covered in the paddocks was 13699 m^2 for lame cows and the area covered by sound cows was 15203 m^2. The average speed for lame cows on the paddocks was of 1.9 km/h and 3.3 km/h on the tracks. Sound cows walked a speed 2.1 km/h on the paddocks and 3.5 km/h on the tracks. Cows with locomotion score 3 walked less distance and they used a smaller grazing area than the area used by sound cows, although this difference was not significant ($P \leq 0.05$). Lack of differences between groups could have been due to the size of the samples, handling of the cows at each farm and the short period of recording (24 h)

Acknowledgments

This work was funded by project FONDECYT 1090373. We thank the farmers for access to their farms.

References

Flor E, Tadich N 2008. Claudicaciones en vacas de rebaños lecheros grandes y pequeños del sur de Chile. Arch. Med. Vet. 40, 125-134.
Sprecher DJ, Hostetler DE, Kaneene JB 1997. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 47, 1179–1187.

Sessions 3 & 4

Monitoring and Measuring Lameness

12. Automatic back posture analysis in the course of lameness in dairy cattle

C Bahr[1], A Poursaberi[1], A Pluk[1], I Veermäe[2], E Kokin[2], V Pokalainen[2], MPastell[3], A Van Nuffel[4], DBerckmans[1]
[1] Division Measure, Model & Manage Biorespones (M3-BIORES), Katholieke Universiteit Leuven, Kasteelpark Arenberg 30, B-3001 Leuven, Belgium; [2] Institute for Agricultural and Fisheries Research Technology & Food Unit – Agricultural Engineering, Burg. van Gansberghelaan 96, B-9820 Merelbeke, Belgium; [3] Estonian University of Life Sciences, Kreutzwaldi 64, 51014 Tartu, Estonia; [4] Department of Agrotechnology & Research Centre for Animal Welfare,University of Helsinki, P.O.Box 28, FI-00014 University of Helsinki, Finland
claudia.bahr@biw.kuleuven.be

Introduction
The objective of this research was to develop a fully automatic algorithm to measure the back posture of dairy cows and classify their degree of lameness.

Materials and Methods
The back posture of each cow was extracted based on an algorithm which utilizes image processing techniques and edge reconstruction. The back arch in addition to the head position was used to evaluate the way of walking. Two ellipses were fitted on back posture pixels and the parameters of the ellipses with head position were used as features for classification of the lameness degree. In a research farm, where cows were filmed while passing a corridor one by one, the lameness degree of 156 cows was classified to 97,4% correctly.
A further objective was to test the algorithm and follow the course of lameness in individual cows in a commercial farm. Therefore 14 cows have been selected from a database, which were scored for lameness in at least four successive weeks and the degree of lameness has changed at least once within this period. The degree of lameness was assessed by a human expert, who scored the cows once a week.

Results and discussion
The algorithm was applied on the data set of 14 cows and the results show that the output of the algorithm confirms in general the scoring results of the human expert and vice versa. In total, 87 measurements of the back posture were taken from 14 cows. 78 automatic measurements confirmed the scoring of the expert, which leads to 89,7% correct classification under commercial farm conditions. By looking at the course of lameness, it can be concluded, that this evolves individually different in single cows. The algorithm was able to follow the course of lameness in successive weeks. In 7 cows the algorithm confirmed the results of the human scorer to 100%. In five cows the automatic scoring system did not match the human score once and in two cows the scoring system did not match the human score twice. It means that the measured features of the back posture alter in individual cows depending on the course lameness. Furthermore it means that the automatic detection of the back posture based on image analysis can contribute to an objective and reliable assessment of lameness of dairy cows.

13. Real Time Location Systems (RTLS): a novel approach to early lameness detection

ZE Barker[1], J Hack[1], EA Codling[2], JA Vazquez Diosdado[2], NJ Bell[3], DP Croft[4], JR Amory[1]
[1]Writtle College, [2]University of Essex, [3]Royal Veterinary College, [4]University of Exeter
zoe.barker@writtle.ac.uk

Introduction

Automatic monitoring of the location of individual cows would provide new opportunities for analysing social behaviour and time budgets relating to cubicle use, feeding, etc. Positional data could identify changes in behaviour associated with the onset of diseases such as lameness. This study describes the optimisation of a Real Time Location System (RTLS) on a UK dairy farm to be used in the development of an on-farm automated early warning system for disease detection.

Materials and Methods

Omnisense series 500 wireless sensors were tested using researchers and cows from a group of 140 high-yielding cows.

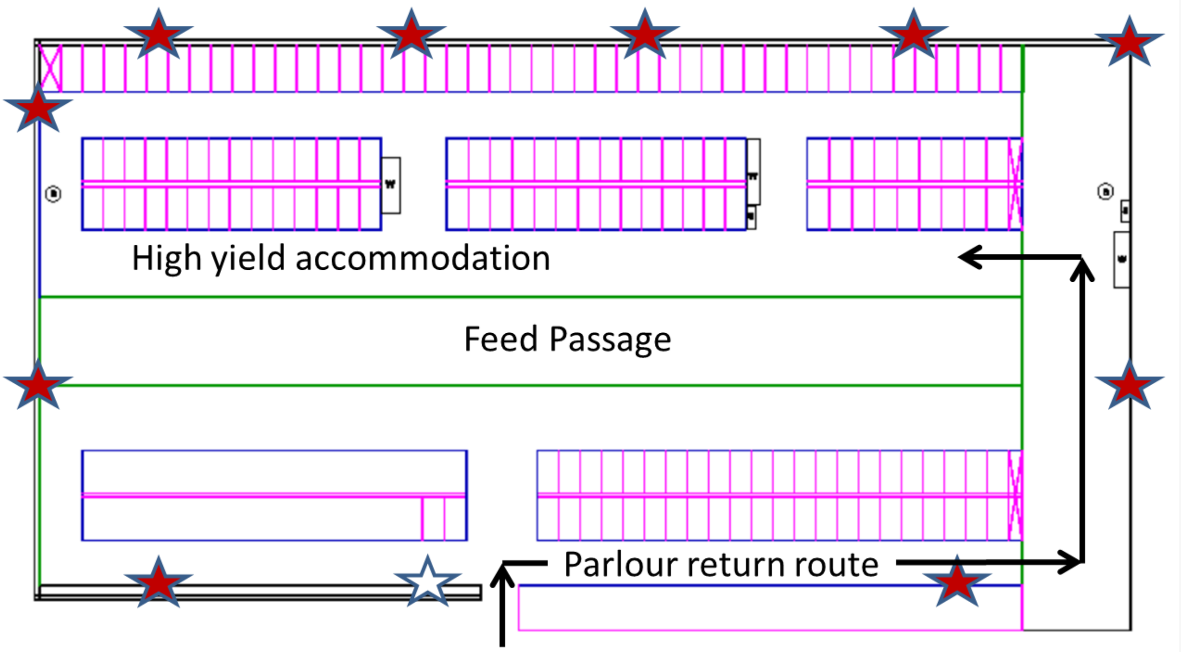


Figure 1. Layout of cubicle building and location of fixed sensors (indicated with stars, the white star being the data collector) with known allocated XYZ-coordinates from which all other sensor locations are derived.

Four researchers positioned themselves in eight pre-allocated positions around the cubicle house for 10-minute intervals. Sensors were worn on the shoulder and in a pocket. Circular errors of probability (CEP) were calculated for each time slot to indicate the accuracy of the XY-sensor readings. The CEP gives the distance around the mean in which 50% (CEP50) and 95% (CEP95) of the sensor readings are recorded. Sensors were also mounted on neck collars on 16 dairy cows across two 48-hour sessions (8 cows per session). The cows were observed for four 10-minute intervals during the 48 hours. Circular errors of probability was calculated where the cow was observed to be at a given XY-coordinate for 2 minutes or more. The mean Z-coordinates (i.e. height of sensor with reference to predetermined fixed sensor positions) were calculated for different areas of the cubicle house and for different activities performed by the cows i.e. lying standing and feeding.

Results

The mean CEP50 and CEP95 for sensors located on the shoulder were 0.96m (±0.07) and 2.58m (±0.21), respectively. For sensors located in the pocket the mean CEP50 and CEP95 were 1.05m (±0.06) and 2.91m (±0.18). Where sensors were mounted on cows the mean CEP50 and CEP95 were 2.39m (±0.23) and 5.19m (±0.32)

There were no significant differences in mean CEP's for the different zones of the cubicle house for the sensors held in static positions by the researchers or those mounted on cows. There was also no significant difference in mean CEP's for cow activity.
The mean z-coordinate from the cows that were standing was significantly greater than cows that were lying or feeding (Table 1).

Table 1. Mean Z-coordinate for cows observed to be standing, feeding or lying in a static position within the cubicle shed

(mean ±S.E.)	feeding	lying	standing	P-value
Z-coordinate	0.82m ± 0.06	0.84m ±0.11	1.20m ± 0.11	0.041

Discussion
Despite the metallic components of the cubicle shed capable of interrupting signals the sensors performed consistently across all areas of the shed. Sensors mounted on the shoulder gave more precise location data confirming the rationale for mounting sensors at highest point on the neck of the cows. Data from the sensors mounted on cows were more variable than for the static positions of the researchers that may be due to cows' movements even when in the same location.
The use of the z-coordinate combined with the inclusion of data from the in-built accelerometers, which were not validated as part of this initial trial should allow differentiation between cows lying down and standing up.

14. Can lame cows be detected using data from voluntary milking systems?

E Garcia[1], I Klaas[1], JM Amigo[2]
[1]University of Copenhagen, HERD - Centre for Herd-oriented Education, Research and Development, Dept. of Large Animal Sciences, Frederiksberg C, Denmark, [2] University of Copenhagen, Department of FOOD, Quality and Technology, Frederiksberg C, Denmark
efg@sund.ku.dk

Introduction

Voluntary milking, a.k.a. AMS, has brought benefits and challenges to dairy farmers. However, tools are still lacking to detect lame cows. Previous research has not yet achieved high specificity (Sp) and low error rate when using AMS data (Jónsson et al. 2011). The present study aimed to explore the potential of data from automatic milking systems to detect lameness using advanced multivariate data analysis and visualization methods, which could be better at identifying complex relations between AMS data and lameness.

Materials and Methods

A Danish dairy farm with 150 milking cows and two free-traffic DeLaval VMS units was selected. Gait scoring of milking cows was done weekly for five weeks in autumn 2012, inside the free-stalls by gently encouraging each cow to walk. Lameness was assessed using a 4-point scale adapted from DairyCo® (Reader et al., 2011) where score 1 corresponds to a non-lame cow, whereas score 4 corresponds to an extremely lame cow very reluctant to put weight on the limb(s). Data obtained from the farm was summarized week-wise. The mean or sum of seven days was calculated for each variable and associated with the respective cow's lameness score. The variables explored were: average of milking duration, sum of kicked off teats during milking, sum of milkings with kicks, average flow, number of milkings and sum of concentrate feed in the robot, days in milk and sum of total milk yield. A classification model was developed with Partial Least Squares-Discriminant Analysis (PLS-DA), which is a method that models the variation of several variables into few latent variables (LV) in order to discriminate classes. Only the scores 1 and 4 were included in order to identify which variables could be more meaningful. All data was autoscaled prior to analysis. Cross-validation was done by estimating the class of the available weekly scores of each cow at a time. The analysis was done by using the PLS-Toolbox (Eigenvector Research) working under MATLAB® environment.

Results

The three LVs extracted explained 65% of the X-block variation. Plotting the two first LVs, Figure 1, shows some separation between non-lame and lame cows. The model was able to detect 25 of 49 extremely lame scores, while having 20 false positives and 91 true negatives. The most important variables, Figure 2, were milking duration (LV 1) and the number of milkings (LV 2). The cross-validated sensitivity (Se) and Sp were respectively 53% and 83% (calibration model: 59% and 84%, Figure 3). The average cross-validated classification error was 32%.

Discussion

Surprisingly, milking duration was an important variable to discriminate lame cows, especially as stage of lactation and milk yield did not improve Se and Sp. Further investigations have to explore whether the association is simply caused by parity effects, not included, and/or physiological stress and pain in lame cows leading to impaired milk let-down. In conclusion, this pilot study seems to indicate that data from automatic milking systems have valuable information to detect lame cows by applying chemometric methods.

References

Jónsson RI, Blanke M, Poulsen NK, Højsgaard S 2011. *Detection of Oestrus and Lameness in Dairy Cows*. Kgs. Lyngby, Denmark: Technical University of Denmark (DTU).

Reader J, Green M, Kaler J, Mason S &Green L 2011 Effect of mobility score on milk yield and activity in dairy cattle. *Journal of Dairy Science* 94: 5045-5052.

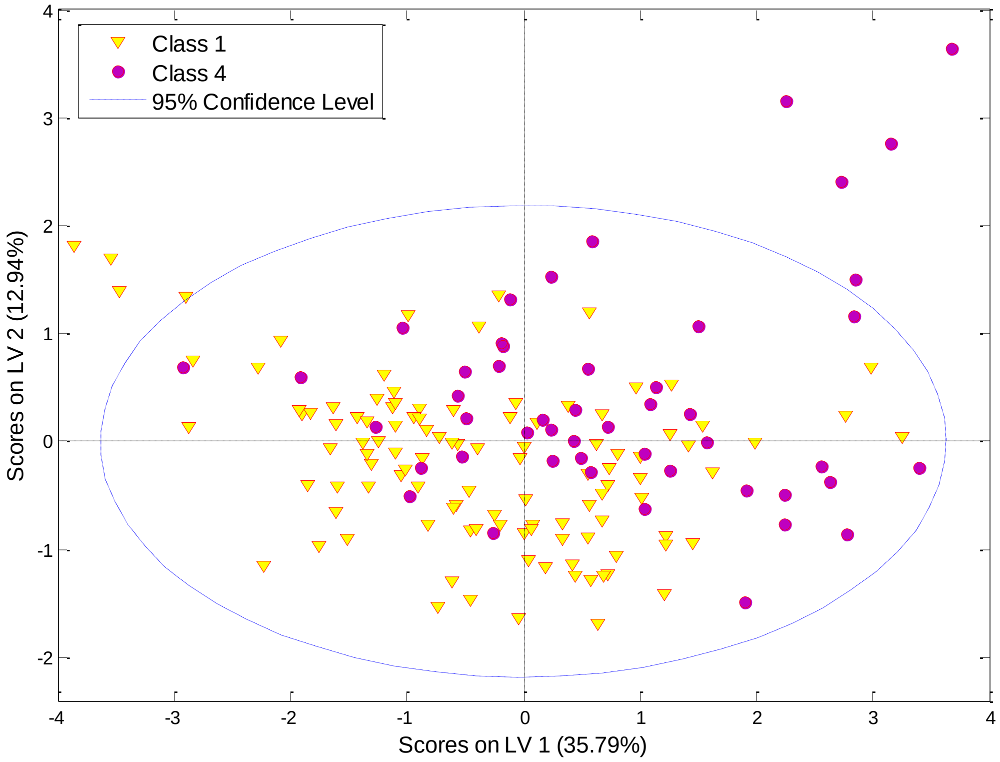


Figure 1. Scores Plot (LV1 vs. LV2) showing that lame cows tend to separate from non-lame towards the upper right quadrant.
Class 1 – non-lame cow, Class 4 – extremely lame cow

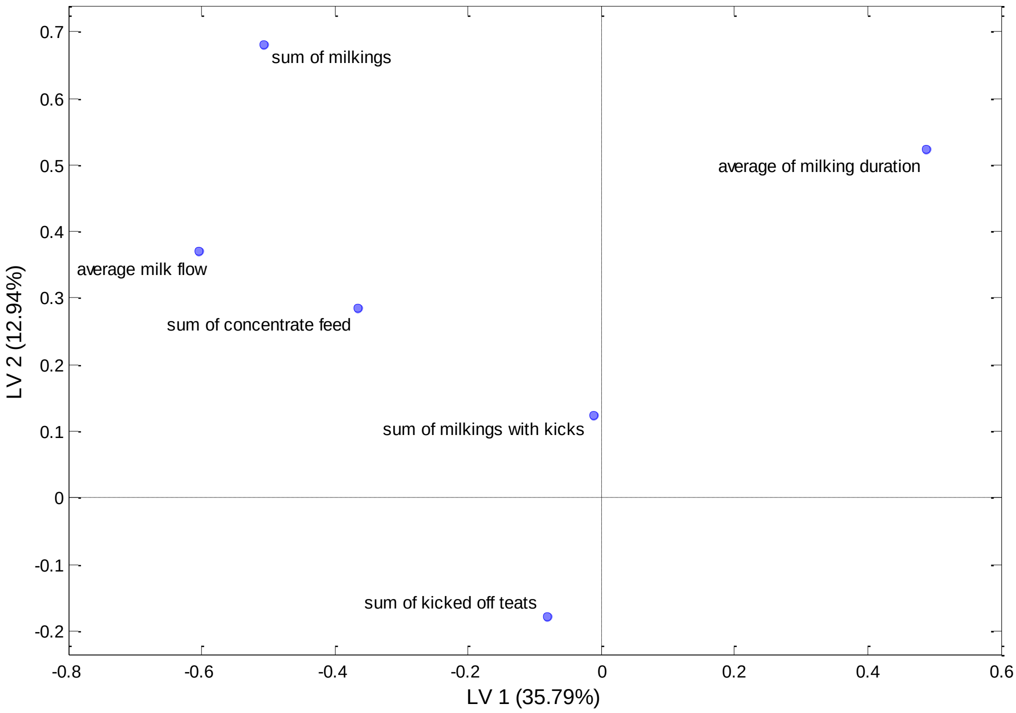


Figure 2. Loadings Plot (LV1 vs. LV2) showing that sum of milkings and average of milking duration are the variables that contribute the most to discriminate lame cows.
Weekly variables: average of milking duration, sum of kicked off teats during milking, sum of milkings with kicks, average milk flow, sum of milkings and sum of concentrate feed in the robot.

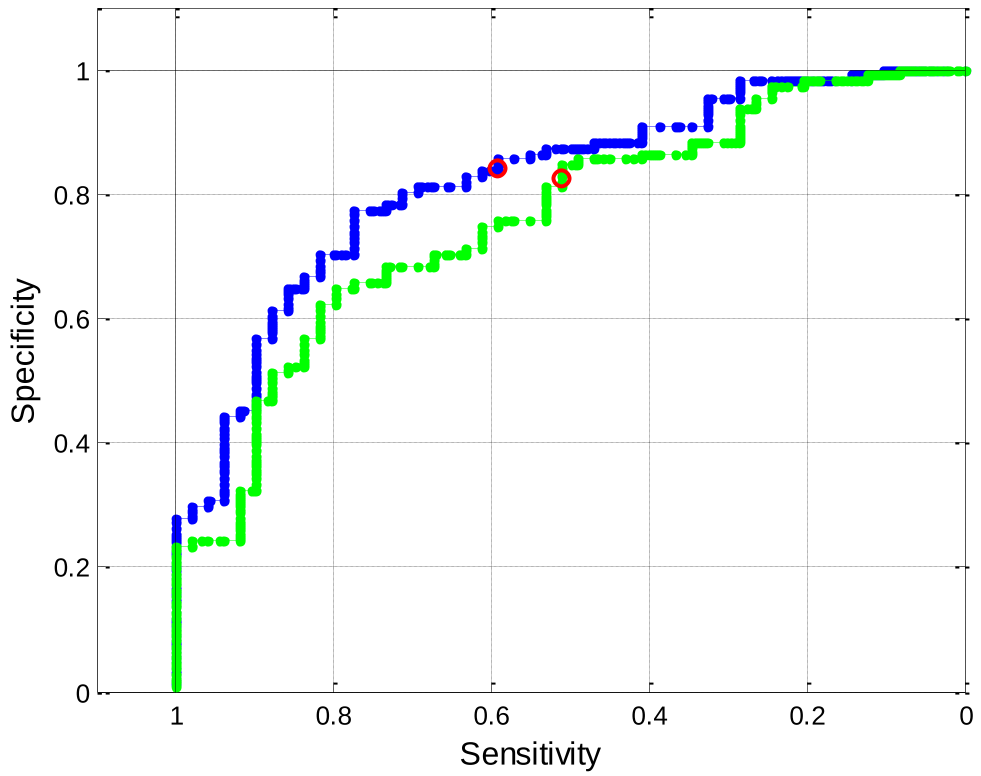


Figure 3. Estimated ROC curves (blue, calibration; green, cross-validation) and the optimal values obtained (red dot). Cross-validated (CV) Sensitivity: 53% CV Specificity: 83% CV classification error: 32%

15. Within and between observer agreement for specific levels in a five levels locomotion score for dairy cows

A Schlageter-Tello[a], EAM Bokkers[b], PWG Groot Koerkamp[a,c], T Van Hertem[d,e], S Viazzi[e], CEB Romanini[e], I Halachmi[d], C Bahr[e], D Berckmans[e] and C Lokhorst[a]
[a]Wageningen UR Livestock Research, P.O. Box 65, 8200AB Lelystad, The Netherlands, [b] Animal Production Systems Group, Wageningen University, P.O. Box 338, 6700 AH, Wageningen, The Netherland, [c]Farm Technology Group, Wageningen University, P.O. Box 317, 6700 AH, Wageningen, The Netherlands, [d]Institute of Agricultural Engineering - Agricultural Research Organization, P.O. Box 6, Bet-Dagan 50250, Israel, [e]Division Measure, Model & Manage Bioresponses, Katholieke Universiteit Leuven, P.O. Box 2456, 3001 Heverlee, Belgium.
andres.schlagetertello@wur.nl

Introduction
In order to support lameness control in dairy cows, several concepts have been devised for the development of an automatic lameness assessment system (ALAS). The development of ALAS requires a gold standard for lameness assessment to be used as reference. Since locomotion scores (LSs) are subjective methods they may suffer poor repeatability. In order to solve the problem of poor repeatability, it is important to understand which specific level of LS has the highest variability (lowest repeatability). Therefore the objective of this study is to determine which level (of a five levels LS) shows the highest variability.

Materials and Methods
The locomotion scoring was conducted on 58 video images of cows walking using a five levels LS. The video images were selected in order to have an equal number of cows in each of the five levels of the LS. Locomotion scoring was performed two times by 7 experienced observers in two different scoring sessions separated by at least four days. Cross tables were used to calculate the pairwise and overall within and between observer repeatability (WOR and BOR, respectively) expressed as percentage of agreement (PA) and Cohen's kappa coefficient (k). The within and between specific agreement (WOA and BOA, respectively) for individual levels in the five level LS were calculated as reported by Cicchetti & Feinstein (1990). The 95% confidence limits for the specific agreement were calculated with the Delta method as proposed by Graham & Bull (1998).

Results
The pairwise WOR ranged from 60.3% to 77.6% expressed as PA and from 0.47 to 0.70 when expressed as k (Table 1).

Table 1 Within observer (in the diagonal) and between observer repeatability for session 1 (over the diagonal) and session 2 (under the diagonal) expressed as percentage of agreement (PA), Cohen's Kappa (k) for 7 observers (Obs)

			Session 1						
			Obs 1	Obs 2	Obs 3	Obs 4	Obs 5	Obs 6	Obs 7
Session 2	Obs 1	PA	**66.1**	68.9	63.7	67.9	58.6	77.2	72.4
		k	**0.56**	0.59	0.53	0.58	0.48	0.70	0.64
	Obs 2	PA	66.1	**72.4**	67.2	69.6	50.0	75.4	65.1
		k	0.56	**0.63**	0.56	0.56	0.36	0.66	0.52
	Obs 3	PA	64.3	62.1	**77.6**	64.3	43.1	66.7	70.7
		k	0.53	0.50	**0.70**	0.53	0.28	0.56	0.61
	Obs 4	PA	43.1	37.7	32.1	**64.7**	46.4	81.8	71.4
		k	0.23	0.18	0.12	**0.50**	0.33	0.75	0.60
	Obs 5	PA	57.1	56.9	63.8	28.3	**67.2**	47.4	43.1
		k	0.46	0.44	0.53	0.11	**0.58**	0.34	0.28
	Obs 6	PA	60.7	63.8	41.4	54.7	50.0	**63.2**	71.9
		k	0.49	0.53	0.25	0.39	0.37	**0.51**	0.62
	Obs 7	PA	51.8	48.3	58.6	39.6	62.1	51.7	**60.3**
		k	0.37	0.32	0.45	0.21	0.51	0.37	**0.47**

Pairwise IOR ranged from 28.5% to 81.8% expressed as PA and from 0.11 to 0.75 when expressed as k. Overall WOR and BOR appear in Table 2. The WOA for level 3 presented the lowest value (60%) whereas the higher WOA were for level 5 (75.5%), level 4 (74.5%) and level 1 (72.5%) (Table 2). The lower BOA were obtained for level 5 (38.7%), level 3 (53.1%) and level 2 (58.9%) (Table 2).

Table 2 Overall within (WOA) and between (BOA) observer agreement for specific levels (Lvl) with a five levels locomotion score by 7 observers. Parenthesis indicate 95% confidence intervals.

	PA	k	Lvl 1	Lvl 2	Lvl 3	Lvl 4	Lvl 5
WOA	67.4	0.57	72.5 (64.4 - 80.6)	63.9 (56.9 - 70.9)	60.0 (51.7 - 68.2)	74.5 (67.2 - 81.9)	75.6 (60.2 - 91.1)
BOA	58.2	0.45	63.9 (60.3 - 67.6)	58.9 (55.9 - 61.6)	53.1 (49.6 - 56.5)	62.1 (58.6 - 65.5)	38.7 (30.5 - 46.9)

Discussion

The values obtained in pairwise WOR and BOR (PA and k) confirm that the observers were experienced. Relative low WOA and BOA indicates that major source of variation in locomotion scoring is between level 2 and 3. WOA for level 5 indicates that observers are consistent scoring extremely lame cows. However, there is a high variability (low BOA) between observers scoring cows at level 5. In conclusion the highest variability is between levels 2 and 3 in a five levels locomotion score.

Acknowledgments

This study is part of the Marie Curie Initial Training Network BioBusiness project (FP7-PEOPLE-ITN-2008).

References

Cicchetti DV and Feinstein AR 1990 High agreement but low kappa: II. Resolving the paradoxes. Journal of Clinical Epidemiology 43: 551-558

Graham P and Bull B 1998 Approximate Standard Errors and Confidence Intervals for Indices of Positive and Negative Agreement. Journal of Clinical Epidemiology 51: 763-771

16. Taking infrared images from bovine digit: new perspectives in lameness surveillance

V Redaelli[1], S Tarantino[2], A Zecconi[3], F Luzi[1], CM Mortellaro[3]
[1] Dept. of Health, Animal Science and Food Safety, University of Milan; [2] Private practitioner, Milan [3]Dept. Veterinary Sciences and Public Health, University of Milan, Italy.
fabio.luzi@unimi.it

Introduction
Nowadays, one of the most important challenges is to determine reliable measures of animals' overall status with non invasive indicators, obtaining reliable data without avoiding undue stress reactions. Infrared thermography (IRT) may be a suitable method to reach this goal, it being a non-contact detecting technology. IRT has found many biological applications, and it may be used to detect subclinical pathological signs and inflammation before the disease becomes evident (Zecconi et al. 2009, Redaelli et al.2011, Luzi et al., 2013).
Since a standardized method is still not available, this study aimed to develop a standard protocol in taking correct, reliable and comparable IRT images from the digital region in dairy cows to diagnose the presence of lameness.

Materials and Methods
The study was performed on 300 Holstein Frisian dairy cows, housed in a free-stall barn, producing about 31,5 Kg/day of milk, in the Parmigiano Reggiano® area. Cows were fed with a total mixed ratio without the use of silage as required by Parmigiano Reggiano® production rules.
Cows were regularly trimmed at the drying-off and 60/80 days after parturition. First lactating cows were trimmed 60/80 days after parturition. Lame cows were visited by the veterinarian within 6 days of an outbreak. A complete database about lameness was recorded and included cows' ID, date, lesion and therapies. Lesions were classified according to the Lesion Severity Scoring Guide, Alberta Dairy Hoof Health Project. We focused our attention on digital problems with the highest prevalence in dairy cattle: Digital Dermatitis (DD), Interdigital Phlegmon (IPH), Sole Ulcer (SU) and White Line Disease (WLD).
The IRT camera used was the AVIO TVS700 with 320x240 microbolometric sensor and images were taken from June to September 2012 monthly. Since a rotatory milking parlour was installed in the herd, the infrared camera can be fixed on a stand, two meters far from the cows. Digital pictures taken allow inspection of claws in their volar or side-volar view. Data obtained by clinical visits and by digital picture analyses were collected into a database and statistically analyzed by SAS 9.2 software.

Results
Due to its multi- purpose features, IRT images of the volar region of the digit was chosen. This shot can be used in all the types of milking parlours and in cows locked in the feeding bunks too.
Four areas with specific anatomical and thermographic characteristics recognizable on the hoof of all animals were defined.
Two areas were drawn on the volar distal region of each limb, from the ground up to the volar plica flexoria; the other two areas reach the distal half of the metatarsal region. Temperature obtained in these areas and their variations were statistically analyzed and compared with the lameness database.

Discussion
The thermal characteristics typical of some areas of the volar region in cattle, defined by the methods proposed were related to the presence of digital pathology. Indeed, the preliminary analysis of the data suggest that IRT can identify the presence of lameness with sufficient accuracy. Further investigations are underway in order to assess if IRT could be used for the early diagnosis of lameness.

References
Luzi F, Mitchell M, Nanni Costa L, Redaelli V 2013 Thermography: current status and advances in livestock animals and veterinary medicine Fondazione Iniziative Zooprofilattiche e Zootecniche, Brescia. Vol. n° 92 (www.fondiz.it)
Redaelli V, Tarantino S, Ricci C, Luzi F, Zecconi A, Verga M 2009 A non-invasive method to measure lameness in dairy cow. Ital. J. of Anim. Sci., 8 (Suppl. 2):671
Zecconi A, Redaelli V, Tarantino S, Luzi F, Verga M. 2011 Infrared thermography as a non-invasive technique to assess lameness in dairy cows. Conference Lameness in ruminants: lameness, a global perspective. 16th symposium and 8th conference lameness, Rotorua, New Zealand

17. Field study: Use of infrared thermography (IRT) as a non-invasive diagnostic tool for early detection of infectious hoof disorders in dairy cows

M Alsaaod[1], C Syring[1], J Dietrich[1], M G Doherr[2], T Gujan[1], A Steiner[1]
[1]Clinic for Ruminants, [2]Veterinary Public Health Institute, Vetsuisse-Faculty, University of Bern, Switzerland
maher.alsaaod@vetsuisse.unibe.ch

Introduction
Infectious foot disorders (IFD) are considered among the most important causes of lameness in dairy cattle. Early detection of these disorders is the first step to reduce the degree of clinical manifestation. Therefore, reliable, practical and non-invasive methods to rapidly screen the prevalence of IFD are needed. Prior investigations have demonstrated that temperature at the coronary band (CB).(1,2) or at the plantar aspect of the lame limb(3) is increased in the presence of a foot lesion. Nevertheless, the reliability of using infrared thermography (IRT) to early detect IFD by measuring CB temperature has not been investigated, and the aim of this field study was to describe this association.

Materials and Methods
A total of 497 IRT observations were collected from124 cows housed in a tie-stall (8 farms). All lesion data were documented by using the claw data analysis software “Klauenmanager”. Recorded foot disorders at hoof trimming were considered as “gold standard”. Infrared thermography (Fluke Ti25 Thermal Imager) was used to assess the maximal surface temperature of the CB region and skin (S), and the temperature difference (ΔT) between CB and S of the fore limbs and hind limbs before claw trimming (mean value of the maximal values of the medial and lateral digits for each foot). The IFD included were: Heel horn erosion (HHE) (healthy 1≤ [0: no signs of HHE and 1: slight HHE no destruction of the bulb horn] or presence 2≥ [2 = moderate HHE; 3 = severe HHE]); Digital dermatitis (DD) and Panaritium (P) (present/not present). For statistical comparison of temperature-related variables between feet and disease categories, One- and Two-Way Analyses of Variance (ANOVA) statistics were performed. The level of significance was set at $P< 0.05$.

Results
The hind feet had a significantly higher temperature at the CB ($P<0.001$) and the S (P<0.001) as compared to fore feet. Feet with IFD (DD, HHE, P) had higher maximum temperatures at the CB and the skin ($P<0.001$) and a lower ΔT ($P<0.05$) as compared to feet without lesions (Fig.1). Both, feet with DD ($P<0.05$) and HHE ($P<0.001$) showed significantly higher maximal temperatures at the CB and the S, but no difference was found concerning ΔT for DD ($P=0.479$).

Discussion
Efficacy of IRT as a method for detecting hoof lesions when lesions occurred at least in one foot as compared to the healthy contralateral foot has been identified.(1) A more recent study found that IRT may be reliable to detect elevated temperature at the plantar aspect of the foot associated with foot lesions, but may not be sensitive enough for lesions specific detection(3). The findings of the current study suggest that IRT may be a useful noninvasive diagnostic technique to identify IFD in dairy cows by measuring the surface temperature of the CB or S.

References
Alsaaod M, Büscher W 2012 Detection of hoof lesions using digital infrared thermography in dairy cows. Journal of Dairy Science 95: 735-742.
Nikkhah A, Plaizier JC, Einarson MS, Berry RJ, Scott SL, Kennedy AD 2005 Infrared thermography and visual examination of hooves of dairy cows in two stages of lactation. Journal of Dairy Science 88: 2749–2753.
Stokes JE, Leach KA, Main DCJ, Whay HR 2012 An investigation into the use of infrared thermography (IRT) as a rapid diagnostic tool for foot lesions in dairy cattle. The Veterinary Journal 193: 674-678.

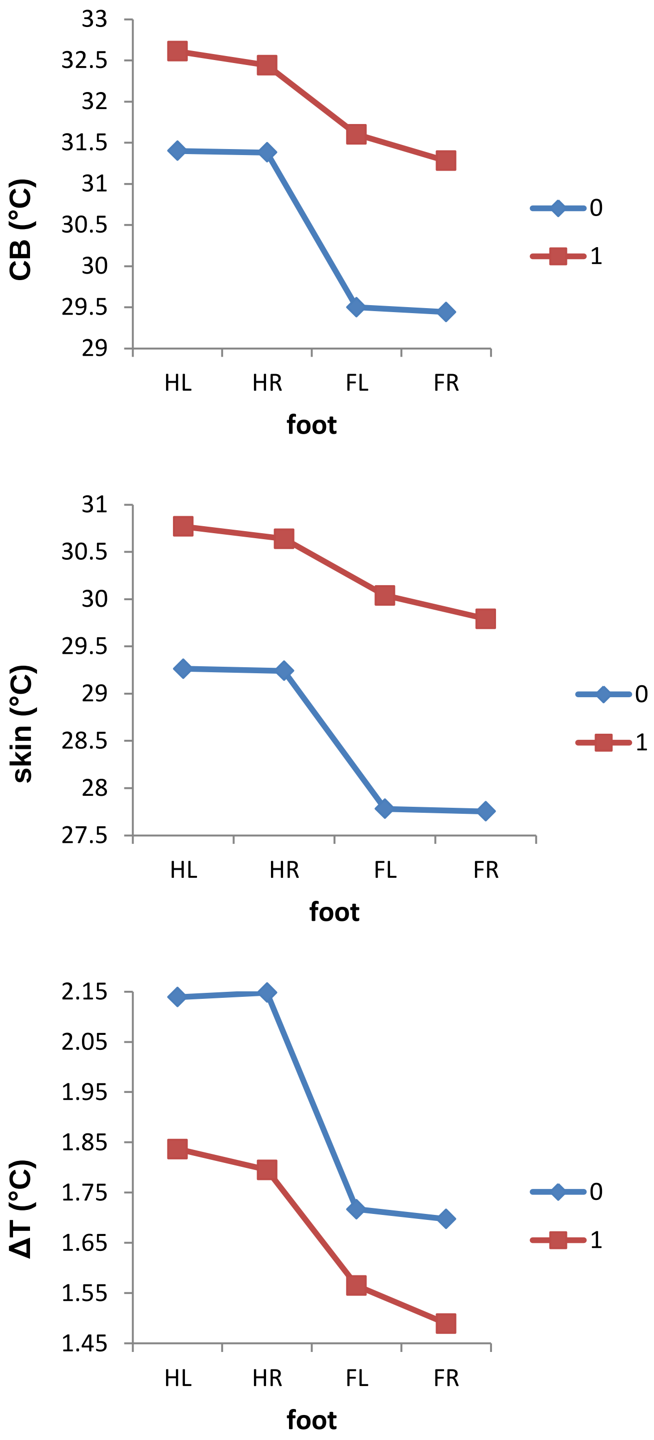


Figure 1. The maximum temperature at the coronary band (CB) and the skin (S) and ΔT between CB and S of 497 feet collected from 124 cows with (1) and without (0) infectious lesions of the fore and hind limbs before claw trimming.

18. Infrared Thermography for Lesion Monitoring in Cattle Lameness

S Wood[1], Y Lin[1], TG Knowles[1], DCJ Main[1]
[1]School of Veterinary Sciences, University of Bristol
Sarah.Harland@bristol.ac.uk

Introduction
Infrared thermography has been shown to be useful for diagnosing claw abnormalities in cattle (Alsaaod & Büscher 2012, Main, et al. 2012, Nikkhah, et al. 2005, Stokes, et al. 2012). As a non-invasive technique, this has the potential to be an effective method of lesion diagnosis, at an individual and herd level. In this study dairy cattle with claw lesions were monitored using infrared thermography to investigate the change in foot temperature over time and the effect of lesion treatment.

Material and Methods
A 990 cow dairy herd in Somerset was enrolled in the study. Data collection was carried out fortnightly for 6 months. Temperatures from both hind feet of every cow were collected in the parlour, using a handheld infrared thermometer. Cows were mobility scored by a trained assessor at the parlour exit using a 0-3 scale, and cows scored >2 were presented for lesion identification and treatment the next day.

Results
Data from 85 cows found to have a claw lesion at foot trimming were available for analysis.
Two level, multilevel analysis of the association between ambient temperature and foot temperature found that the former was a significant predictor of the latter (coefficient estimate [SE] = 0.277 [0.02]. Actual foot temperatures were calculated by adjusting for this covariate.
The 3 sessions (6 weeks) before and after treatment of the lesion were assessed and are plotted as Figure 1.

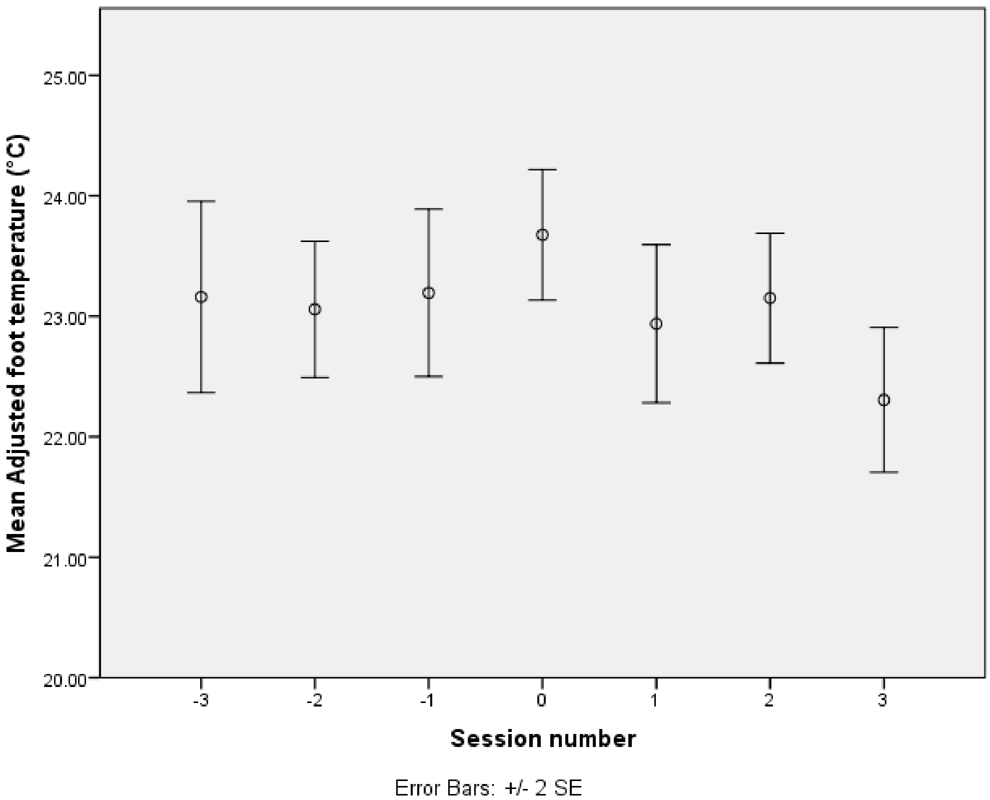


Figure 1 The foot temperature (adjusted to a standard 10 C ambient temperature) observed in feet with a lesion at time zero and for three recording sessions before and after identification of the lesion.

At the point of lesion identification, the adjusted foot temperature was highest (23.6°C ±2.25). A marked drop in temperature of the foot is evident after the lesion is trimmed, with the lowest temperature being recorded 6 weeks after treatment (22.3° ±2.09), this was significantly different to the point of lesion identification (p=0.003). The adjusted foot temperature was also significantly lower than the day the lesion was observed on the session immediately before (p=0.04) and after identification of the lesion (p=0.007).

Discussion
The hand held infrared thermometer is a non-invasive tool, practical for use on farm. Previous work has shown it to be useful in the identification of claw lesions at an individual and a herd level. In this study we show how temperature of the foot changes with time, with a significant decrease following treatment of the lesion. This can be accounted for by an improvement in pain and inflammation, associated with improving comfort for the cow and successful treatment of the lesion.

Acknowledgements
The authors would like to thank Jon Reader, Yvonne Critchell and Dave Frecknall for their involvement in this project.

References
Alsaaod M, Büscher W 2012 Detection of hoof lesions using digital infrared thermography in dairy cows. Journal of Dairy Science 95: 735-742.
Main DC, Stokes JE, Reader JD, Whay HR 2012 Detecting hoof lesions in dairy cattle using a hand-held thermometer. Veterinary Record 171: 504.
Nikkhah A, Plaizier JC, Einarson MS, Berry RJ, Scott SL, Kennedy AD 2005 Short communication: infrared thermography and visual examination of hooves of dairy cows in two stages of lactation. Journal of Dairy Science 88: 2749-2753.
Stokes JE, Leach KA, Main DC, Whay HR 2012 An investigation into the use of infrared thermography (IRT) as a rapid diagnostic tool for foot lesions in dairy cattle. Veterinary Journal 193: 674-678.

19. Is the within measurement variation of gait variables useful for early detection of cattle lameness using the GAITWISE ?

A. Van Nuffel[1], J. Vangeyte[1], K.C. Mertens[1], S. De Campeneere[2], L. Pluym[1], W. Saeys[3], G. Opsomer[4], S. Van Weyenberg[1]
[1] Technology and Food Science Unit, Institute of Agricultural and Fisheries Research; Burg. Van Gansberghelaan 115, 9820 Merelbeke; Belgium; [2] Animal Sciences Unit, Institute of Agricultural and Fisheries Research; Scheldeweg 68, 9090 Melle; Belgium; [3] Division Mechatronics, Biostatistics and Sensors, KULeuven, Kasteelpark Arenberg 30, 3001 Heverlee; Belgium; [4] Department of Reproduction, Obstetrics and Herd Health, Faculty of Veterinary Medicine, Ghent University, Salisburylaan 133, 9820 Merelbeke; Belgium.
annelies.vannuffel@ilvo.vlaanderen.be

Introduction
Studies on cattle lameness mainly focus on specific gait variables such as stride time, arched back, etc., assuming that these variables change when a cow develops lameness and therefore are able to indicate lameness. Indeed, several variables have shown to distinguish lame from non lame cows on group level (Chapinal et al., 2009; Maertens et al., 2011). At the individual cow level, analyzing how the (averaged) values of gait variables alter over time has predictive power for changes in lameness behavior (Pastell et al., 2008; and others).
In human gait research, stride to stride fluctuation as a reflection of gait inconsistency demonstrated to be more closely related to health problems than average gait speed, average stride length or other averaged variables over time (Hausdorff, 2005; and others). In this paper, such within measurement variations of gait variables were investigated for their potential in early detection of locomotion problems in cattle.

Materials and Methods
The measurements were performed at ILVO’s experimental farm with the GAITWISE system developed by Maertens et al. (2011). In a case-control study, the new inconsistency variables were compared between 17 ‘non-lame’ cows and 17 cows that were scored mildly lame by a trained observer but not yet noticed lame by the farmer (‘becoming lame’ cows). Approximately 70% of the lame cows were mildly lame at their left hind leg.

Results and Discussion
The new set of inconsistency variables were able to distinguish between non lame and becoming lame (mildly lame but not yet noticed by the farmer) cows. Indeed, these cows showed more variation in support on their left hind leg. The same could be seen in the inconsistency in placing their legs in the Y- direction and the timing of this placement, especially between left hind and right front legs and between left hind and right hind legs. This strong relationship between the localization of the lameness (70% at left hind leg) and the significantly changed variables, suggest that the variables measured by the GAITWISE could even be promising in defining which leg is developing lameness in cows.
In general, these results support the suggestion that variables of inconsistent gait within a measurement might be useful for early lameness detection.

References
Chapinal N, De Passille AM, Weary DM, von Keyserlingk MAG, Rushen J, 2009. Using gaitscore, walking speed and lying behaviour to detect hoof lesions in dairy cows. J. Dairy Sci. 92, 4365-4374.
Hausdorff JM, 2005. Gait variability: methods, modeling and meaning. J. Neurol. Rehabil., 2:19.
Maertens W, Vangeyte J, Baert J, Jantuan A, Mertens K, De Campeneere S, Pluk A, Opsomer G, Van Weyenberg S, Van Nuffel A, 2011. Development of a real time cow gait tracking and analysing tool to assess lameness using pressure sensitive walkway: The GAITWISE system. Biosystems Eng. 110, 29-39.
Pastell M, Hautala M, Poikalainen V, Praks J, Veermäe I, Kujala M, Ahokas J, 2008. Automatic observation of cow leg health using load sensors. Comput. Electron Agric. 62, 48-53.

20. Electronic hoof lesion data collection using the Accu-Trim Hoof Analyzer as a tool for monitoring, assessing and managing hoof health

K Burgi[1],TB Bennett[2], NB Cook[2]
[1] Dairyland Hoof Care Institute Inc., Baraboo, Wisconsin, USA; [2]School of Veterinary Medicine, University of Wisconsin, Madison, Wisconsin, USA
nbcook@wisc.edu

Introduction

As dairy herd expansion continues worldwide, the recording of routine hoof trimming and lameness treatment events becomes more challenging, yet these records are a vital component of successful herd management.
While chute-side paper records have been used by many trimmers successfully in smaller herds, their usefulness in larger herds is challenging by the sheer volume of data gathered. Rarely is this information transferred to the cow's permanent record in on-farm computer systems, making valuable information unavailable for analysis. While computer-recording systems have been available for several years (Pijl, 2004) for use chute-side, many of the early systems were cumbersome to use and not robust enough for daily use in all weathers. Additionally, these programs still suffer from inaccuracies in lesion recognition and inputting and the transfer of cow history data into and out of the program has been challenging. This abstract highlights the advantages of the new Accu-Trim Hoof Analyzer software system.

Materials and Methods

Accu-Trim software was developed in Visual Studio 2010 Professional with the main objective of simplifying data entry to improve accuracy of recording. Cow history data is simply transferred from farm management software using .csv file structure with a header row. Once the initial herd data is entered, lame, trim and re-check events maybe simply entered once the cow identification is selected. A single touch screen facilitates rapid entry of all information with the gloved finger or stylus (Figure 1). The affected limb is selected then lesion entry is based on the abc lesion identification system with particular emphasis on the 6 main claw lesions ((A= White Line Lesion, D= Digital Dermatitis, F= Foot Rot, S = Sole Fracture, T= Toe Ulcer and U= Sole Ulcer). For each lesion, a picture is presented representing up to 5 different severities and the correct lesion categorization is simply selected by touching the picture. After lesion entry, the hoof trimmer may select a treatment, action and a recheck period. Multiple lesions maybe entered for each foot in a matter of seconds.

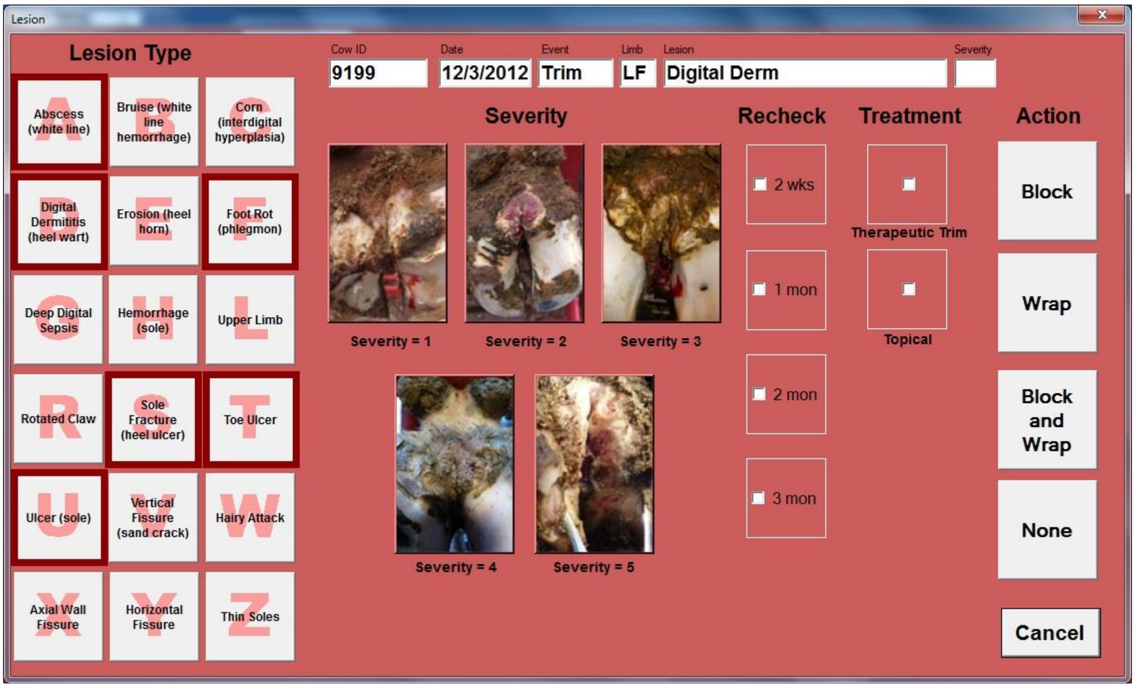


Figure 1. The lesion input screen in the Accu-Trim Hoof Analyzer.
At the end of the visit, data maybe transferred back to the on-farm management software, or analyzed and printed off within the program itself.

Analysis is available for whatever period of time is selected for the first lesion in a lactation, all lesions or lesions for either lame, trim or recheck events. The data can be presented by date and by days in milk and summarized in a table or in a histogram graphic (Figure 2). A particularly useful feature is the ability of the program to assess the persistency of lesions over time as a monitor of treatment efficacy.

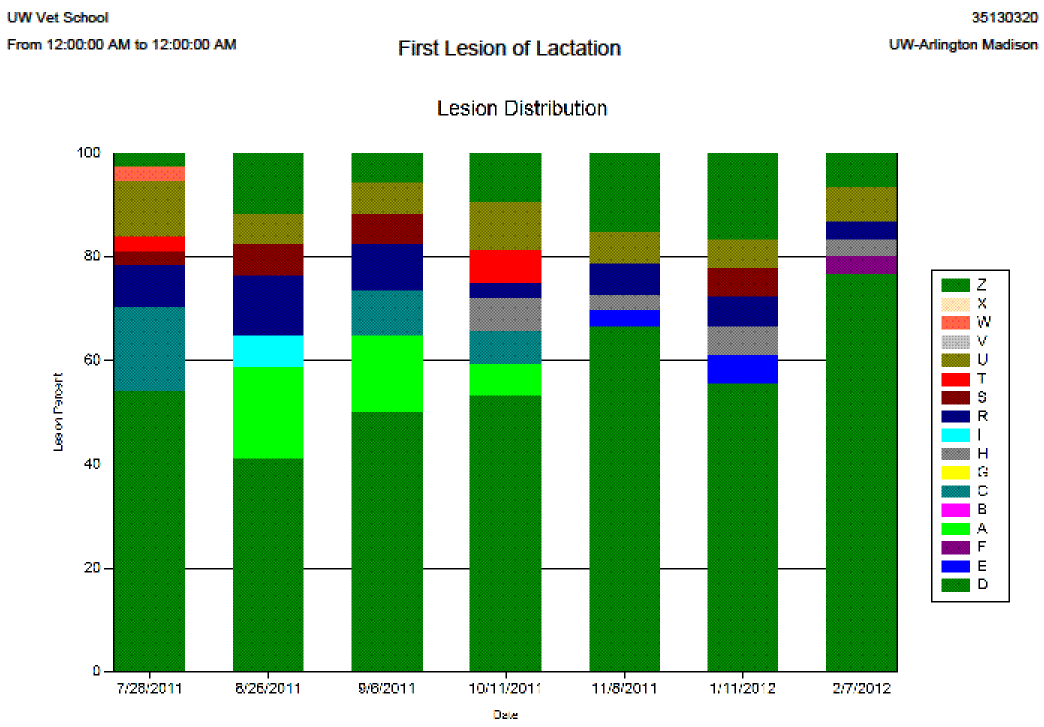


Figure 2. An example graphic of first lesion occurrence in a lactation by date, by lesion type. Note the increase in white line abscesses (A) in late summer.

Discussion

Accu-Trim hoof analyzer has been beta-tested in several long-term hoof lesion recording trials over the last 3 years and is now commercially available. This presentation will highlight some of the capabilities of the program and the analysis of hoof lesions over time.

References

Pijl R 2004 Electronic data recording during claw trimming. In: Proceedings 13th International Symposium and 5th Conference on Lameness in Ruminants Maribor Slovenia, pp 114–115.

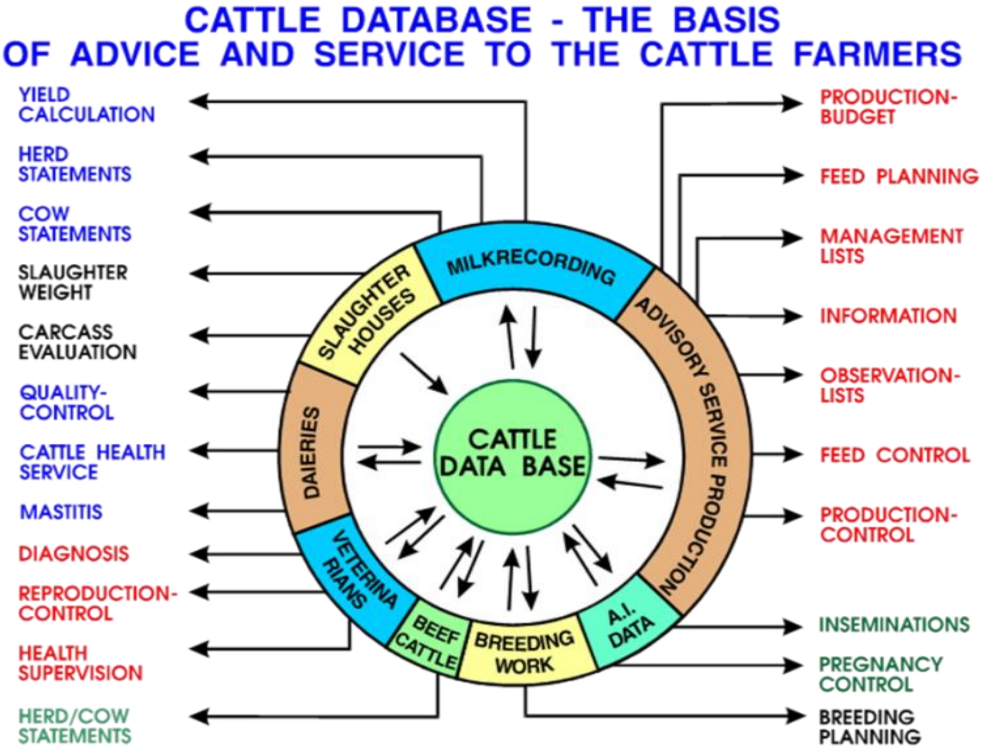
21. Claw health data recording and usage in Denmark

P Nielsen
Danish Cattle Federation
pin@vfl.dk

Most claw disorders have multifactorial etiologies. Therefore an affective prevention scheme needs both knowledge on claw health and data on lactation status and number as a minimum. In Denmark we use data on claw health for breeding, advisory service and scientific evaluations.

Program and Database
The Danish Cattle Database contains information about milk yield, reproductive status, health etc. (fig. 1).

The claw recording program can be used on any device with a Windows operating system. It is meant for claw trimmers ensuring the right diagnoses, but it may also be used by veterinarians and cattle farmers.



There is no need for internet while recording. When on-line the program can send data to The Danish Cattle Database where other data on the trimmed cows and the herd can be viewed together with claw data. The first trimmers started recording claw disorders in April 2010. Today about 50 % of the Danish trimmers record their findings during trimming. Data from about 1.2 million trimmings are now available in the cattle database.

Usage of Data
Breeding
In Denmark, claw recording data have been used for breeding purposes since autumn 2011. Today the claw recording program is co-owned by the Nordic countries Sweden, Finland, Norway and Denmark. The four countries have agreed upon common trait definitions so that experiences, research results and data for breeding can be shared across the borders.

Figure 1. The Danish Cattle Database

Advisory service
In management and advisory services, data on claw health have been used since spring 2010. Graphs and lists visualise the occurrence of different claw disorders and different amounts of a certain disorder in different groups of animals. By comparing the recordings for different groups of animals on a specific farm

the advisors can locate the problems (diagnosis and risk assessment) and make prevention schemes (action plans) based on the data.
On farms with a significant peak in sole haemorrhage 45-120 days post-partum the farmer should reconsider his management of animals around calving i.e. preventive trimming, soft bedding etc. (fig. 2).

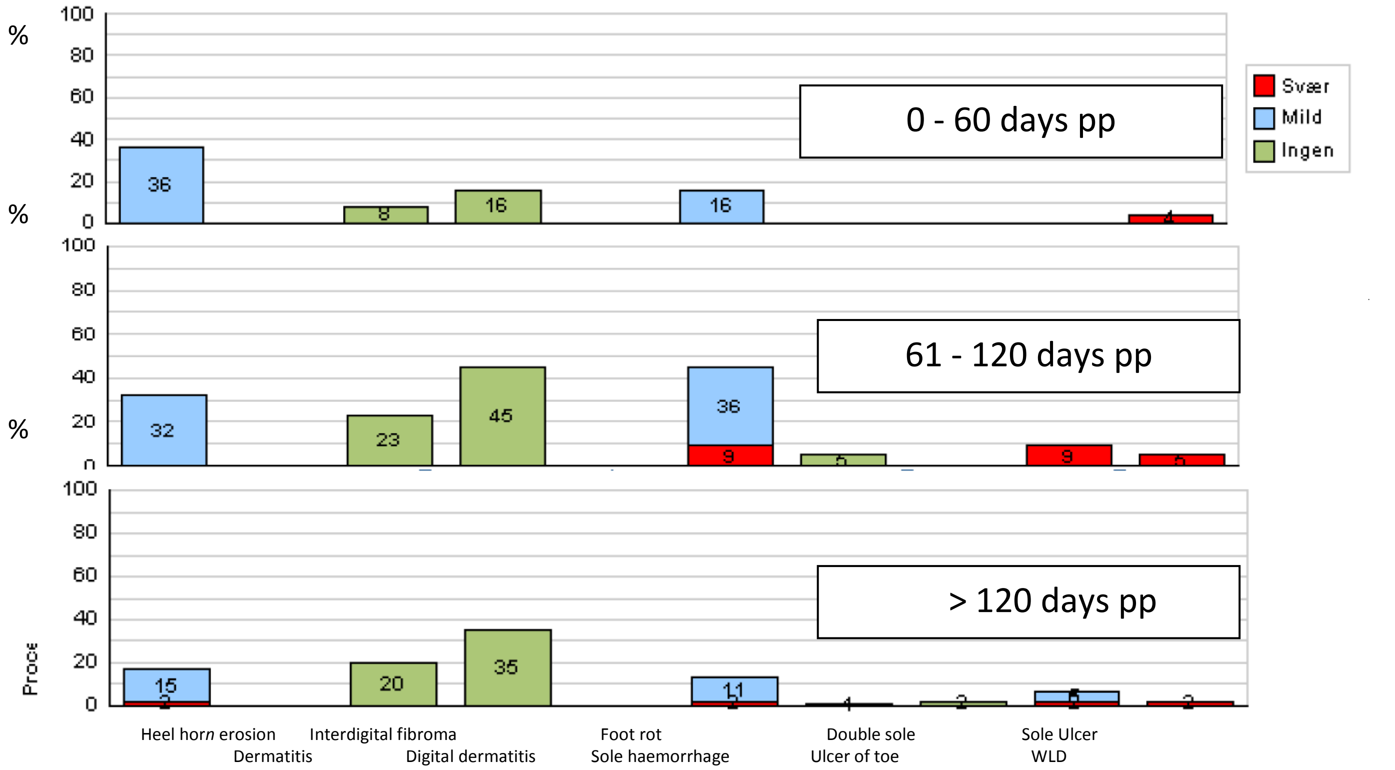


Figure 2. Claw disorders for three different lactation stages on a specific farm

On the other hand, on farms where many cows in late lactation suffer from sole haemorrhage attention should instead be focused on feeding problems, overcrowding, cubicle dimensions and rough handling.

Four to six month after the farmer has implemented the preventive action plan the advisor will make a follow up visit and evaluate the graphs showing the development in claw health over time (monitoring).

Scientific evaluations
Statistical analysis of trimming data available in the cattle database have enabled us to show

- interesting tendencies in trimming habits
- occurrence of different claw disorders in different lactations stages
- how claw disorders affect milk production, reproduction and cow mortality.

With regard to trimming habits Danish farmers tend to trim their cows in early lactation (fig. 3) whereas most disorders do not occur before 1½-2 months after calving – this is valuable knowledge for advisors.

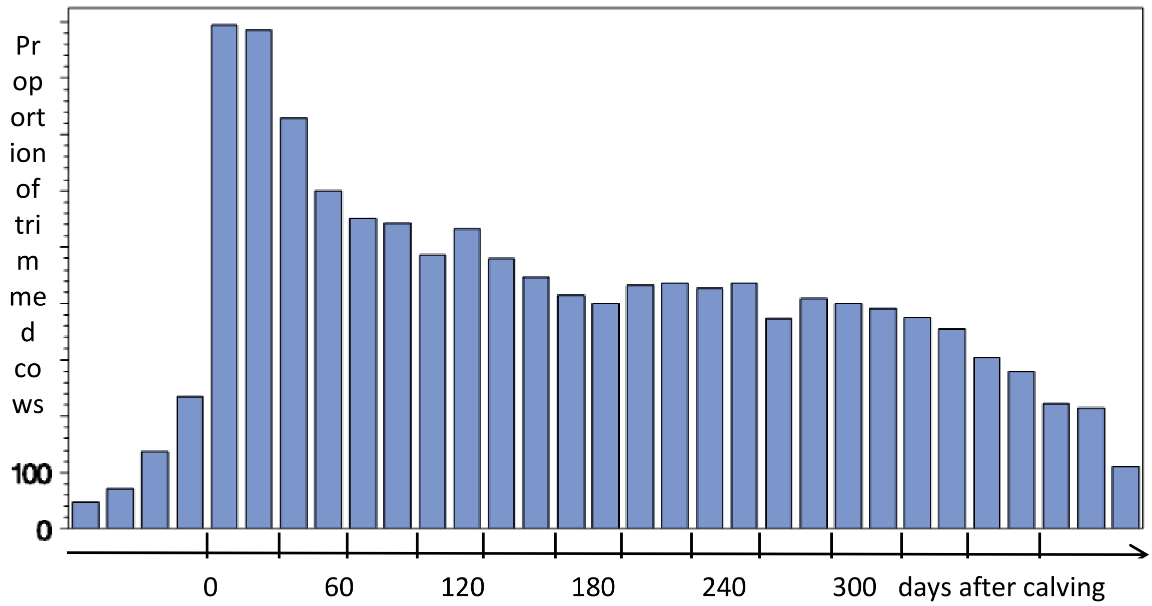


Figure 3. Cows trimmed proportional to calving

Finally, as claw disorders are recorded by more than 50 different trimmers, there is an ongoing need for intercalibration e.g. through workshops on recording.

22. Centralized Electronic Recording System of Claw Health Data in Spain: I-SAP

N. Charfeddine[1], J.L. Tejeda[1], A. Gonzalez[2], P. Codesido[3]
[1]Confederation of Spanish Friesian Associations; [2]ANKA Hoof Care, S.L.; [3]SERAGRO, Sociedad Cooperativa Galega
nouredine.charfeddine@conafe.com

Introduction

Lameness, after fertility and mastitis, is the most important cause for culling in Spanish dairy farms. It reduces productivity and also prejudices animal welfare.

In 2012, Spanish Holstein Association, CONAFE, implemented a centralized electronic recording system of 6 claw disorder traits (I-SAP), to improve claw health and reduce the incidence of lame cows in herds, through the analysis of this information and genomic selection for better claw health. Some preliminary results of data collected have been already obtained.

Materials and Methods

Description of I-SAP. CONAFE signed an agreement with ANKA Hoof Care Company, for developing a regular electronic recording system of claw health data, and another one for exchange of information, with SERAGRO, a Spanish service cooperative which has an own recording system for claw health data. CONAFE provides each trimmer a tactile PC-tablet and an application called DATPAT was developed by CONAFE for farm recording data and connection with the data base. Figure 1 shows one of the screens of DATPAT. Recording data relies on an easy procedure. Trimmers score 6 disease traits as mild or severe lesion for each claw: Dermatitis (DE), Sole Ulcer (SU), White Line separation (WL), Interdigital Hyperplasia (HP), Interdigital Phlegmon (PH) and Chronic Laminitis (CL).

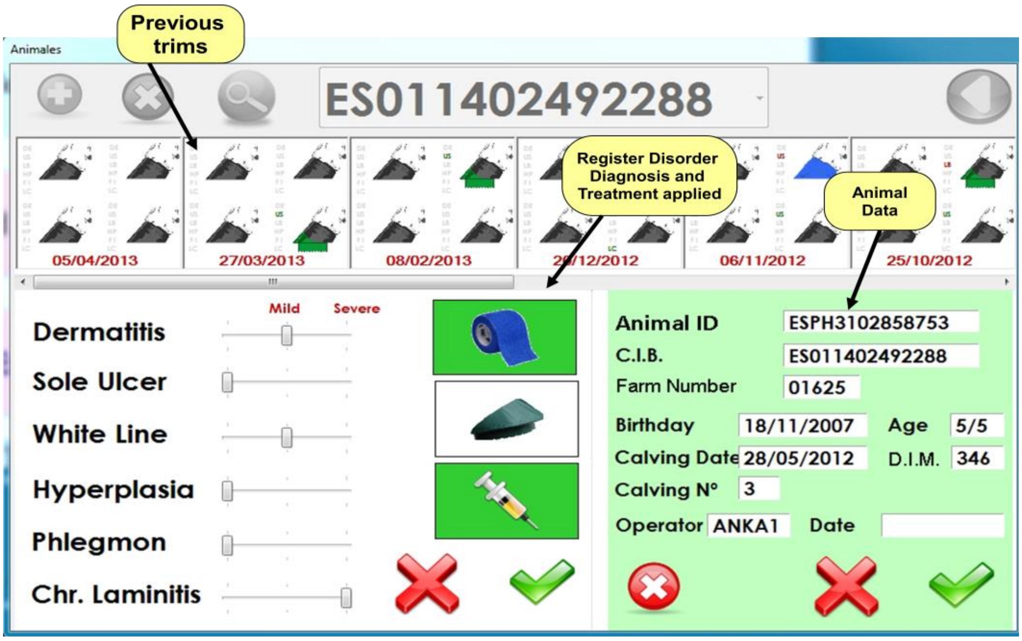


Figure 1 Registration of lesion severity and applied treatment.

After finishing the work, the claw trimmer delivers a summary report for the farmer (Figure 2). Moreover, farmers and foot trimmers can connect to the I-SAP data base through CONAFE web site, using own password to explore claw statistics on different levels (animal, visit, herd, regional or national).

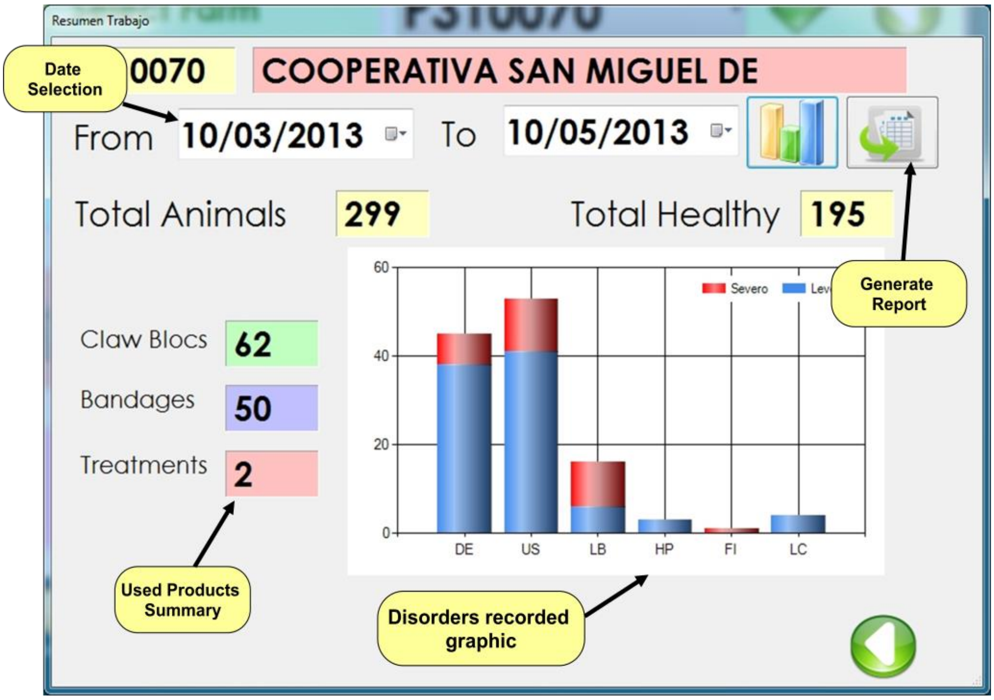


Figure 2 Summary report

Results

Prevalence of claw health disorders in Spanish population.

Claw trimming data from April 2012 to March 2013, including 95,156 records registered by 27 trimmers in 913 dairy herds, from routine and urgent visits, were used to calculate the observed prevalence rate within herd for the 6 claw disorders. After edition, final data set corresponds to 57,674 dairy cows (Table 1).

Table 1 Description of recorded data

	Herd Size	% Animal Trimmed	% Animal Healthy	Lactation			DIM	
				% 1st	**% 2nd**	**% 3rd or >**	**% ≥ 180d**	**% > 180d**
Mean	79	68.2	42.8	30.0	26.9	43.2	45.5	54.5
SD	71	31.5	23.2	13.8	10.5	15.6	13.2	13.2
Minimum	5	4	2	0	0	10	3	0
25 percentile	39	41	25	22	21	34	39	48
Median	60	81	39	32	26	40	46	54
75 percentile	95	96	57	38	33	50	52	61
Maximum	579	100	100	88	75	100	100	100

Table 2 Observed herd prevalence statistics mean within herds

		DE	SU	WL	HP	PH	CL
Herd prevalence	**Mean**	16.9	19.6	12.3	6.3	4.3	8.7
	SD	13.9	15.4	11.8	9.0	5.5	10.5
Within Herd prevalence	Minimum	1	1	1	0	0	0.1
	25 percentile	7	9	5	1	1	3
	Median	13	15	9	2	3	6
	75 percentile	23	25	15	7.5	5	11
	Maximum	82	83	63	25	25	53

Average rates (table 2) showed wide range as reported in the literature (Häggman and Juga, 2012). If non trimmed cows are considered as healthy, average incidence rates for DE, SU, WL, HP, PH and CL within herd, were lower: 11%, 11.8%, 6.7%, 2.1%, 5.4% and 1.9%, respectively. The mean (±SD) herd prevalence of cows with at least one lesion was 57.2±23.2%.

Conclusion

I-SAP is managed for improving claw health in dairy cattle in Spain. Today, many farmers demand this service from their trimmers because it provides them with valuable management information.

Reference

Häggman J, J Juga 2012 The genetic correlation between different claw disorders in Finnish Ayrshire cows. INTERBULL BULLETIN NO. 46 Cork, Ireland

P9(a). Locomotion score of cows as a strategy for the control and prevention of lameness

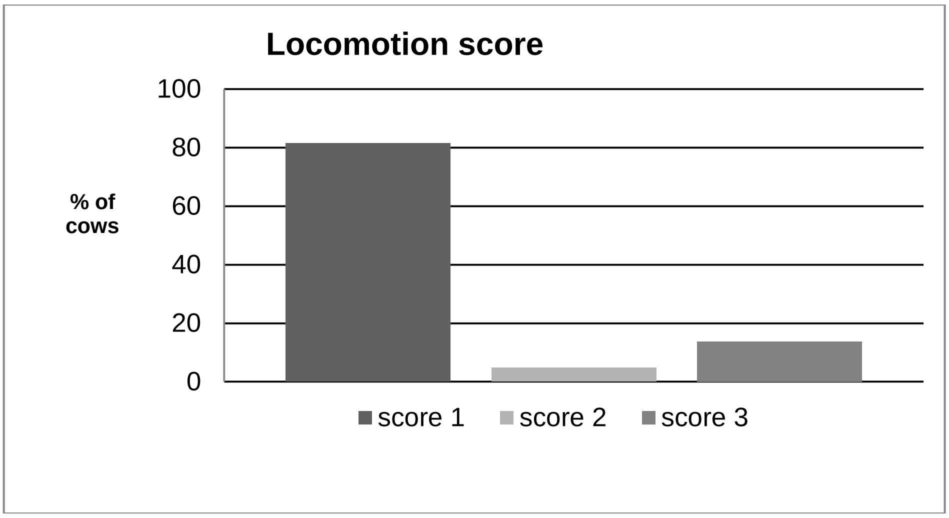
F Galleguillos[1], J Borkert[1]
[1]Borkert y Cía Ltda. Osorno, Chile
fgalleguillos@cuidatuvaca.com

Introduction
Locomotion scoring (LS) is a tremendous tool in the prevention and control of lameness. The LS permits us to diagnose the total number of lame cows in the herds, including the subacute lame cows, so that farmers can define the goals and objectives to tackle the problem.

Objective
Implement the allocation of locomotion score with a scale of 1, 2 or 3 to stratify the herd according to their locomotion.

Material and Methods
A group of 11829 lactating cows from 23 herds in the X region of Chile were observed during March of 2011 on the way out of the milking parlour. These cows were classified according to their locomotion score as 1, 2 or 3 (1 = normal, 2 = abnormal movement with arched back, 3 = abnormal movement with evident limb pain and lameness). The idea was to use a simplified scale to incorporate monthly LS and collect periodical information to determine the most critical periods for lameness. LS Data were entered to EXCEL and compared between farms.

Results
Of the 11829 cows, 81.5% presented a LS grade 1, 4.7% had a LS grade 2 and 13.7% presented evidence of LS Grade 3.



Conclusion
The allocation of locomotion scoring gives relevant information about evident and subacute lame cows, so it could be possible to prioritize the evaluation and treatments of LS grade 3 cows and then examine the LS grade 2 cows. The 13.7% of grade 3 cows is similar to the prevalence described in recent works carried out in Chile (Borkert, 2010). This data corresponds on many occasions to the information obtained from the farmers, which under estimate the number of lame cows in their herds. Finally, LS is a tool that farmers could use and record periodically, so they could estimate periodical incidences and determine what the most critical periods for lameness are and be prepared to control and prevent this issue at these times.

P9(b). Development of a weighted visual lesion scoring system to assess the severity of claw horn lesions in dairy cows

HJ Thomas[1], D Byron-Chance[1], G Miguel Pacheco[1], JN Huxley[1]
[1]University of Nottingham, School of Veterinary Medicine and Science, Sutton Bonington Campus, Leicestershire LE12 5RD.
stxht1@nottingham.ac.uk

Introduction

Recent work in the field of cattle lameness has emphasised the need for early and effective treatment of claw horn lesions. This pilot study was designed to establish a means of grading sole haemorrhage (SH), sole ulceration (SU) and white line disease (WLD) lesions in newly lame cows by their visual severity and determine whether visual severity had an impact on clinical recovery.

Materials and Methods

Photographic and diagrammatic records of claw horn lesions were taken following a five stage, therapeutic foot trim. Fortnightly locomotion scoring allowed animals to be identified as newly lame prior to trimming and lameness to be assessed at two and four weeks post treatment.

A prospective, weighted visual lesion scoring system was established in consultation with a panel of eight, cattle veterinary specialists. Five lesion categories were created as a basis for scoring; SH size, SH severity, SU severity, WLD length and WLD severity. Each of the five categories was assigned a scale of zero to three (0=no lesions present, 1=mild lesion, 2=moderate lesion, 3= severe lesion). The specialists were asked to independently weight the biological significance of lesions, both within each category scoring scale and between categories. A value of 1 was pre-assigned to a mild lesion in each category and to the category 'SH severity' as a baseline. Using the values obtained across the experts, an average weighted score was established to determine the relative significance of a score 1, 2 or 3 within each category and also to determine the relative significance between categories.

Weighted visual lesion scores (WVLS) were determined for each claw on 77 photographs taken at the time of trimming. Lesions were categorised then graded as mild, moderate or severe and given a weighted score. Each category score was then multiplied by the category weighting to give an overall WVLS for the claw.

Results

Table 1. Weighted scores for claw horn lesions and categories

Category	Weighting			
	Mild	Moderate	Severe	Category
SH size	1	2	4	1
SH severity	1	2	5	1
SU severity	1	5	13	7
WLD severity	1	2	5	5
WLD length	1	2	4	3

Table 1 shows the weightings given to the biological significance of lesions within each category and between categories. High WVLS at time of trimming were significantly associated with higher mobility scores at the time of trimming (P=0.02). There was no difference in the WVLS at trimming between animals which were lame and non-lame (i.e. recovered animals) at two weeks post treatment (Figure 1). At four weeks post treatment, animals which were non-lame recorded significantly lower (P<0.001) WVLS at the time of trimming (Figure 2).

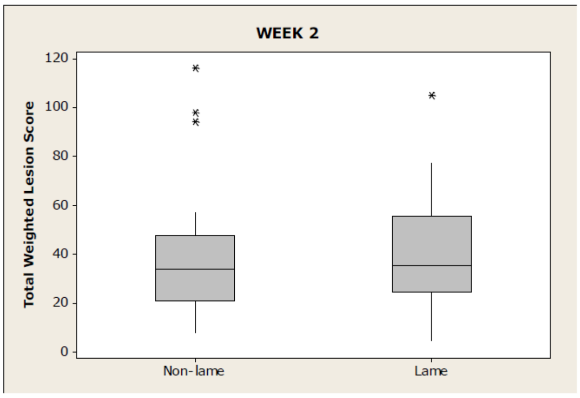


Figure 1. WVLS (at trimming) of animals which were lame and non-lame at week two post treatment

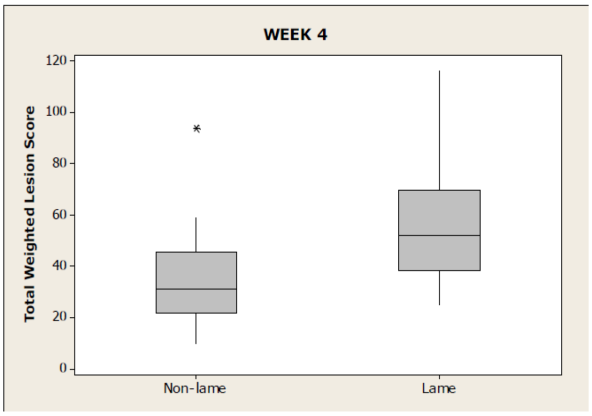


Figure 2. WVLS (at trimming) of animals which were lame and non-lame at week four post treatment

Discussion

Preliminary results suggest 'specialist' perceptions of the biological significance and WVLS developed are relevant to the clinical situation. Using the scoring system, cows with more severe lesions were shown to be significantly more likely to be lame at four weeks post-trimming than those with mild lesions. Such information may be of value in determining management of individual animals post-treatment. Further investigation of the dataset to is required to fully elucidate the impact of claw horn lesion severity on recovery following a therapeutic trim.

P10(a). Farmers opinions concerning lameness detection systems compared to oestrus detection systems

A. Van Nuffel[1], P. Briene[2], J. Vangeyte[1], K.C. Mertens[1], W. Saeys[3], S. Van Weyenberg[1]
[1] Technology and Food Science Unit, Institute of Agricultural and Fisheries Research; Burg. Van Gansberghelaan 115, 9820 Merelbeke; Belgium; [2] University College Ghent, Faculty of Science and Technology; Brusselsesteenweg 116, 9090 Melle; Belgium; [3] Division Mechatronics, Biostatistics and Sensors, KULeuven, Kasteelpark Arenberg 30, 3001 Heverlee; Belgium
annelies.vannuffel@ilvo.vlaanderen.be

Introduction
Besides mastitis and fertility problems, lameness is seen as one of the main health problems for dairy cattle. Several detection systems for mastitis and estrus are already successfully on the market, detection systems for lameness however are less successful. This might be caused by the farmers' underestimation of lameness prevalence on their farms (Leach et al., 2010) and by the fact that the economical consequences of a lame cow are less obvious for a farmer compared to mastitis (loss of milk) and fertility problems (missed estrus) (Bruijnis 2012; Leach et al., 2010). To better understand the farmers' opinions, a pilot study was carried out to see whether the farmers shift the importance of detection-characteristics depending on which of these disease they find most important.

Materials and Methods
An oral survey with 15 questions was performed on Agriflanders, a bi-annual fair for and by Flemish agriculture. Two hundred and four dairy farmers answered the questions. The main questions are summarised in the table below.

Main questions of questionnaire

Number of cows	/
Milking system used	Conventional Milking Parlour Automatic Milking System
Please order the following health problems in order of priority for detection (1 = most important; 3 = less important)	Lameness Mastitis Fertility problems
Do you use a sensor for estrus detection?	Yes / No
Do you visually check your cattle for signs of lameness or estrus?	Yes / No
Please order the following characteristics of a oestrus detection system / lameness detection system in order of priority (1 = most important; 5 = less important)	Low cost Ease of use Little false alarms All cows in heat get detected Yes / No

Results and Discussion
Not surprisingly, the majority of the farmers pointed to mastitis (37.5%) and fertility problems (34.1%) as most important diseases. Lameness was the top priority of only 22.1% of the farmers in this study. Almost 4% of the farmers quoted the three diseases as equally important.
Surprisingly however, the percentage of farmers that claim to regularly check their cows for lameness was higher in the group of farmers that revealed lameness as second or third important disease compared to the group of farmers that saw lameness as top priority. 'Little false alarms' seemed highly relevant for lameness detection systems, whereas 'decreased workload' seemed highly relevant for oestrus detection systems. 'Detection of all cows' was equally important for both detection systems but 'ease of use' and 'low cost' were more important for a lameness detection system compared to oestrus detection.

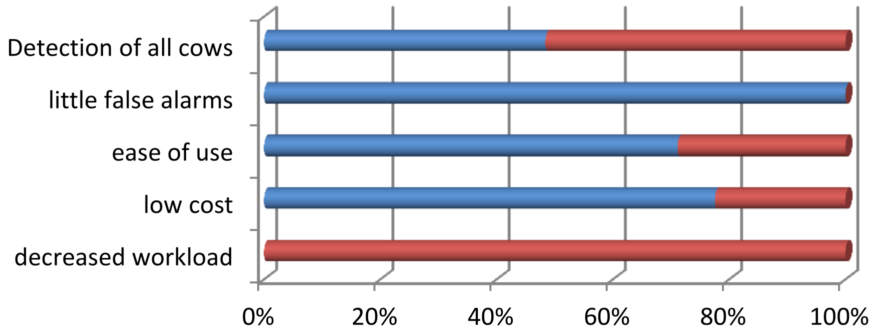


Figure 1. % of farmers that quoted the characteristics as top priority for a lameness detection system (blue) and a sensor for cows in heat (red).

These findings show some primary results and this questionnaire will be ameliorated and expanded in the near future.

References

Bruynis M., 2012. Foor disorder in dairy cattle. PhD thesis, WUR (NED), 174p.

Leach KA, Whay HR, Maggs CM, Barker ZE, Paul ES, Bell AK, 2010. Working towards a reduction in cattle lameness: 1. Understanding barriers to lameness control on dairy farms. Research in Veterinary Science 89, 311-317.

P10(b). Animal suitability index and lameness in dairy farms in Saxony, Germany

AM Englisch[1], E Ullrich[3], U Bergfeld[3], J Fleischer[4], U Roesler[2], KE Mueller[1]
[1] Clinic for Ruminants and Swine, [2]Institute of Animal Hygiene and Environmental Health Freie Universitaet Berlin; [3] Saechsisches Landesamt für Umwelt, Landwirtschaft und Geologie [4] Saechsischer Landeskontrollverband e.V.
annemarie.englisch@fu-berlin.de

Introduction
Inappropriate housing and management are putative causes for the increasing lameness prevalence in indoor kept dairy cows. Andersson et al (1994) developed an animal suitability index (TGI 200/1994) for cattle as an on farm assessment tool for housing conditions and management based on the evaluation of seven spheres of influence, namely walking, feeding, social, resting and comfort behavior, hygiene and care. The objective of this work was to evaluate animal suitability applying this tool as well as mobility scoring and scoring of hock lesions.

Material and Methods
Ten dairy farms (380 -1400 cows, milk yields 8,500 - 11,700l) were visited in 2011/2012. We evaluated the animal suitability (TGI 200/1994) including space allowance, cubicle dimensions, feed bunk space, water supply, walking surface conditions, etc. for each lactation group separately. Scoring was performed for mobility (Sprecher et al.1997) and hock lesions (Welfare Quality Network 2009) on 100 cows per farm.

Results
Cows were kept in free stall barns with cubicles either on slatted or concrete floors. Conditions for dry cows included access to pasture, deep straw bedding and cubicles. The results of the TGI 200/1994 are shown in Table 1. Maximum score 200 points, with 200 points being the ‘best’ score.

Table 1. Results TGI 200/1994 in different lactation groups

Farm	fresh cows	high yielding	late lactation	dry cows
1	86-89	86	86	x
2	115	113-114	113-116	161
3	121	98	99	x
4	111	112	111	x
5	94-104	104	110	126-140
6	107-110	109	96-97	111-115
7	88-90	88-93	88-91	x
8	x	118	122	105-112
9	101	78	94	x
10	113-115	101-109	100	127-148

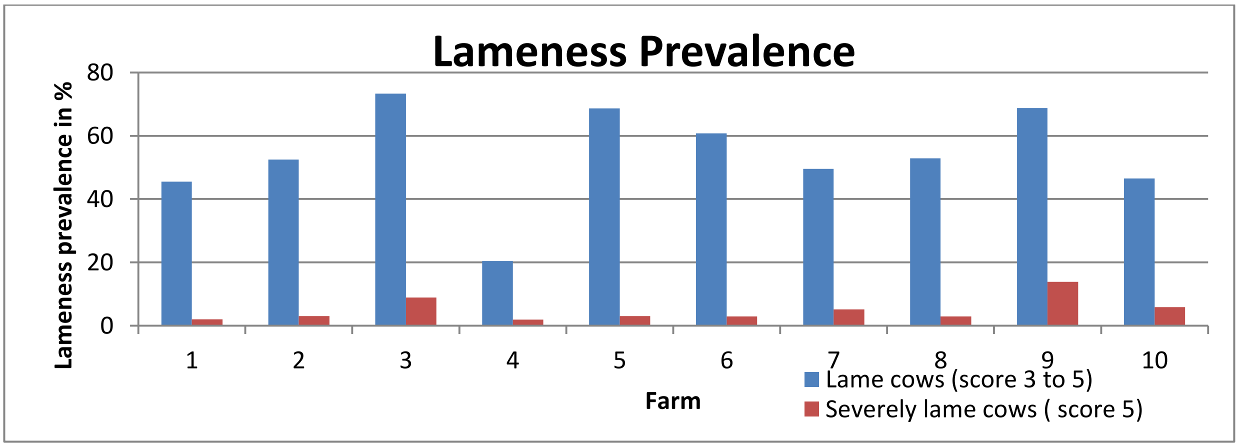


Figure 1. Lameness prevalence per farm

Prevalence of clinical lameness (scores 3 to 5) varied from 20.4% to 73.3% (mean 53.89%).1.9 to 13.8% (mean 4.95%) of the cows were scored severely lame (Figure 1). Prevalence of hair loss in hocks ranged from 14.55 to 95.1% on farm level (mean 66.94%), 4.5 to 59.8% of the animals had hock ulcerations (mean 35.08%) and 24 to 84.85% of the hocks were swollen (mean 59.94%) (Figure 2).

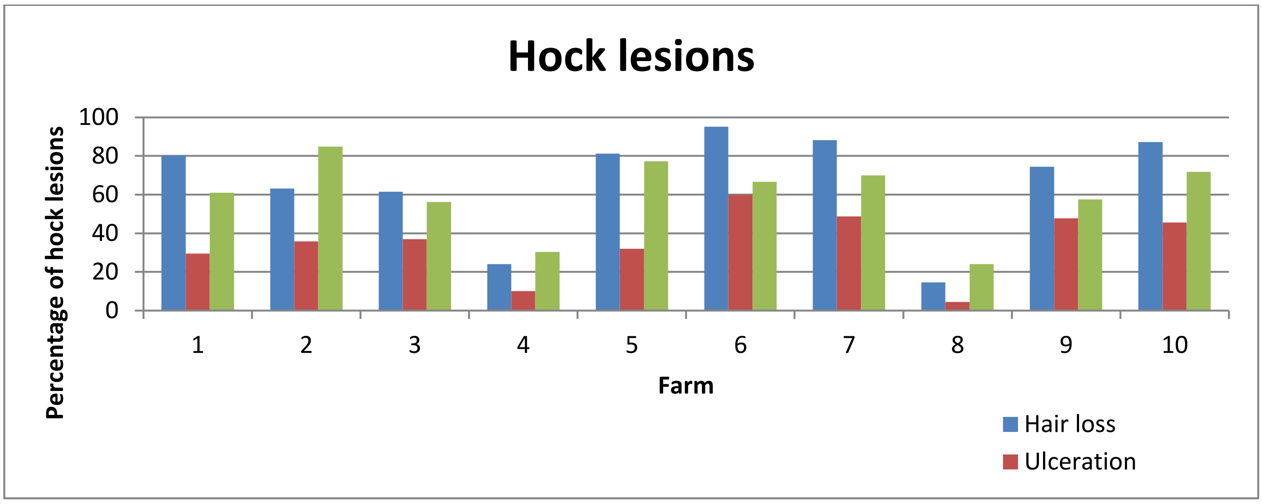


Figure 2. Hock lesions per farm.

Discussion

Prevalence of lameness and hock lesions was high but varied considerably between farms. None of the farms undercut the target value of 9% for clinically lame cows. (Esselmont and Kosaibati 1996). Maximum animal suitability index points were not attained due to high stocking density, insufficient cubicle design and feed bunk space. Shortcomings were mainly observed in high lactation groups. Considering the frequent changes of group constellations in large farms the TGI 200/1994 seems to be more suitable for counseling rather than for benchmarking farms.

Acknowledgments

This research work was supported by SMUL Sachsen and LKV Sachsen.

References

Andersson R, Postler G, Schneider H, Striezel A, Sundrum A 1994 Tiergerechtheitsindex für Rinder. In: Tiergerechtheitsindex – 200 1994 Ein Leitfaden zur Beurteilung von Haltungssystemen pp 30-59. Köllen Druck + Verlag GmbH, Bonn, Germany

Esselmont RJ, Kossaibati MA 1996 Incidence of production disease and other health problems in a group of dairy herds in England. Vet Rec 139: 486-490

Sprecher DJ, Hostetler and Kaneene JB 1997 A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology. 1997 Apr 15;47(6):1179-87

von Keyserlingk MA, Barrientos A, Ito K, Galo E, Weary DM 2012 Benchmarking cow comfort on North American freestall dairies: lameness, leg injuries, lying time, facility design, and management for high-producing Holstein dairy cows. Journal of Dairy Science 95(12):7399-408

Welfare Quality Network 2009 Welfare Quality® Assessment protocol for cattle. http://www.welfarequality.net/network/45848/7/0/40

P11(a). Effect of Danish and Canadian hoof trimmer's training on quality of hoof health records

RP Kviesgaard[1], N Capion[2]
[1] Boehringer Ingelheim, Denmark, [2] Faculty of Health and Medical Sciences, University of Copenhagen
ritapalmelund@hotmail.com

Introduction

Professional Danish hoof trimmers (both certified (CTs) and uncertified (UTs)) have been making digital records of foot lesions during regular trimming of dairy cattle since 2010. The CTs have had specialized training in lesion identification and severity scoring. In The Ontario Dairy Hoof Health Project from 2012, Canadian hoof trimmers (TTs) received three days of training in standardized lesion identification before starting the digital data recording (Daniel, 2012). By using a gold standard, it is possible to compare the quality of trimming records of Danish and Canadian trimmers respectively. The study objective was to evaluate the effect of training of Danish and Canadian hoof trimmers on the quality of their trimming records.

Materials and Methods

In this blinded study, 13 randomly selected Danish trimmers were included; five CTs, eight UTs plus additional five TTs. The ability to recognize and score lesions was tested on minimum 150 cows during routine trimming and on 20 photographs. The results were compared to the gold standard. Lesions were identified on the basis of observations of the skin and claws as described in the trait definitions (Greenough and et al 2011, Nielsen, personal communication). Inter-observer agreement between the trimmer and the gold standard was calculated as weighted kappa (K).

Results

Records from 2,437 cows were included in the study. In general, the trimmers had higher agreement when recording sole ulcers, digital dermatitis, and interdigital hyperplasia compared with heel erosion, sole hemorrhages, and white line lesion. Disagreement was most often due to no recordings of a lesion rather than discrepancy in the severity. There was neither a correlation between inter-observer agreement and years of trimming experience, nor time of data collection. There was neither consistency in K for individual trimmers, nor for trimmers working in pairs compared with trimmers working alone. When using lesion scoring photographs the trimmers performed acceptably.

Discussion

An amplified severity guide with more pictures of each lesion and severity may improve record quality. Several studies have suggested that inter-observer agreement increases with practice (Manske et al. 2002 Thomsen and Baadsgaard, 2006 Capion et al 2008). Annual standardization of the trimmers could be a way to unify records. Under field conditions the trimmers did not perform according to their ability. The tendency was interpreted as trimmers having a lower motivation for recording clinically less important lesions. Trimmers with a high motivation for recording tended to make trimming records of higher quality compared with trimmers who had lower motivation, regardless of education. In conclusion, there is no effect of hoof trimmer's education on quality of hoof health records.

Acknowledgements

The author wishes to thank trimmers, farmers, friends, and family for their help. A special thanks to Vic Daniel for exceptional hospitality, discussions, and encouragement. The study received funding from Viking Genetics, PLAN-Danmark, Oticon fonden, and Dansk Klovbeskærerforening.

References

Capion, N, Thamsborg SM & Enevoldsen C 2008 Prevalence of foot lesions in Danish Holstein cows. Veterinary Record163: 3 80-86
Daniel V 2012 Ontario dairy hoof health project. http://www.ontariohoofhealth.ca/OHHDfinal.pdf. Accessed 30.05.2013
Greenough P, Koster E, Spence P, Geier R, Hofstra M, Hansma T, Bell D and Bremer E 2011 Lesion severity scoring guide http://www.ontariohoofhealth.ca/LesionSeverityGuide.pdf. Accessed 30.05.2013
Manske T, Hultgren J & Bergsten C 2002 Prevalence and interrelationships of hoof lesions and lameness in Swedish dairy cows. Preventive Veterinary Medicine 54: 3 247-263
Thomsen P & Baadsgaard N 2006 Intra- and inter-observer agreement of a protocol for clinical examination of dairy cows. Preventive Veterinary Medicine 75:133-139

P11(b). Advantages and pitfalls of using recordings from hoof trimming in Danish vet-practice

K Bach
Faculty of Health and Medical Sciences. University of Copenhagen
kurtbach@sund.ku.dk

Since the spring of 2010, 42 out of approximately 100 Danish hoof trimmers have recorded diseases and abnormalities in the claws during trimming in dairy herds. These recordings are uploaded to the national cattle database where farmers, nutritionists and veterinarians can access the data to get an overview of hoof health problems on a given farm. Recording of data provides an important source of information and is a valuable tool for farmers and consultants' work on identifying problems in the herds. However, recording is voluntary for the trimmer and before using the data, it is important to have a critical look at how it is made. The following observations are based on experiences of the author during work in cattle practice.
Data is presented as prevalence of different hoof diseases at the time of trimming for the whole herd as well as for different parities or stages of lactation. However, crude prevalence does not display what happens between two trimmings and it does not reveal whether one cow did not improve since last trimming or if it is a new case in a new cow. The data only gives a snap shot picture of the claw health in the given herd on the day of the trimming.

If the trimmer records on several visits the data can also provide an indication of the development of claw health in the herd. If changes are observed from one trimming to the next, it is important to notice if changes in management have been introduced on the farm. Changes in feeding, the moving of cows to pasture, new cleaning routines of the floor can have real effects on claw health. But the introduction of a new hoof trimmer who has different recording routines can also influence the data. If these factors are not taken in to account, and interpreted correctly, incorrect conclusions could be drawn.
When the problems are described, the next step is to identify the causes of the problems. In an ideal setup the farmer, nutritionist, trimmer and veterinarian as a team should go through all the aspects of management and housing. The thorough investigation should include feed, bedding, floor hygiene, sharp edges and bolts on the walkways and observation of handling around milking and also calving. It can be helpful to take photos and videos and then discuss the findings afterwards.
The consultants should talk to the trimmer about the recordings before drawing to many conclusions. This discussion should preferably take place on the farm on the day of the trimming, so both parties can agree on their observations. Important questions to clarify are e.g: Does the trimmer record everything, or only the more serve cases? Are there two different trimmers on the same farm that doesn't agree about the diagnoses? Is the trimmer too busy to make proper recordings? #

Conclusions

Recordings from trimming are a valuable tool to create an overview and to monitor the hoof health in the herd. This Danish practice of collecting data in a central database which can be combining with information about stage of lactation and parity is unique. Prevalence as a measure has its limitations. It would be preferable to have an incidence rate too, as a measure of what happens over time. Finally, recordings are never more accurate, than the trimmer that makes them and therefore it is crucial to have a good dialogue between the hoof trimmer and the consultant.

P12(a). Application of a computerised hoof trimming database program for monitoring the claw health of dairy cows over consecutive visits

J Kofler[1], R Pesenhofer[2]
[1]Department of Farm Animals and Veterinary Public Health, Clinic for Ruminants, University of Veterinary Medicine Vienna, A-1210 Vienna, Austria, [2]Claw Trimming Practice Robert Pesenhofer, A-8151 Hitzendorf, Austria
Johann.Kofler@vetmeduni.ac.at

Introduction

Lameness is an important animal welfare issue and ranked as the third highest cause for economic losses in dairy farming. Nevertheless, continuous claw health monitoring in dairy herds is not yet widely established. One substantial reason could be that computerised documentation and analysis of claw data is rarely applied *(*Shearer et al 2004*).*
The aim of this study was to present a program for monitoring the claw health of dairy herds over a defined time period using the computerised hoof trimming database program "Klauenmanager".

Material and Methods

The data of 557 cows were documented electronically during routine hoof trimming at ten dairy farms. The cows' feet were trimmed two and three times with intervals of five to twelve months. The data of these 23 visits were analysed automatically for the following parameters: prevalence of claw lesions, severity scores, lameness, Cow-Claw-Score (CCS), Farm-Claw-Score (FCS) and Farm-Zone-Score (FZS)*.* The CCS is the sum of the geometrically calculated severity scores of the lesions in all 10 zones of all eight claws in one cow (Greenough & Vermunt 1991; Leach et al 1998; Smilie et al 1999). The FCS is the median of all CCS of a herd (Huber et al 2004). The FZS is the total of all CCS of all cows in a herd for each particular claw zone (Kofler et al 2011). The chronological progression of the CCS and FCS values was illustrated graphically.

Results

At the first visit, the lameness prevalence ranged between 5.0% and 78.9%. The mean prevalence of claw lesions in all ten herds was 62.4% for heel horn erosion (HHE), followed by white line lesions (WLL, 33.6%), sole haemorrhages (SH, 27.2%), and acute stages of digital dermatitis (DD, 16.7%). The prevalence of these lesions varied distinctively between herds. However HHE (n=10), WLL (n=9), SH (n=10), acute DD (n=4) and chronic laminitic claws (n=2) were consistently within the three most frequently observed lesions.

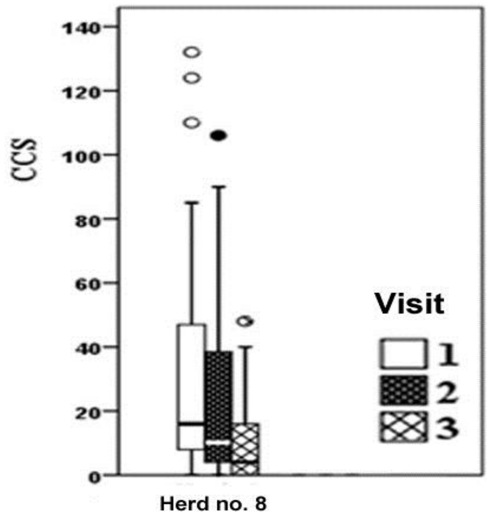


Figure 1. Graphical presentation of the CCS values at the trimming visits 1, 2 and 3 of the cows of one herd: The bold line within the boxes indicates the median (=FCS). The upper whiskers and circles represent the upper 25% of the CCS values.

The CCS ranged from zero (CCSmin) to 276 (CCSmax), the FCS ranged from six to 72. The CCS of the cows of eight herds improved significantly from the first to the second visit. A statistical improvement of the locomotion scores was assessed in four herds. The FCS was reduced in seven herds at the second visit, in two herds the FCS remained constant, and in one herd the FCS increased slightly. Boxplot graphs enabled a simple and practical overview of the chronological progression of CCS values of a herd.

Discussion

Computerised claw trimming database programs provide the basis for claw trimmers and veterinarians to establish a modern claw health monitoring program. Moreover it facilitates an integrated herd health monitoring program using network interfaces which allow the combination of claw health data with the monthly milk record data and reproductive parameters. The numerical parameters CCS and FCS enable an easy way to monitor claw health data of one herd over time or a comparison of claw data of different herds. The FZS parameter is helpful to identify the most severely and most frequently affected claw zones in a herd, which enables to elucidate potential risk factors for these claw lesions (Kofler et al., 2011, 2013).

References

Greenough PR Vermunt JJ 1991 Evaluation of subclinical laminitis in a dairy herd and observations of associated nutritional and management factors. Veterinary Record 128: 11 17.

Huber J Stanek C Troxler J 2004 Effects of regular claw trimming in different housing systems. In: Proceedings of the 13th International Symposium on Lameness in Ruminants, pp. 116–117, Maribor, Slovenia.

Kofler J Hangl A Pesenhofer R Landl G 2011 Evaluation of claw health in heifers in seven dairy farms using a digital claw trimming protocol and program for analysis of claw data. Berliner Muenchener Tieraerztliche Wochenschrift 124: 10–19.

Kofler J Pesenhofer R Landl G Sommerfeld-Stur I Peham C 2013 Monitoring of dairy cow claw health status in 15 herds using the computerised documentation program Claw Manager and digital parameters. Tieraerztliche Praxis 41 (G): 31-44.

Leach KA Logue DN Randall JM Kempson SA 1998 Claw lesions in dairy cattle: methods or assessment of sole and white line lesions. The Veterinary Journal 155: 91-102.

Shearer JK Anderson D Ayars W et al 2004 A record-keeping system for capture of lameness and foot-care information in cattle lameness. Bovine Practitioner 38: 83-92.

Smilie RH Hoblet KH Eastridge ML Weiss WP Schnitkey GL Moeschberger ML 1999 Subclinical laminitis in dairy cows: use of severity of hoof lesions to rank and evaluate herds. Veterinary Record 144: 17–21.

P12(b). Results of training 15 dairy administrators and 27 farm trimmers on theoretical evaluation and locomotion scoring in dairy farms in southern Chile

J Borkert, F Galleguillos
Borkert y Cía. Ltda., Hoof Trimming Company, Osorno, Chile.
jborkert@cuidatuvaca.com

Introduction

The presence of lameness in dairy herds is an important concern. One of the solutions to this problem is prevention and early diagnosis of the abnormality in locomotion of cows. Making an early intervention can reduce lameness and avoid the negative evolution of the cases and economic losses as well as helping to animal welfare.

Objective

To present the results of the theoretical evaluation of lameness in dairy cows and the result of the locomotion score of 15 dairy administrators v/s 27 employees in dairy herds in southern Chile.

Material and Methods

A group of 42 people were trained (16 hours total), half theory and half practice, in a dairy farm in 2 days. Two weeks later, a theoretical test was administered to those people (50 questions with alternatives). The dairy administrators and the employees (farm trimmer) had to do the locomotion score in the dairy herds. With that information, two results of locomotion score were obtained, one from the dairy administrator and one from the employees. The evaluated cows and people who participated belonged to 15 dairy farms. The training period was carried out in the 10^{th} region of Chile in November of 2010. The data gathered of the evaluation and locomotion score was processed in Excel.

Results

From the theoretical evaluation, administrators got better results on functional trimming and locomotion score than employees. On the other hand, the employees got better results on injuries identification and treatments (Figure 1). Furthermore, when both groups did the locomotion score the dairy administrators identified 29% of score 3 v/s employees who identified only a 3% of score 3 finding here big difference (figure 2).

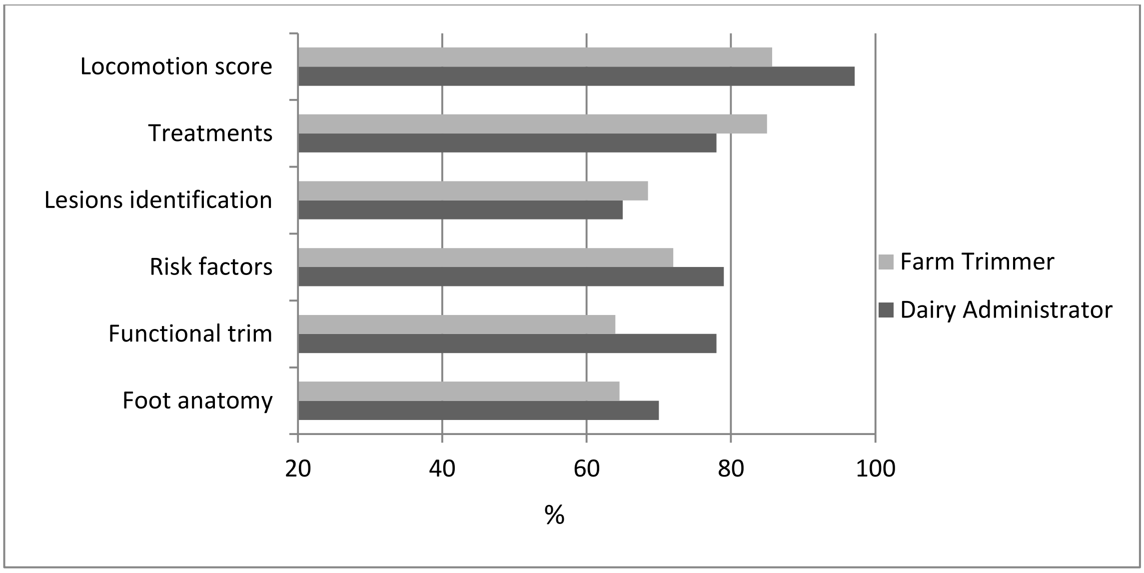


Figure 1. Result by concepts of the theoretical evaluation done by dairy administrator and farm trimmer.

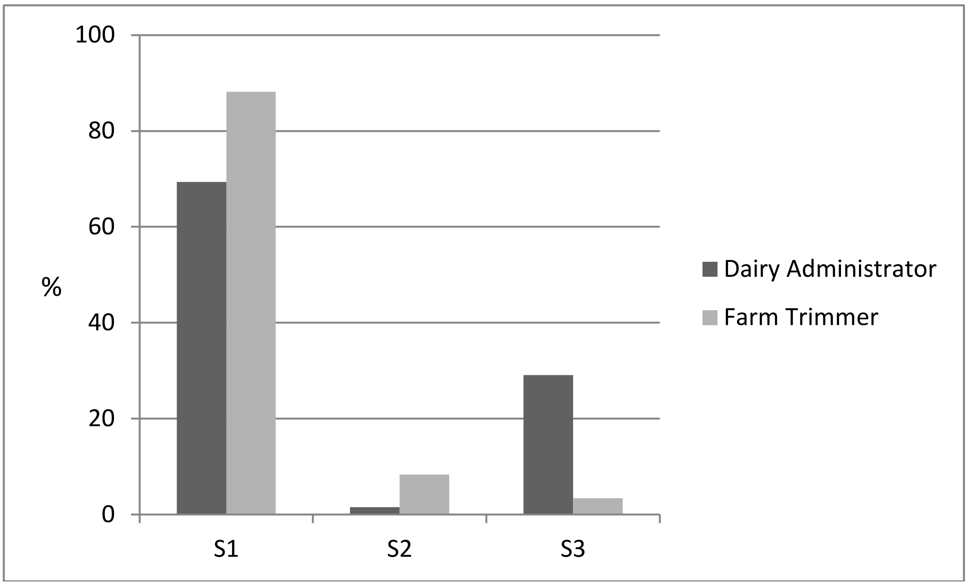


Figure 2. Differences in locomotion score between dairy administrators and farm trimmers in lactating cows from dairy herds in southern Chile.

Conclusion

The results of the theoretical evaluations show the weaknesses and strengths of the training period in both groups and the areas to be enhanced. We observed big differences in locomotion score in both groups which show who were better at lameness identification and who underestimate the issue. Maybe the answer is that the farm trimmer in this farms win the same salary with more or less lame cows, in this case they prefer work less for the same money. But for other hand the administrator is very interesting in the economic result for this reason every health problem with the dairy is important for them. Finally that the farm trimmers did not understand the locomotion score and not applied correctly.

P13(a). Novel lameness detection by using hand-held infrared thermometer device

Y Lin[1], S Wood[1], S Mullan[1], DCJ Main[1]
[1]Department of Clinical Veterinary Science, University of Bristol
Yichun.Lin@bristol.ac.uk

Introduction

Lameness is one of the most serious economic and welfare issues in the dairy industry (Green et al., 2002). Detecting lameness early can be difficult but providing treatment at early stage is important (Whay et al., 2003). The efficacy of the infrared thermograph camera has been previously shown (Alsaaod & Buscher, 2012; Stokes et al., 2012). In this study a cheaper portable infrared thermometer was tested as an alternative. The objective of this preliminary study was to examine the relationship between mobility score, foot temperature and ambient temperature.

Materials and Methods

The study was carried out on one farm (herd size=990 cows) and visits to the farm were carried out once every two weeks for six months. The temperatures of both hind feet of all milking cows were measured by infrared thermometer during afternoon milking in the parlour. Additionally, the mobility of each cow was scored by a professional using the DairyCo 4-point scale (0, 1, 2, and 3) as the cows exited the parlour. Ambient temperature was recorded once at the start of each milking session.

Table 1 Summary of data collected for each visit

Visit		1	2	3	4	5	6	7	8	9	10	11	12	Mean
Mobility score 0 (%)		63.25	65.66	68.72	69.08	66.09	62.25	57.58	58.08	58.92	57.05	60.52	54.61	61.82
Mobility score 1 (%)		32.26	30.17	27.11	26.78	30.45	33.68	37.12	37.02	35.66	38.07	35.06	39.55	33.58
Mobility score 2 (%)		4.49	4.18	4.17	4.14	3.46	4.07	5.30	4.90	5.42	4.88	4.42	5.84	4.61
Ambient temperature (^{0}C)		6	7	12	13	10	12	10	21	14	21	17	23	13.83
Mean temperature of left feet (^{0}C)		21.92	21.12	23.14	24.17	22.57	21.78	22.35	25.53	22.19	24.87	24.48	25.77	23.32
Mean temperature of right feet (^{0}C)		21.63	20.73	23.09	23.92	22.19	21.78	21.95	25.53	22.18	24.70	24.31	25.54	23.13
Mean temperature of maximum (^{0}C)		22.83	21.78	23.81	24.81	23.20	22.49	22.87	26.01	22.75	25.26	24.87	26.10	23.90
Number above 25.5 ^{0}C		224	140	281	397	217	143	181	612	97	379	357	610	303.17
Temperature of mobility score 0 (^{0}C)	Mean	22.65	21.53	23.64	24.66	22.98	22.38	22.83	25.94	22.69	25.27	24.73	25.94	23.77
	±s.e.m	0.46	0.16	0.13	0.11	0.14	0.13	0.14	0.09	0.20	0.08	0.10	0.09	0.15
Temperature of mobility score 1 (^{0}C)	Mean	23.30	22.23	24.06	25.06	23.35	22.52	22.82	26.11	22.83	25.24	24.94	26.20	24.06
	±s.e.m	0.21	0.22	0.18	0.18	0.18	0.16	0.19	0.10	0.12	0.11	0.14	0.09	0.16
Temperature of mobility score 2 (^{0}C)	Mean	23.80	22.89	25.15	26.14	25.48	23.63	23.44	26.62	24.03	25.59	25.45	26.91	24.93
	±s.e.m	0.48	0.50	0.40	0.45	0.36	0.30	0.44	0.25	0.27	0.29	0.35	0.21	0.36

Results

Foot temperature ranged between 7°C-32°C(Mean±SEM=23.83±0.03°C) and ambient temperature ranged between 6°C-23°C(Mean±SEM=13.99±1.60°C), shown in Table 1. Over 12 visits 62%, 33% and 5% of the 11891 assessments of the cows recorded mobility scores of 0(not lame), 1(mildly lame) and 2(moderately lame) respectively. No cows were recorded as score 3(severely lame). For assessments where cows had mobility scores of 0, 1 and 2 the mean foot temperature was 23.77±0.15°C, 24.06±0.16°C and 24.93±0.36°C respectively and the mean differential between right and left foot temperature was 1.35±0.02°C, 1.25±0.02° and 1.65±0.08°C respectively.

A one-way ANOVA test showed that there was a significant difference between the foot temperature of cows with each mobility score (P<.001) and a significant difference between the differential between both feet temperature (P<.001) for cows with each mobility score. Furthermore, a positive correlation was demonstrated between foot temperature (R^2=0.151, P<.001) and ambient temperature and a negative correlation between the temperature differential between both feet of a cow (R^2=0.049, P<.001) and ambient temperature in Figure 2.

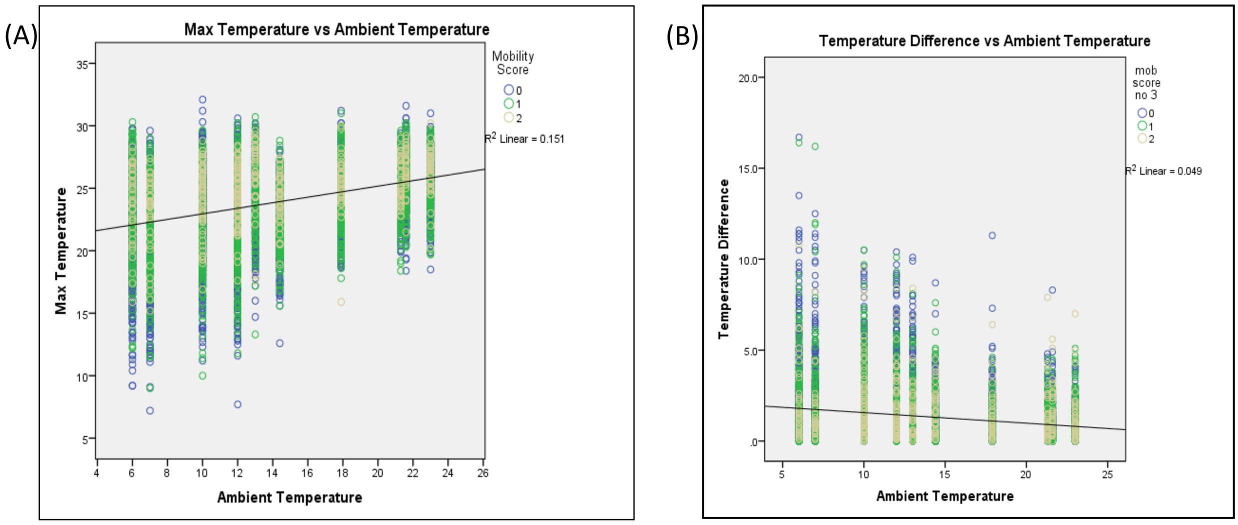


Figure 2A & 1B Figures of ambient temperature versus maximum temperature and temperature difference between left and right foot. (A) Distribution of the maximum temperatures between right foot and left foot at different ambient temperatures with a correlation coefficient of determination of 0.151. (B) Distribution of the temperature differences between right and left foot at different ambient temperatures with a correlation coefficient of determination of 0.049.

Discussion

The infrared thermometer was able to demonstrate increasing foot temperature with increasing lameness. Work is ongoing to validate this method as an on-farm lameness detection tool to account for the confounding effect of ambient temperature, which may be reduced if the temperature differential between right and left feet is used.

References

Alsaaod M,Buscher W 2012 Detection of hoof lesions using digital infrared thermography in dairy cows. Journal of Dairy Science 95(2), 735-742

Green LE, Hedges VJ, Schukken YH, Blowey RW, Packington AJ 2002 The impact of clinical lameness on the milk yield of dairy cows, Journal of Dairy Science 85(9), 2250-2256

Stokes JE, Leach KA, Main DCJ, Whay HR 2012 An investigation into the use of infrared thermography (IRT) as a rapid diagnostic tool for foot lesions in dairy cattle. Veterinary journal 193(3), 674-678

Whay HR, Main DCJ, Green LE, Webster AJF 2003 Assessment of the welfare of dairy cattle using animal-based measurements: direct observations and investigation of farm records. Veterinary Record 153(7), 197-202.

Acknowledgments

The authors would like to thank the farmer, stock-people and mobility scorer who participated in this study and Jon Reader who assisted us.

P13(b). Inter-observer agreement between foot trimmers on foot lesions in cattle

JER Rossiter[1], S Van Winden[2], M Burnell[3], NJ Bell[2]
[1]Pomice Cottage, Filford, Bridport, Dorset, DT6 5JW; [2]The Royal Veterinary College, Stinsford Farmhouse, Kingston Maurward College, Stinsford, Dorchester DT2 8PY; [3]Synergy Farm Health Ltd, West Hill Barns, Evershot, Dorset DT2 0LD
njbell@rvc.ac.uk

Introduction
Lameness in dairy cattle has been increasingly recognised as an important economic and welfare issue for the dairy industry. The majority of lameness cases are caused by foot lesions (Murray et al. 1996) and it has been suggested to target lesion-specific causes of lameness in a herd (Amory et al 2008), rather than making generalised preventative changes. Drawing conclusions about the epidemiology and risk factors for specific lesions from existing studies is problematic. In order to research the epidemiology and risk factors for specific causes of lameness further, a standardised protocol for categorising foot lesions is needed. Furthermore, the use of paraprofessional foot trimmers is becoming increasingly popular, meaning lesion-specific herd management changes and future research studies will rely on their recording ability. The aim of this study was to evaluate the inter-observer agreement between five foot trimmers from one vet practice when recording foot lesions in cattle.

Materials and Methods
The assessment was carried out using a picture quiz including six photographs each of 13 different lesions. Each observer was compared with a gold standard which was set by a veterinary practitioner. Percentage agreement (sensitivity), specificity and kappa statistic were calculated for each lesion and the strength of agreement was determined.

Results
Table 1 shows the kappa values, specificity and percentage agreement for each lesion and the strength of agreement according to Burn et al (2009) reliability rating scale. Alternative lesion names recognised internationally are given in brackets but were not presented to foot trimmers.

Lesion	Sensitivity/ Percentage Agreement (%)	Specificity (%)	Kappa value	Strength of Agreement
Horizontal fissure	93	100	0.94	Excellent
Sole ulcer	90	95	0.7	Substantial
White line	87	95	0.66	Substantial
Toe necrosis	83	99	0.81	Excellent
Sole bruising (sole haemorrhage)	80	99	0.8	Substantial
Sandcrack (vertical wall fissure)	77	99	0.79	Substantial
Bulb infection (deep digital sepsis/heel abscess)	67	98	0.69	Poor
Interdigital growth (interdigital hyperplasia)	67	99	0.7	Poor
Sole separation (double sole)	60	99	0.66	Poor
Sole penetration	43	97	0.47	Poor
Digital dermatitis	40	96	0.37	Poor
Foul (foot rot/ interdigital necrobacillosis)	40	98	0.44	Poor
Slurry heel (heel horn erosion)	30	99	0.38	Poor

Discussion

Finding poor observer agreements is useful in alerting us to the need to improve training for foot trimmers or redefine the categorisation of these lesions. The variable results between the lesions emphasises the importance of recording inter-observer agreement when carrying out studies focussing on specific foot lesions.The specificity of the lesion scoring was high, suggesting that when a lesion is identified, it is identified correctly. The low sensitivity for some lesions suggests that a lot of lesions are missed by the foot trimmer or may reflect the limitations of assessing a lesion by looking at a photo rather than seeing, smelling or touching the foot and observing the pain response of the cow during examination.

Acknowledgements

Thank you to the foot trimmers who participated in this study.

References

Amory JR, Barker ZE, Wright JL, et al. 2008 Associations between sole ulcer, white line disease and digital dermatitis and the milk yield of 1824 dairy cows on 30 dairy cow farms in England and Wales from February 2003–November 2004. In: Preventive Veterinary Medicine 83:381-391.

Burn CC, Pritchard JC, Whay HR. 2009 Observer reliability for working equine welfare assessment: problems with high prevalences of certain results. Anim Welfare 18:177-187.

Murray RD, Downham DY, Clarkson MJ, et al.1996 Epidemiology of lameness in dairy cattle: description and analysis of foot lesions. Vet Rec 138:586-591.

P14(a). Relationship between Locomotion Score and Milk Yield and Composition in Holstein Dairy Cows

I Akin[1], N Silva-del-Río[2]
[1] Adnan Menderes University Veterinary Faculty Department of Surgery, Aydın, TR; [2] VMTRC, University of California Davis, Tulare, CA, US
ibraak@adu.edu.tr

Introduction
Previous studies have evaluated the effect of hoof lesions on milk production (Bicalho et al., 2008; Warnick et al., 2001). However, there is no information on the impact of lameness on milk yield and composition. On dairies, lameness can be easily recognized by using a locomotion scoring system (Sprecher et al., 1997). The objective of this study was to evaluate the effect of locomotion score on milk yield and milk composition [fat (%), protein (%) and Somatic Cell Count (SCC)].

Materials and methods
In March 2013, six Holstein dairies in Tulare County, California were visited within 2 d of the Dairy Herd Improvement Association milk test-day. Cow's locomotion score (LS) was evaluated by a single individual at the exit of the milking parlor. Dairies enrolled in the study ranged in size from 800 to 3,000 cows. Cows (representing 27.5% to 72.7% of the herd) were evaluated and classified based on the Sprecher et al. (1997) locomotion scoring system as: normal (LS=1), mildly lame (LS=2), moderately lame (LS=3), and lame or severely lame (LS=4&5). Information on lactation number, DIM, milk yield (kg), milk fat (%), milk protein (%), and SCC (cells/mL) was obtained from March 2013 DHIA records. The final data set included complete information from 3,022 cows (LS1, n=1907; LS2, n=718; LS3, n=248; LS4&5, n=149). Statistical analyses were conducted with the MIXED procedure of SAS with herd included as random. SCC data was log transformed. Milk yield and composition were adjusted by DIM and lactation number.

Results
Moderate, lame and severely lame cows had lower milk yield than non lame cows. However, milk protein (%), milk fat (%) and SCC was not affected by locomotion score. Least square means of milk yield, milk fat, milk protein, and SCC are presented in Table 1.

Table 1 Effects of lameness score on milk yield (kg), protein (%), fat (%) and SCC (cells/mL)

	LS1	LS2	LS3	LS4&5	*P*-value
Milk Yield (kg)	36.2	35.4	33.3	33.3	0.0006
Protein (%)	3.11	3.11	3.15	3.15	0.167
Fat (%)	3.72	3.66	3.72	3.75	0.172
SCC (cells/mL)	318	294	349	340	0.955

Discussion
Previous studies have reported mixed results on the impact of hoof lesions on milk yield. However, when evaluating lameness at the time of the DHIA test moderate, lame and severely lame cows produced 3 kg less than non lame cows. Lame cows may have a different eating and resting behavior that may result on differences not only in milk yield but also in milk composition; however, based on our results lameness score does not seem to be a factor that impacts milk composition.

Acknowledgments
We would like to thank the six dairies enrrolled in the study, AgriTech Analytics (Visalia, CA) and DHIA-Tulare for their cooperation in the study.

References
Bicalho RC, Warnick LD, Guard CL 2008 Strategies to Analyze Milk Losses Caused by Diseases with Potential Incidence Throughout the Lactation: A Lameness Example. Journal of Dairy Science 91:2653–2661
Sprecher DJ, Hostetler DE, Kanneene JB 1997 A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 1997, 47:1179-1187
Warnick LD, Janssen D, Guard CL, Gröhn YT 2001 The effect of lameness on milk production in dairy cows. Journal of Dairy Science 84:1988–1997

Session 5

Treatment of Claw Lesions

23. Recovery rates of different lesion classes following early treatment

M Groenevelt[1], DCJ Main[1], D Tisdall[1], NJ Bell[2]
[1] University of Bristol, School of Veterinary, Langford House, Langford, Bristol, UK, BS40 5DU, [2] The Royal Veterinary College, Stinsford Farmhouse, Kingston Maurward College, Dorchester, Dorset, UK, DT2 8PY
margit.groenevelt@bristol.ac.uk

Introduction

Although lameness is thought to be a disease with a high impact on welfare, research still shows long treatment delays (Leach et al 2012, Whay et al 2002). It has been proposed that early treatment of lame cows would result in better cure rates (Bell 2006). This paper reports the effect of early treatment on different lesion classes.

Materials and Methods

Two weekly mobility scoring (score 0 – 3, DairyCo 2013) was carried out over the housing period on four dairy farms for three consecutive years. Cows on each farm were paired for parity and stage of lactation and randomly assigned to a treatment (TX) or a positive control (CX) group. Animals became eligible for participation once they had had two consecutive sound scores (0 or 1) followed by a lame score (2 or 3). The TX group was treated by the trained researcher 3 – 48 hours after being scored lame. All normal foot treatments continued on the farms as per usual.

The primary lesion considered to cause lameness was recorded. Distinction was made between claw horn lesions (CH), soft tissue lesions (ST) and upper leg lameness (UL). Combinations of these were also recorded.

Results

A total of 171 animals were included in the TX group. Sole hemorrhage (41%) and digital dermatitis (33%) were the lesions most commonly found. Severe lesions such as sole ulcer and toe necrosis were found in 6.5% of cases. CH lesions were found to be the sole cause of lameness in 51% (88) of cases. ST lesions were found to be the sole cause of lameness in 13% (22) of cases and 33% (56) of cases had a combination of CH and ST lesions. 2% (4) of cases were thought to be upper leg lameness and 1% (1) no lesions were found. Animals with only ST lesions showed highest recovery rates (86%) two weeks after initial treatment. In the animals with only a CH lesion recovery rates peaked at 6 weeks (79%) after initial treatment the recovery rate for both ST and CH groups is similar, 72 and 75% respectively. In the group that had both ST and CH lesions the recovery rate was 73% 2 weeks after initial treatment but dropped to 64% at 6 weeks.

Discussion

When lame cows are treated within 2 weeks of becoming lame, recovery rates can be higher than when treated under a conventional treatment regime (Leach et al 2012). Early treatment could result in the cows having less severe lesions as sole hemorrhage (41% of cases) compared to sole ulcers which can be found in up to 40% of cases under more conventional circumstances (Murray et al 1996, Leach et al 2012).

It is unclear what underlies low recovery rates when both CH and ST lesions are found. It could be possible that CH lesions become infected or that the animal has acquired a CH lesions due to altered gait to reduce painful locomotion. It does, however, accentuate the need to adopt measures to prevent both CH and ST lesions when dealing with a herd lameness problem.

Acknowledgements

The authors would like to thank the generous funding of the Dartington Cattle Breeding Trust, the support of the participating farmers and the support of the Tubney Charitable Trust.

References

Bell NJ 2006 The alleviation and prevention of lameness in dairy heifers. PhD Thesis, University of Bristol
DairyCo 2013 Mobility scoring: early detection. http://www.dairyco.org.uk/technical-information/animal-health-welfare/lameness/husbandry-prevention/mobility-scoring/early-detection/(accessed 24 April 2013)
Leach KA, Tisdall DA, Bell NJ, Main DC and Green LE 2012 The effects of early treatment for hindlimb lameness in dairy cows on four commercial UK farms. Veterinary Journal 193**:** 626-32
Murray RD, Downham DY, Clarkson MJ, Faull WB, Hughes JW, Manson FJ, Merritt JB, Russell WB, Sutherst JE and Ward WR 1996. Epidemiology of lameness in dairy cattle: Description and analysis of foot lesions. Veterinary Record 138: 586-591
Whay H 2002 Locomotion scoring and lameness detection in dairy cattle. In Practice 24: 444-449

24. A handy way to treat complicated white line lesions with undermining of the wall horn and other claw lesions

M Van Aert[1], D Valckenier[2]
[1] Ghent University, Department of Reproduction, Obstetrics and Herd Health, practitioner + practical assistant ambulatory clinic, Salisburylaan 133 9820 Merelbeke, Belgium, [2] Ghent University, Department of Reproduction, Obstetrics and Herd Health, PhD student + practical assistant ambulatory clinic, Salisburylaan 133 9820 Merelbeke, Belgium
marcel.vanaert@ugent.be

Introduction
The white line forms the junction between the harder horn of the sole and the wall. During claw trimming one or more little fissures in the white line zone are regularly discovered. These lesions occur predominantly on the lateral (abaxial) side of the outer claw in the hind legs (zone 3). That specific part of the wall horn has a very steep angle relative to the floor and undergoes most compression and torsion on each step and turn of the claw. In many cases, these fissures are caused by laminitis and coriitis. The wall horn tears loose from the sole horn and initially dirt can fill the fissure. At this stage the cow is not lame yet. When the fissure reaches deeper, a painful infection can develop in the underlying corium (“the quick” UK). This infectious process develops into a painful abscess and often undermines the horn of the wall, sole or heel. In a few days the cow becomes progressively more lame, has difficulty walking and increasingly abducts the painful leg. The coronary band in the heel zone of the affected claw becomes swollen, red and painful, as the pus seeks to burst out. The outburst of the abscess can occur in three different places: in the heel zone, at the abaxial side of the coronary band from the wall horn, or at the axial side.

A real fissure, with or without infection, has to be cut away with a sharp knife by carefully removing the undermined or loose wall and sole horn in an ellipse-form.
Extended lesions with undermined wall horn or granulation tissue need to be treated repeatedly, as these heal very slowly. Complicated lesions need “intensive care” in combination with a block or shoe and often an anti-inflammatory treatment.

Materials and Methods
A ligature is placed just below the tarsus before the start of the procedure, and the foot is anaesthetized using the intravenous anesthesia technique from August Bier.
After functional and curative trimming, a simple but handy electrocauter is used to remove the granulation tissue and to coagulate the superficial layer of the corium. In our experience, this results in a fair healing of such complicated lesions.
Case Example: Limousine bull (3 years old, 1.200kg) with an extended wall horn lesion, medial side inner claw, right hind foot.
The lesion was treated three times in four months (6 January 2012 - 14 February 2012 - 10 April 2012).

After four months and repeated treatments (3x) this lesion was completely healed and the bull could be used again for breeding.

Results and Discussion

Complicated white line lesions need a repeated and intensive treatment. With this electrocauter one can work more precisely and coagulate the superficial layers. Destruction of the germinative tissue of the epidermal corium should be avoided.

The same method can be used to remove a tyloma (fibroma or corns).

Acknowledgements

We are grateful for the co-operation of our farmers and our veterinary students during the clawtrimming sessions.

References

Toussaint Raven 1977, “Klauwverzorging bij het rund” Universiteit Utrecht The Netherlands p. 53.

Blowey R 1993, “Cattle lameness and hoofcare an illustrated guide”. Farming press Ipswich UK p. 39 – 47.

Budras K-D & Habel E.R. 2003, “Bovine anatomy” p. 25-27.

Fiedler, Maierl, Huss 2003, “Erkrankungen der Klauen und Zehen des Rindes” Munich/ Zurich Germany p. 39, 60.

Greenough P.R., Bergsten C., Brizzi A., Mülling C.K.W. 2007, “Bovine laminitis and lameness” Canada p. 89-95.

Delacroix M. 2008, “Maladie des bovins” Institut de l’élevage France p. 254,256,261,285.

http://www.buitenpraktijk.ugent.be/v2/singlepages/artikelenarchief/artikelenrund/klauwletselsmarcelvanaert.pdf

25. Complicated toe lesions in cattle – Treatment and post-surgical care

A. Starke[1], H. Müller[1], W. Wippermann[1], D. Goerigk[1], H. Fieseler[1], M. Reckardt[1]
[1] Clinic for Ruminants and Swine, Faculty of Veterinary Medicine, University Leipzig, An den Tierkliniken 11, D - 04103 Leipzig, Germany
alexander.starke@vetmed.uni-leipzig.de

Introduction
The current high prevalence of lame cows in high producing dairy farms can be traced back to individual animals going lame for a long period. To some extent those animals are presented to the hoof trimmer more than once, before veterinary consult is taken. In the range of complicated claw diseases the therapeutic approach to defects of the dorsal wall of the claw horn will be described in the following. A possible etiology that might decisively influence the therapy will be discussed.

Materials and Methods
In this study 30 German Holstein Friesian dairy cows from 13 free-stallfarms (540 ± 174 milking cows, 10216 ± 704 kg milk yield) in Saxony/Germany were included. All of them went lame for over six months and already had been treated by hoof trimmers or veterinarians. These cows suffered from profound, partially perforated inflammation of the pododerma of the dorsal wall of one claw. In each of these cases the lesion departed from the dorsal coronary band, where Dermatitis digitalis was clinically diagnosed. In the affected leg the toes were severely hyperextended. The cows walked almost entirely on plantar part of the toe. The dorsal wall of these claws was far longer than on the opposite side. The surgical treatment occurs under retrograde intraveneous anesthesia (15 ml Procainhydrochlorid, Procasel 2% ®, Selectavet GmbH). After a complete resection of the surrounding horn and the necrotic tissue the wounds were treated with chlorotetracyclinehydrochloride-spray (CTC-Blauspray ®, WDT) and formosulfthiazole-ointment (Socatyl® SFD. WDT). An extra-large (14 cm) wooden-block was attached to the healthy claw. Starting ahead the surgery the animals were treated with non steroid antiphlogistics and antibiotics for three consecutive days after surgery.

Results and Discussion
The first three replacements of the bandage and wound revision were performed with a three-day range and later with a five- to seven-day range. In all cases the defects were completely healed. A correct position of the toes could be observed during the inspection.
The reason for these defects can obviously be lead back to the development of poor horn due to Dermatitis digitalis infections of the coronary band. As the very hard horn of the claw wall cannot be removed appropriately without anesthesia, these animals suffered from this disease for many months. The anaerobic setting in the area of the undermined horn creates a perfect condition for infection. Furthermore these dorsal defects can hardly be reached during surgical treatment in a common standing hoof trimming crash. A recurrent infection of the granulation tissue inhibits the growth of the horn above the wounded area.
In the authors' view a therapeutical success in these kinds of defects is related to an initial consequent revealing of the lesion and an intensive, frequent inspection during the first two weeks.

26. Effect of surgical removal of Interdigital Hyperplasia on survival of Dutch dairy cows

F van Soest[1], R Jorritsma[2], PJI Vedder[3], K Frankena[1]
[1]Wageningen University, QVE, The Netherlands, [2]Utrecht University, Farm Animal Health Department, The Netherlands , [3]Association Médecins Vétérinaires Mersch S.à.r.l., Mersch G.D. Luxembourg
r.jorritsma@uu.nl

Introduction
Lameness is next to mastitis one of the most common and costly diseases for a dairy farmer (Bruijnis et al, 2010). Of the various underlying causes of lameness, this study focuses on severe forms of interdigital hyperplasia (HYP) which are in need of surgical treatment. HYP is mostly secondary in nature as a direct consequence of an infection in the interdigital space of the claw (e.g. heel horn erosion and interdigital dermatitis) (Enevoldsen et al, 1991).

Materials and Methods
Surgical removal of HYP was performed in 39 lame dairy cows originating from 18 herds upon farmers' request between March 2004 and August 2008. The claw was prepared and cleaned with water and hibiscrub® and disinfected with hibisol®. Depending on the preference of the veterinary surgeon, local infiltration anaesthesia or intravenous regional anaesthesia was performed. HYP was removed using an electric coagulator. Subsequently most interdigital fat tissue was removed, leaving a gap of approximately 2 cm. This area was sprayed with tetracycline-chloride, filled with tetracycline-chloride sprayed cotton wool and subsequently the claws were bandaged together with either Vetrap® or Coflex®. The bandage was removed after approximately ten days. No further treatment was performed. Culling of cows having had HYP removal were compared with data from 140 matched cows within the same herds of the same parity class (1, 2, or ≥3) and lactation class (≤60 days, 60<days≤150, 150<days≤270 or ≥270 days). Cox survival analysis was used to evaluate the effect of HYP surgical treatment on culling, using culling as the event and the time between HYP removal and culling as survival time. Cows were deemed censored if not culled at 365 days after HYP treatment or not culled at the end of the follow-up period (December 2009). Matching group was included as a strata variable to account for confounding. A random herd effect was included in the model as more than one matched group was present on 10 farms.
In order to include some quantitative information of the economic value of the cows for the farmer, we used the lactation value (LV) in the model. The LV is calculated on a regular basis at milk recording dates for all Dutch cows and provides the relative economic value of the milk production given milk production and milk solids (Grondman et al., 2006).

Results
One cow succumbed (died) due to persistent bleeding from the wound within 2 days and was not used in the analyses. While wound healing with minor scars was observed within 2-3 weeks and no recidivism occurred in all other cows, limited bleeding from the wound was observed in some of them. No other complications occurred. Of the 38 HYP treated cows six (15.8%) were culled, while 38 out of 140 (27.1%) matched cow were culled. HYP treated cows had a significantly lower hazard to be culled (HR=0.33, 95%CI 0.13-0.86) compared to matched cows. Having a higher LV reduced the hazard to be culled.

Discussion
Our findings show that surgical removal of HYP decreases the risk of being culled compared to matched cows in the same herd. Also, we found that a cow with a high LV compared to a cow with a low LV has a decreased risk of being culled. This may be explained by an effect of production on the decision to treat the animals as well as on the decision to cull treated cows. The HYP treatment is apparently satisfactory for the owners to reduce culling for other reasons, but this may also partly be due to above average performance of the cows before treatment. Whether this is important, could be assessed in a clinical trial. Also, farmers may have maintained HYP treated animals in the herd in an attempt to compensate for the costs of the treatment, known as concorde fallacy.

References
Bruijnis, MRN, Hogeveen, H, Stassen, EN, 2010. Assessing economic consequences of foot disorders in dairy cattle using a dynamic stochastic simulation model. Journal of Dairy Science 93, 2419-2432.
Enevoldsen, C, Gröhn, YT, Thysen, I, 1991. Heel erosion and other interdigital disorders in dairy cows: associations with season, cow characteristics, disease, and production. Journal of Dairy Science 74, 1299-1309.
Grondman, W, Booij, AP, 2006. Beslissen van kalf tot koe. NRS Arnhem.

27. Milk yield in dairy cows before and after treatment for foot diseases

I Akın[1], A Belge[1], H Bardakcıoglu[2], M Sarıerler[1], N Kilic[1]
[1]Adnan Menderes University Veterinary Faculty Department of Surgery, Aydin, TR, [2]Adnan Menderes University Veterinary Faculty Department of Animal Sciences, Aydin, TR
ibraak@adu.edu.tr, ibraak@hotmail.com

Introduction
The objective of this study was to investigate the impact of foot disease treatment on milk yield in dairy cows.

Material and Methods
Lame cows (n=57) from a 467 cow Holstein dairy farm in Turkey were included in the study over an 8 month period. Cows had an average (range) lactation number of 2.29±1.29 (1-7), Day in milk (DIM) 47.49±39.93 (1-170), and weight 419.03±29.02 (375-475) kg. Lame Cows were classified in five foot disease groups (DGrp); digital dermatitis (DD, n:19), interdigital dermatitis (IDD, n:10), heel erosion (HE, n:7), sole ulcer (SU, n:15) and white line disease (WLD, n:6). Bandages were applied on each foot lesion in all cows (Figure 1), and blocks (Easy Bloc®Demotec) were also used for SU and WLD groups. Each cow, for their treatment, was separated to a different pen, without any changes of management.

Figure 1. Applied bandage for white line diseases group. Sterile gauze and antibiotic (Synulox L.C.®Pfizer) (a), cotton (b, c), gauze (d), vet-flex (e), tar bandage (f) applications, and (g) and (h) standing with bandage.

Milk yield information was obtained from daily computer records (Alpro®Delaval) at four levels: 1) at the beginning day value of lactation (BV), 2) peak value before diagnosis day (PVBD), 3) diagnosis day value (DV), and 4) after treatment (at the end of the treatment day) value (TV).
General Linear Model was used to analyze the least square means of milk production traits (MPT). The significant differences between the milk production traits (BV, PVBD, DV and TV) and/or disease groups were performed with repeated measures two-way analysis of variance (RM-ANOVA). Lactation number and DIM for each MPT was used as covariates.

Results
The mean±SD values and statistical significances between the milk yield values in each disease group are presented in Table 1.

Table 1. Milk yield (kg) values (Mean±SD) in disease groups.

DGrp	MPT				
	BV	**PVBD**	**DV**	**TV**	***Overall MPT***
DD (n:19)	27.6±6.55	33.8±8.26	25.9±7.23	35.5±7.15	30.4±7.30^{a}
IDD (n:10)	31.5±9.67	35.5±11.40	26.2±10.59	38.9±8.46	33.8±10.03^{a,b}
HE (n:7)	37.1±3.80	44.9±5.17	36.9±10.85	45.4±6.34	41.9±6.54^{b}
SU (n:15)	31.5±7.84	39.2±6.49	27.2±8.67	37.4±7.95	33.8±7.74^{a,b}
WLD (n:6)	30.3±5.46	33.8±6.48	22.8±8.56	36.8±5.65	29.6±6.54^{a,b}
***Overall Dgrp* (n:57)**	30.8±7.56^{a}	36.9±8.61^{b}	27.3±9.36^{a}	38.0±7.77^{b}	

$^{a,\,b}$ Different superscripts are indicate significance (P≤0.05) in the same row or column.
P values for DGrp, MPT, and MPT*DGrp are 0.050, 0.013, and 0.516, respectively.

In this study, there was increase in milk yield from DV to TV. In this study, we observed milk yield values in dairy cows which had already foot diseases, so were not designed experimentally. Therefore, we did not use control group in this study.

Discussion
As a conclusion, treatment of foot disease could have an impact on milk yield, as we consider PVBD, DV and TV in each diseases group.

Acknowledgements
The present study was financed by Adnan Menderes University Research Fund (BAP-Project Number VTF-11005). We thank to Aykut Gokturk Uner for contributions to Statistical Analyses

28. Survey of veterinarians and hoof trimmers on methods applied to treat claw lesions in dairy cattle

JK Shearer, PJ Plummer, LC Shearer, J Danielson
College of Veterinary Medicine, Iowa State University, Ames IA, USA
JKS@iastate.edu

Introduction
The literature contains relatively little specific information on the treatment of claw lesions. As a consequence, treatments commonly applied are highly empirical and in some cases may represent therapeutic strategies with the potential for more harm than good. We hypothesize that in North America, the most common topical treatments would include tetracycline/oxytetracycline soluble powder and copper sulfate. Clinical observation of cows during the immediate post-treatment period suggests that these products cause significant irritation and discomfort when applied to raw corium tissues. In addition to pain, we hypothesize that this irritation may lead to delayed healing and the requirement of more time for recovery of the corium and epithelium to normal function.

Materials and Methods
Efforts to better understand treatment of claw lesions by veterinarians and hoof trimmers was assessed by means of a survey of the memberships of both American Association of Bovine Practitioners (AABP) and the Hoof Trimmers Association (HTA). The survey consisted of 26 questions and was posted on-line using surveymonkey.com to maintain anonymity of each participant. Many of the questions permitted the selection of more than 1 response, thus the percent response for each question frequently computes to more than 100%.

Results and Discussion
A total of 345 people responded to the survey; of these 205 identified themselves as veterinarians with membership in AABP, 120 were hoof trimmers in HTA, 9 identified themselves as having membership in both organizations and 11 provided no information as to affiliation with either organization. With respect to training in foot care, 80% of veterinarians indicated that it was part of their veterinary education, 34% were self-taught or gained much of their understanding of foot care by the experiential route (various continuing education programs, etc.) and 10% cited attendance to the Master Hoof Care program, Dairyland Hoof Care Institute or other foot care training program. Training cited by hoof trimmers was: 60% apprentice with another trimmer, 41% Master Hoof Care program, Dairyland Hoof Care Institute or the training program offered at Hoof Care Department PTC+ Oenkerk, the Netherlands, and 29% indicated they learned primarily from experience (i.e. self-taught). When asked about their approach to the corrective trimming of a sole ulcer; 65% of veterinarians and 85% of hoof trimmers indicated that they remove all loose horn adjacent to the lesion without causing it to bleed (i.e. without causing damage to surrounding tissues). With respect to the treatment of sole ulcers, 87% of hoof trimmers reported using foot blocks to relieve weight bearing on affected claws compared with 77% of veterinarians. Topical medications for ulcers and abscessed claw lesions were used by 58% of veterinarians compared with 51% of hoof trimmers. The medication used most frequently was tetracycline or oxytetracycline powder 59% (49% by veterinarians and 80% by hoof trimmers). When asked if they recommended a period for withholding milk from treated cows following topical treatment with tetracycline or oxytetracycline; 82.5% or veterinarians and 88.6% of hoof trimmers answered “no”. Wrapping or bandaging of claw lesions was a routine treatment procedure for 51% of both veterinarians and hoof trimmers.

Conclusions
There were multiple similarities in replies from veterinarians and trimmers who responded to the survey. Among other items of interest was confirmation that the topical treatments: tetracycline, oxytetracycline and copper sulfate powder, are the most commonly used topical treatments for claw lesions. Part II of our on-going study will be to be verify the benefit of these treatments for treatment of claw lesions.

Acknowledgements
The authors gratefully acknowledge funding for this study from a grant by the AABP and HTA.

P14(b). Gross-pathologic and therapeutic implications of uncomplicated white line disease in dairy cows: A case series study

F Katouli[1], M Nouri[1], F Zibaee[1], I Nowrouzian[2], SMK SeyedJavad [2]
[1] Iranian Arad Pajouh Veterinary University Center, Tehran, Iran; [2]Department of Clinical Sciences, Faculty of Veterinary Medicine, the University of Tehran, Tehran, Iran
mnouri2@yahoo.com

Introduction

White line disease (WLD) is a commonly observed lesion and has frequently been reported as a major cause of lameness. Several reports from Iran indicated the condition as responsible for between 1.53 % and 27.14 % of lameness (Meimandi-Parizi and Eskandari, 1996; Mansouri *et al.*, 2011; Nouri *et al.*, 2011). This short communication describes the gross-pathologic and therapeutic implications of uncomplicated WLD in one large dairy herd with records of lameness events over a 7 months period in the vicinity of Tehran, Iran.

Material and Methods

Two hundred and thirty two Holstein cows having WLD were treated and the healing process was observed in the course of veterinary practice. The cows were attended at the request of a farmer and the details of each case were recorded on a prepared lameness form at completion of the farm visit. Cows were kept in free stall with sand bedding on concrete floor and fed a total-mixed ration. Lameness was assessed by means of a visual locomotion score (1-5). The animals were examined in a claw trimming box and the claws were trimmed in accordance with the principle of therapeutic foot care. The criteria such as hemorrhage, separation and abscess at white line region in zone 1, 2 and 3 served as a basis for the diagnosis.

Results

WL lesions were confirmed on 232 of cows with the locomotion score of 3 and 4. The prevalence rate of WL lesions in axial wall at zone 1, apex of toe at zone 1 and abaxial wall at zone 1, 2 and 3 were 53 Cases (23.0 %), 44 Cases (19.0 %) and 130 Cases (58.0 %), respectively. The colors of the pus escaping from wound were cream (14.5 %) and black (43.5 %). Fourteen percent have been trimmed incorrectly; the sole becomes too thin during trimming and exposed corium. Full treatment results achieved in 87.0 % of cases in an average of 28 days.

Discussion

In cases of deep sepsis of the digit, antimicrobial therapy alone does not usually elicit a cure. It is possible that necrosis of infected tissue and the resultant loss of blood supply prevent effective concentrations of antimicrobials from reaching all areas of bacterial colonization. On the other hand, complication by secondary infections can effect on healing process.

In a proportion of cases lameness did not resolve following drainage of the white line abscess and re-examination of the foot revealed a protrusion of granulation tissue from the original lesion. This is often an indication that not all of the under-run horn was removed at the first examination. Foreign bodies and secondary infection such as the infectious agents of bovine digital dermatitis (BDD) can effect on healing process. Recently, there have been a number of reports of ‘new’ disorders affecting the bovine digit. All studies suggested the potential involvement of BDD (Nouri and Ashrafi, 2012).

This study showed that laminitis- associated white line disease responds well to appropriate therapy and proper trimming can play an important role for lameness prevention strategies in large dairy herds.

References

Mansouri-Nejad SE, Ahmadpanah A, Katoli F, Zibaee F, Karbalaee SeyedJava SM and Nowrouzian I 2011 A case series study of white line disease in dairy cows: complication and consequences, In Proceeding: 16th International Symposium on Lameness in Ruminants, Rotorua, New Zealand, pp. 158.

Meimandi-Parizi A and Eskandari A 1996 Prevalence of lameness in dairy and beef cattle of Marvdasht area during the winter, Pajouhesh & Sazandegi 35:115-119 (in Farsi).

Nouri M and Ashrafi-Helan J 2012 Clinical and gross pathologic findings of complicated vertical fissures with digital dermatitis in a dairy herd, Veterinary Research Forum 3: 291-295.

Nouri M, Nowrouzian I, Vajhi A, Marjanmehr SH and Faskhoudi D 2011 Morphometric radiographic findings of the digital region in culling lame cows, Asian Journal of Animal Science 5:256-267.

P15(a). Lameness on dairy goats: What is the level of pain experienced and how can we evaluate it? Preliminary results

IG Ajuda[a], AC Vieira[a], FF de Almeida[a], G Stilwell[a]
[a]Faculty of Veterinary Medicine of Lisbon. AWIN Project UTL-FMV
adinesajuda@fmv.utl.pt

Introduction
There is a lack of information about lameness in goats. This gap is reflected by the non-existence of an objective scale to evaluate the level of lameness and by the poor knowledge about the causes, mainly in intensive production. The main causes for lameness in this kind of production system seem to be claw overgrowth and deformation due to insufficient wear on the straw beds. One of the main goals of the workpackage 2 of the AWIN Project is to evaluate the level of pain linked to lameness and its impact on animal welfare. In order to better understand this issue we are conducting several trials so as to assess the role of pain in lame goats with deformed/overgrown claws.

Material and Methods
Ninety dairy goats from the same pen on a commercial dairy farm were classified for gait scoring (0 to 3 from a developing scale) and for claw deformation. Each claw was photographed with a thermography camera and blood, saliva and hair were collected for pain biomarker analysis and cortisol determination. Production data was also gathered. The claws were then trimmed in all animals. Fifteen days later the collection of data was repeated, except for the hair that will be collected 2 months later.

Results
38% of the goats showed severely deformed claws. There was a significant difference between the temperature of the deformed (23.27 Cº) and the not deformed claws (20.86 Cº) on day 0 ($p= 0.01$). On day 15 there was no significant difference in claw temperature between both groups ($p= 0.618$). Gait scoring showed a significant improvement ($P= 0.001$) after trimming – increase in score 0 (from 35% to 43% of goats) and reduction of animals with score 3 (from 13.5% to 5%). Milk yield, blood, saliva and hair data are still being analyzed.

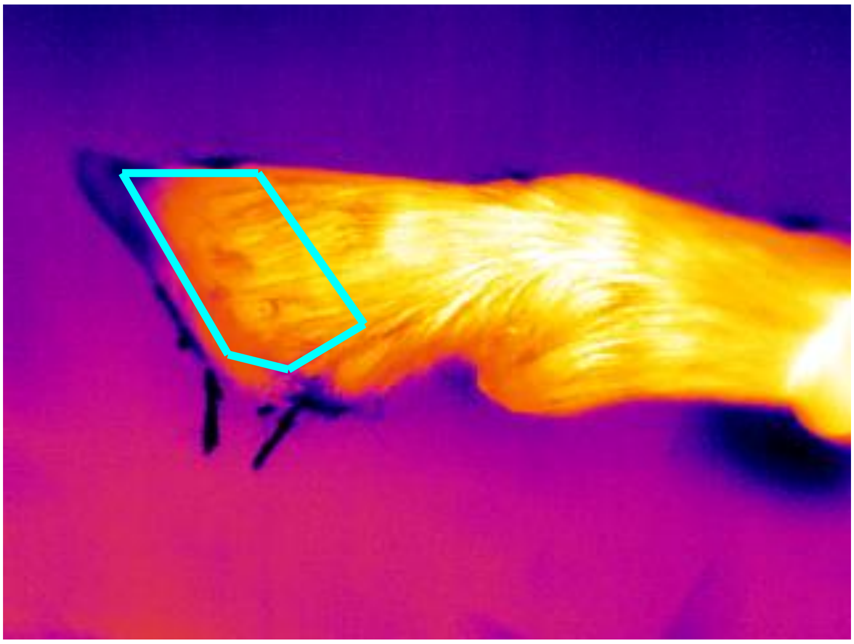


Figure 3 Area of the hoof evaluated on the thermographic photo

Discussion
The significant difference between the deformed and not deformed claws on day 0 could indicate the presence of inflammation associated with higher temperature (Luzi, F. et al., 2013). With the rest of the

analysis ongoing we will try to correlate this increase in temperature with the level of pain. After claw trimming we observed an improvement in the gait score accompanied by an absence of temperature difference, which could indicate a reduction of the inflammation. This preliminary data suggests that deformation/overgrowth of the claws in dairy goats may be correlated with inflammation and pain and not only with mechanical shortcomings

Acknowledgements
The authors wish to thank the EU VII Framework programme (FP7-KBBE-2010-4) for financing the Animal Welfare Indicators, the farmers who were kind enough to let us use their animals and facilities and MRA instruments for lending the thermography camera.

References
Luzi F, Mitchell M, Costa LN, Redaelli V 2013. Thermal imaging: History and applications. In: Luzi F, Mitchell M, Costa LN, Redaelli V (Eds) Thermography. Current status and advances in livestock animals and in veterinary medicine, p. 14. Fondazione Iniziative Zooprofilattiche e Zootecniche. Brescia, Italy.

15(b). Treatment of claw disorders in the veterinary practice

B Brummelman[1], JAM Baerveldt[1], M Holzhauer[2]
[1]Veterinary Clinic Wolvega, [2]Animal Health Service, Deventer, The Netherlands
berend.brummelman@gmail.com

Introduction
With the announcement concerning the theme of this Conference 'Lameness in Ruminants: Past, Present and Future', the subject of this paper has been conceived from a literal point of view for the bovine practitioner. Veterinary work on bovine lameness in the nineties of last century is analysed and compared within the same practice about 15 years later.

Material and Methods
The invoice-program of a veterinary practice in the northern part of the Netherlands was analysed about treatments for bovine lameness. This practice consisted in the nineties of 5 veterinarians, 4 were mainly involved with dairy. By fusion with a neighbouring practice and extension, nowadays this practice consists of 12 veterinarians, 4 still mainly working in dairy.
Independent variables, with respect to adult cattle, were:
1. first treatment (general) claw disorder
2. treatment (peri-)carpitis/-tarsitis
3. gluing or nailing a block
4. surgical removal interdigital hyperplasia (IH)
5. claw amputation
6. resection distal interphalangeal joint (DIJ) and/or navicular bone (NB)
7. delivery bovine lameness related pharmaceuticals, a. chlortetracyclin-HCl-(3.2g)/lincomycin-spray (=CTC-spray) for local treatment, b. lincomycin-(spectinomycin-)powder, 150g, application in footbaths, c. oxytetracyclin-HCl-powder, 1kg, also for footbaths.

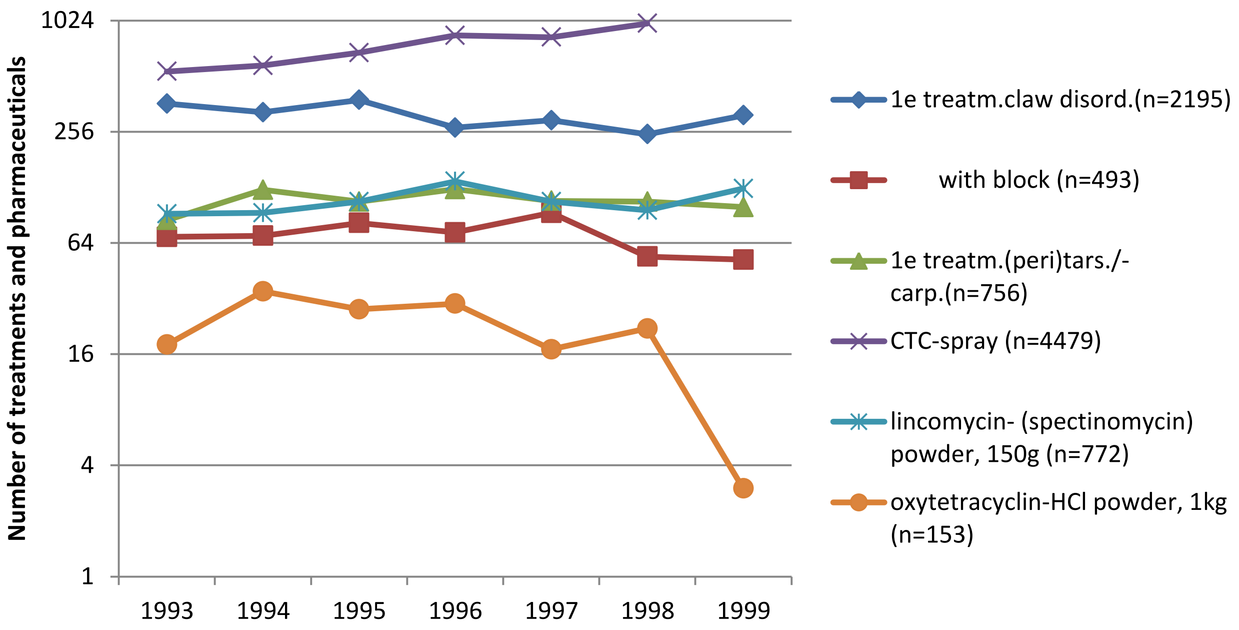
Dependent variables were: 1. year 2. month. Data of the invoice-program gave no information about diagnosis.

Results
Data 1993-1999
Figure 1 presents, per year, number of treated cows for (general) claw disorders, of which with block got an apart curve, number of cows treated for (peri-)carpitis/-tarsitis and delivery of lameness related pharmaceuticals. Figure 2 shows the same data per month. Numbers of more specialized treatments, incorporated in the data of total claw disorders, spread over these years: 59, 25, 24 respectively for surgical removal IH, claw amputation and resection DIJ/NB.

Data 2006-2012
Since the first years of this millennium treatments of claw disorders decreased dramatically. Nowadays, besides incidentally treating a (general) claw disorder, only done are: surgical removal IH and claw amputation, respectively average 3 and 2 cows yearly. Delivery lameness related pharmaceuticals was: chlortetracyclin-HCl-spray (=CTC-spray), average 1040 yearly.
The bovine veterinarians in this practice have more an advisory function. There is used a veterinary software program, recently extended with a module for claw trimming data.

Discussion
Seasonal effects in 1993-1999-data are seen for all independent variables, except blocks, presented in figure 2: the most in winter season. Seasonality of claw disorders is in line with literature.
The curve of total treatments shows a slight decrease from 1993 to 1998, again increasing in 1999. Delivery of CTC-spray nearly doubled between 1993 and 1998 (Figure 1) and still increased the first decennium of 21^{e} century.
Remembering the time Toussaint Raven (1989) developed claw trimming at the Veterinary Faculty of Utrecht University, individual treatment of claw disorders was a substantial part of veterinary practice: in the seventies yearly 14% of the bovine population, older than 3 months, in the Utrecht practice was treated (Peterse, 1980). It is assumed data of the practice in this paper are more or less similar to most other practices in The Netherlands: practical work in lameness has diminished and veterinary advisory in prevention is increasing with help of computerized claw trimming data. Practical work seems mainly done by veterinarians who are much dedicated to claw disorders, which is difficult nowadays where is paid per time on commercial base.

1a



1b

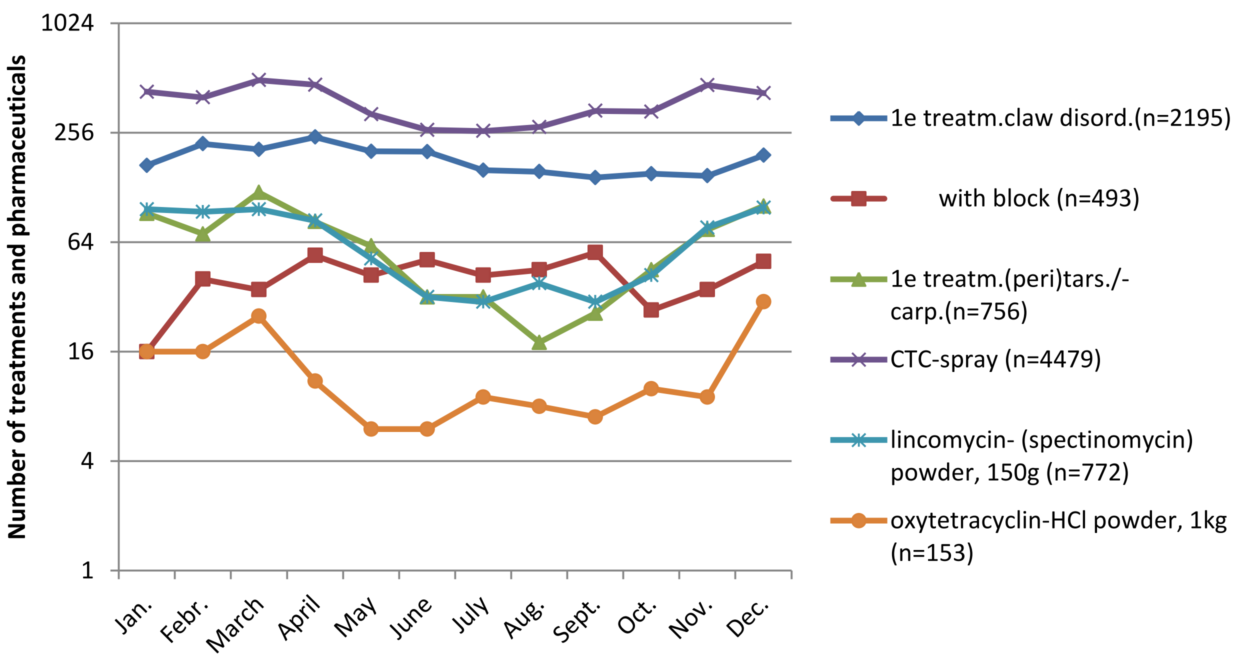


Figure 1. Number of cows: first treatment claw disorder, with block and (peri-)carpitis/-tarsitis; and delivery lameness related pharmaceuticals in a veterinary practice in The Netherlands, 1993-1999, yearly(**1a**), monthly(**1b**).

References

Peterse DJ, 1980 Judgement of bovine claws by the occurrence of sole lesions. Ph.D. thesis, St. Univ. Utrecht, The Netherlands.

Toussaint Raven E, 1989 Cattle foot care and claw trimming. Ipswich, UK. Farming Press.

P16(a). Location, location, location – A comparison of the outcomes of sole ulcers and heel ulcers in dairy cattle

Roberts JM[1], Blowey R[2]
[1]Zoetis UK ltd, Walton Oaks, Tadworth, Surrey KT20 7NS; [2]Wood Veterinary Group
Judith.roberts@zoetis.com

Introduction
Despite an incidence of almost half that of sole ulcers (5.8 vs. 13.9 cases per 100 cows pa; Hedges et al 2000), there is little published information about the aetiology, presentation and outcomes of dairy cows with heel ulcers. This study compares heel ulcers with sole ulcers on a UK dairy farm and analyses presentation, recovery and outcome for both types of lesion. Our findings indicate that heel ulcers differ significantly from sole ulcers with longer time for recovery and increased chance of amputation and/or removal from the herd in cows with heel ulcers. This suggests the complex aetiology of the two conditions differs significantly and that risk factors and preventative measures for the two lesions may be different, an important consideration for UK dairy farms.

Materials and Methods
Dairy cows from one UK dairy farm were selected for the study following diagnosis of lameness caused by a heel or sole ulcer. Parity, days in milk and foot affected were recorded in each case. Cows were re-examined weekly until sound. Association between exposure, parity and outcome was examined using Fisher's exact test. Time to recovery (days) by heel or sole ulcer was examined by t-test. A two year follow up assessed the number of cows in the study that had left the herd in both groups.

Results
137 cows were eligible for analysis: 59 with heel ulcers and 78 with sole ulcers. The cows were assessed in the period from July 2008 until December 2009 with follow up in February 2011. Findings are summarised table 1.

Table 1 Summary of study results - * denotes significant difference (p >0 .05)

Observation	**Sole ulcers**	**Heel ulcers**
Limb distribution:		
Percentage Forelimb lesions	16	10
Percentage Hindlimb lesions	84	90
Mean parity	1.7*	3.9*
Mean days in milk (range)	81 (1-302)	90 (1-479)
Mean days to recovery (range)	41.3* (14-399)	74.2* (21-497)
Outcome:		
Percentage with digit amputated	2.7*	16.9*
Percentage no longer in herd after 12 months	7.1*	39.0*
Follow up: percentage no longer in the herd after 24 months	37.0*	61.0*

Discussion and Conclusion
Sole ulcers and heel ulcers differ significantly in their presentation (Blowey et al 2000), days to recovery and clinical outcome. Heel ulcers are more likely to affect older animals with a long time taken for recovery and more likely to result in digit amputation and/or their subsequent removal from the herd than sole ulcers. One hypothesis is that, due to their siting at the caudal aspect of the heel, secondary bony changes are more likely to develop. These are demonstrated in another paper. Further studies are needed.

Acknowledgements
The authors would like to acknowledge the work at Cambridge University of Rob Paton and Toby Floyd for their involvement in the initial study and also Fernando Constantinez for his ongoing work on pathological samples.

References
Blowey RW, Ossent P, Watson CL, Hedges V, Green LE, Packington AJ 2000 Possible distinction between sole ulcers and heel ulcers as a cause of bovine lameness, The Veterinary Record 147 110 - 11
Hedges VJ, Blowey RW, O'Callaghan C 2001 A Longitudinal Field Trial of the Effect of Biotin on Lameness in Dairy Cows. Jounal of Dairy Science 84:1969 –1974

P16(b). A new method as an intervention for thin soles

A Fiedler[1], C Mueller[2], R Hoefler[3], D Doepfer[4] J Maierl[5]
[1]Practicing veterinarian, Munich, Germany; [2]Farrier, Hooftrimmer, Reinhardsried, Germany; [3]Bavarian State Research Center for Agriculture, Grub - Achselschwang, Germany; [4]FAPM, SVM, UW Madison, USA [5] Department of Veterinary Sciences, University of Munich, Germany
dr.andrea.fiedler@t-online.de

Introduction
Thin soles in cattle hooves mainly have two causes: 1. an abrasive floor, particularly a new one in a barn cows have recently moved into; 2. excessive hoof trimming. Without immediate intervention some cows will completely lose the sole horn and the underlying corium which is especially thin at the tip of the toe will be uncovered. Therefore this area is very vulnerable for ascending infections leading to progressive, life-threatening inflammations.
It was the objective of this study to develop an easy-to-use and feasible solution to this problem.

Materials and Methods
In two commercial herds (63 and 82 animals resp.) there were several dairy cows with locomotion score 4 to 5 (Sprecher et al. 1997), in one herd after moving into a new barn, in the other after recent hoof trimming. Animals with horn separation were excluded from the study. A total of seven animals received this special relief of strain.
To relieve the pain caused by the thin soles wood blocks (length 130 mm) were fixed under the inner claw. A 5/16 inch hole was pre-drilled in the blocks (Figure 2). For fixing the blocks a fast-setting adhesive (Bovi Bond, Vettec, Oxnard, CA, USA) and for „shock-absorbance“ and to imitate the sole horn Equi-Pak Extra-Soft Instant Pad Material (Vettec, Oxnard, CA, USA) was used.

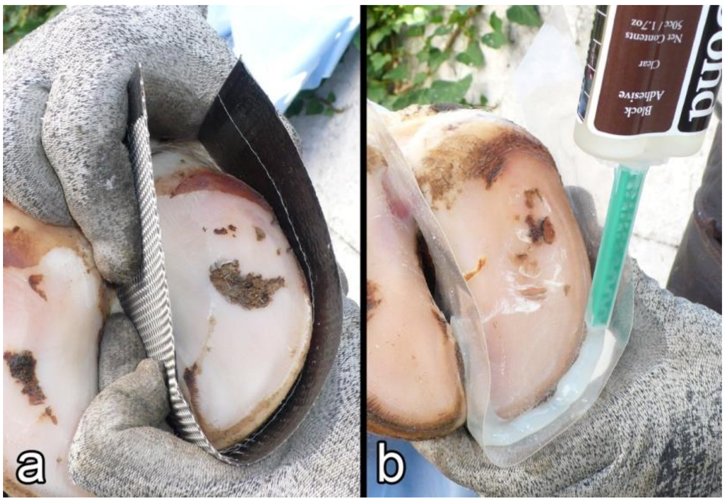


Figure 1. Applying the metal grid to form the mould (a), building an artificial bearing edge (b)

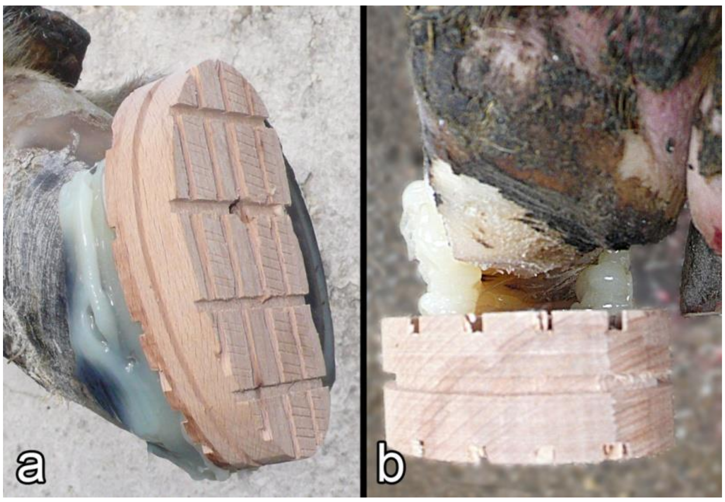


Figure 2. Fixing a block to the artificial edge

Method

The horn of the sole in the medial and lateral hind hooves was soft and could be compressed with a hoof tester triggering a pain reaction, this was suggestive of a horn thickness of less than 3 mm. The hooves were carefully trimmed when necessary. To avoid greater horn loss, all loose sole material and dirt were removed with a wire brush.

1. Dry hoof thoroughly using a hair dryer
2. Dispense carefully the fast-setting adhesive with the mixing tip along the lateral and medial wall of the medial hind hoof, 2 to 3 cm at the wall, ½ cm to 1 cm above the sole surface and strictly at the weight bearing edge, using a strip of deformable metal grid, covered with adhesive tape, as a mould (Fig. 1a)
3. Avoid dispensing glue at the white line or the sole, at the modeling and at the heels (Fig. 1b)
4. Wait until the glue is hard and trim it with a grinder to a height of about 3 to 5 mm above the sole surface
5. Fix wooden block with further fast-setting adhesive to the artificial edge (Fig. 2a, b)
6. After hardening wrap a self-adhesive bandage around the hoof and the block (Fig. 3a)
7. Place mixing tip against the hole in the block and dispense Equi-Pak Extra-Soft Instant Pad Material until you can see the filling under the bandage (Fig. 3a)
8. Remove bandage after 45-60 sec and trim any excess material, particularly underneath the soft heel
9. Control the height of the complete system, and use a grinder to correct it to about 20-23 mm (Fig. 3b)
10. Release the hoof

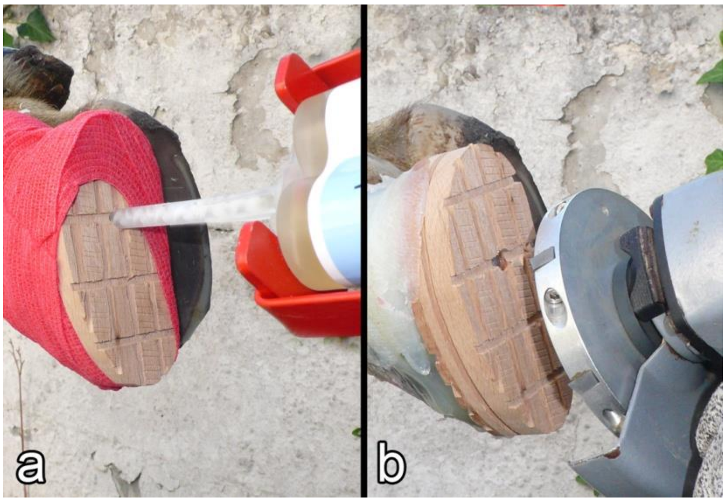


Figure 3 Filling the space between sole horn and wood block with Equi-Pak Extra-Soft Instant Pad material (a), using a grinder to correct the height to about 20-23 mm (b)

Results and Discussion

The strong adhesive sets quickly and secures a solid bond to the hoof wall. So the wall and the weight bearing edge are able to take over the load for some days. To support this, a soft material, successfully used in horses, is filled under a fixed wood block. The soft material with a Shore-D hardness of 30°-35° imitates the lost sole horn. The locomotion score of the treated cows was 1 to 2 after fixing these blocks. To remove the block after two to three weeks use pliers or a grinder as in any other block. The horn will be regrown. The method can be recommended for intact, thin soles caused by excessive abrasion.

Acknowledgments

Vettec, Oxnard, CA, USA, has supported this study by supplying the adhesive products.

References

Sprecher DJ, Hostetler DE and Kaneene JB 1997 A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 47: 1178–1187.

P17(a). Effect of oral biotin supplementation on white line lesions observed in a lowland sheep flock

KPA Wheeler[1], CJ Phythian[2], KA Phillips[1]
[1] ADAS UK Ltd, Wolverhampton, WV9 5AP, UK, [2] University of Bristol, School of Veterinary Science.
Karen.Wheeler@adas.co.uk

Introduction

Lameness is a common welfare issue for UK sheep flocks and causes significant production losses. White line separation and impaction is a common finding during routine ovine foot examinations but little is currently known about the pathogenesis of the condition. In dairy cattle oral biotin supplementation has been shown to reduce the prevalence of white line lesions (WL) (Hedges *et al.*, 2001). The aim of this study was to evaluate the effect of oral biotin supplementation on the percentage and severity of white line lesions in a lowland sheep flock.

Materials and Methods

A single randomised split flock trial was conducted in a commercial North Country Mule flock with a history of WL. During a one-year longitudinal study, the feet of 302 ewe lambs were repeatedly scored using a categorical scoring scale (Table 1). Animals with WL in one or more feet (n=260) and those without WL (n=42) were randomly allocated to one of three groups;

- Control – no supplementation,
- Zinc – zinc-based rumen bolus (releasing 82 mg bioavailable zinc/head/day) and
- Biotin - a biotin and zinc bolus (releasing 5 mg biotin and 82 mg zinc/head/day over four months).

At four-monthly intervals, sheep were re-bolused and individual feet scored by the same assessor who was blinded to the treatments. All study animals were managed as a single group for the study duration.

Table 2. WL scoring scale

Score	Description
0	No lesion observed/lesion healed
1	Minor separation of white line
2	Moderate separation of white line
3	Major separation of white line
4	Discrete lesions with no separation
5	Active infection of white line

Results

Most sheep at study commencement (86%) and throughout the trial period were observed with WL although few were recorded with severe lesion scores at any assessment visit (Figure 1). Logistic regression analysis identified no significant difference ($p>0.05$) between the proportion or severity of WL scores recorded in Control, Zinc or Biotin groups at any of the four assessment visits. Figure 2 illustrates that in feet observed with WL in January 2012 (n=763) there was some reduction in the percentage of WL across all three treatment groups, although significant treatment differences were not observed.

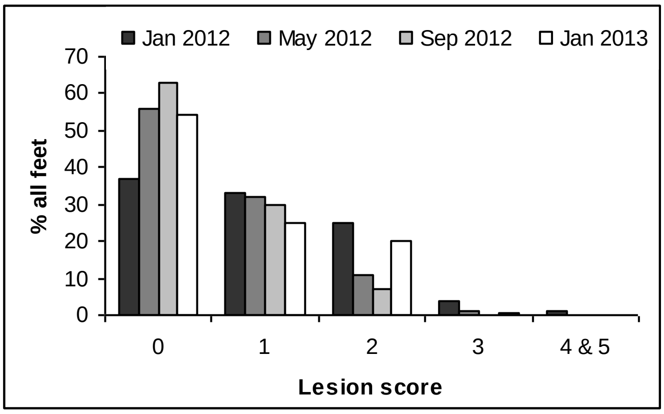


Figure 4. Distribution of WL scores at each assessment visit

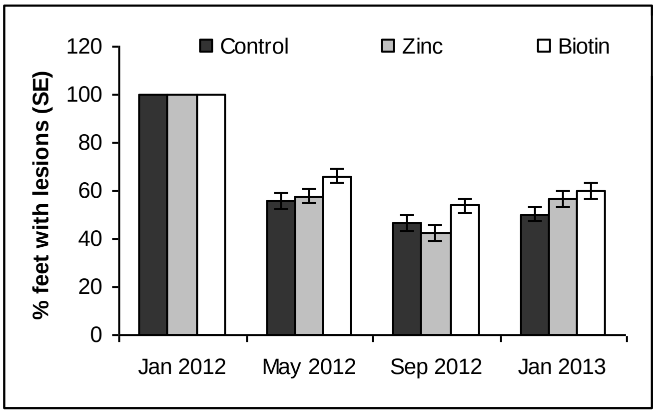


Figure 5. Feet with WL (scores 1-5) at the first assessment (January 2012) and the percentage of these feet recorded with WL at subsequent assessments

Discussion

This study identified that compared to control animals, four-monthly oral supplementation with a bolus releasing 82 mg/day available zinc only or 5mg/day biotin and 82 mg/day zinc did not have a significant effect on the severity of WL scores. As the study was conducted in a single lowland flock of sheep with relatively mild lesions it may be useful to evaluate the effect of biotin in a larger population with more severe lesions over a longer study period. The effect of environmental and climatic conditions and the role of genetics in WL of sheep also warrant further research.

Acknowledgments

This project was funded by EBLEX. The support of the host farmer, DSM Nutritional Products UK Ltd for supplying the biotin and Agrimin Ltd for supplying and administering boluses is gratefully acknowledged.

References

Hedges J, Blowey RW, Packington AJ, O'Callaghan JC, Green LE 2001 A longitudinal field trial of the effect of biotin supplementation on lameness in dairy cows. Journal of Dairy Science 84:1969-1975.

P17(b). Awareness of ovine lameness and acceptability of flock owners to surgical intervention as a prophylaxis for lameness due to interdigital pouch inflammation in Zaria, Nigeria

B Usman[1], AZ Hassan[2], US Abdullahi[3], L. Khalid[4], ST Fadason[2], BD Remi-Adewunmi[2], A Mohammed[5]
[1]Veterinary Teaching Hospital, Ahmadu Bello University, Zaria, Nigeria, [2]Department of Veterinary Surgery and Radiology, Ahmadu Bello University, Zaria, Nigeria, [3]Department of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria, [4]Department of Surgery, Ahmadu Bello University Teaching Hospital, Zaria, Nigeria,
[5]Department of Veterinary Surgery and Reproduction, University of Maiduguri, Nigeria
usmanab40@yahoo.com

Introduction

Sheep provide major source of income and food security to rural and urban dwellers in northern Nigeria owing to their efficiency in converting poor quality feed into desirable low cost products. Conditions of limbs that cause lameness in sheep during the wet season constitute major constraint to the development of small ruminant production systems in Nigeria. The economic implications of lameness are tremendous in terms of reduced market value and reduced overall productivity of the sheep.

Materials and Methods

A cross sectional study was conducted to determine the awareness of ovine lameness and acceptability or otherwise of flock owners to surgical intervention as a prophylaxis for lameness due to interdigital pouch inflammation in Zaria and environs. Three wards were randomly selected from Zaria, Sabon Gari and Giwa Local Government Areas that formed the study area where the research was conducted. One hundred and seventeen flock owners were interviewed using structured questionnaire to know the relevant details regarding awareness of ovine lameness in general and lameness due to interdigital pouch inflammation in particular. The willingness to accept a surgical intervention as a prophylaxis for lameness due to interdigital pouch inflammation to be carried out in the flocks of the respondents was also recorded.

Results and Discussion

Of the total number of flock owners interviewed, 106(91%) of them indicated awareness of lameness as a problem in their flocks. This emphasizes the significant role that lameness conditions play as impediment towards profitable sheep production. Majority of them also did observe the condition more frequently during the rainy season with the peak in August. Thirty percent [78(30%)] and 74(29%) of the respondent flock owners have identified weight loss and locomotory problems as the major consequences of lameness in their sheep, respectively. Fifty-nine percent [69(59%)] and 27(23%) of flock owners were found to engage in semi-intensive and extensive systems of management, respectively. There was significant association ($p<0.05$) between these management systems and the occurrence of lameness in sheep in the study area. The study showed that majority 70(60%) of the respondent flock owners could not provide adequate housing for their flocks. This finding in relation to occurrence of lameness as observed by respondent flock owners was statistically significant ($p<0.05$). This could have been the major contributing factor for the high rate of occurrence of lameness in the sheep that were poorly housed. The results obtained also showed that the forelimbs were more affected by lameness due to interdigital pouch inflammation compared to the hind limbs because of their position making them more prone to contamination and injuries. Finally, the study has revealed that 113(96.6%) of the respondent flock owners in Zaria and environs did accept and approved the application of the use of surgical excision of the interdigital pouch in their sheep as a preventive measure against lameness due to interdigital pouch inflammation. With the kind of response obtained it shows that sheep owners are in dire need of assured lameness preventive measure and should the intervention work they would employ it as part of their management strategy.

P18(a). Habituation to test procedure improves precision of mechanical nociceptive threshold testing

PM Raundal[a], PH Andersen[b], B Forkman[b], MS Herskin[c], L Munksgaard[c]
[a]Dairy and Cattle Farming, Knowledge Centre for Agriculture, DK-8200 Aarhus N, Denmark, [b]Department of Large Animal Science, University of Copenhagen, Hoejbakkegaard Allé 5, DK-2630 Taastrup, Denmark, [c]Department of Animal Science, Aarhus University, AU-Foulum, DK-8830 Tjele, Denmark
pra@vfl.dk

Introduction

Lameness has been linked to changes in nociceptive threshold. However, so far mechanical nociceptive threshold (MNT) testing had required handling of the experimental cows. Handling can be a potential stressor and thus influence the nociceptive thresholds (Herskin et al 2007). Therefore, to reduce handling, we used a handheld device and freely moving cows kept in their home environment and investigated the effect of habituation of dairy cows to the initial tactile phase of the test procedure on measures of MNT. We evaluated the intra-individual variation and the mean of MNT.

Materials and Methods

We used the Pressure Application Measurement device (PAM, UgoBasile, Comerio, Italy), adapted for bovine use (0.8 mm diameter blunt pin). Sixty healthy and lactating Danish Holsteins were selected from a production herd. Cows were randomly allocated to one of two habituation groups (H1 and H2) or one control group (C) in a parallel group design. Each cow was restrained in a cubicle by tying a robe behind her. Habituation procedure: The habituation cows were stroked repeatedly, first with the hand of the observer and then with the head of the PAM, from the base of the tail to the stimulation site (a 2x5-cm area on the dorsal aspect of left metatarsus) until the head of the device could be rotated and the tip brought in contact with the skin for 3 seconds. Maximum duration of each habituation session: 3 minutes. One session was performed just prior to testing for H1 and H2. H2 received an additional session 1-4 h earlier. A ramped stimulus (rate= 210 g/sec) was applied to the stimulation site until a leg lift response was observed or if the safety endpoint of 1500g force was reached. Each cow was stimulated 5 times (30s interval). One coefficient of variation (CV) was calculated per cow. Effects of habituation were analyzed in mixed effects models using R, version 3.0.0 (R Core Team, 2013) and presented as estimated means and standard errors.

Results

Intra-individual CVs and mean MNTs are given in Figures 1 and 2 respectively.

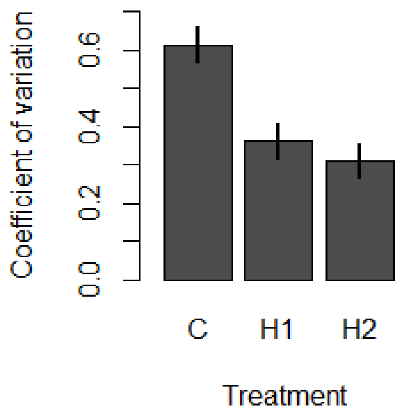


Figure 1 Mean (SE) intra-individual CV in treatment groups. H1 and H2 cows had lower CV than C cows ($p<0.001$) with no difference between habituations groups.

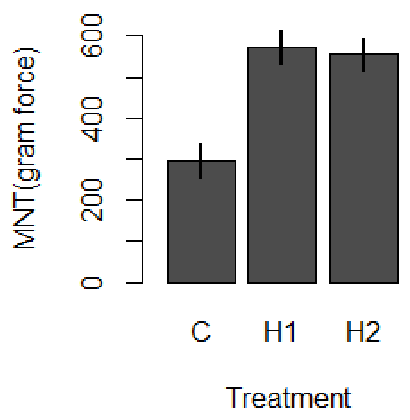


Figure 2 Mean (SE) of MNT in treatment groups. H1 and H2 cows had higher mean MNT than C cows ($p<0.001$) with no difference between habituation groups.

Discussion

Habituation significantly improved precision (decreased CV) to a level comparable with results from thermal nociceptive threshold testing (remote stimulation) in cattle (Veissier et al 2000). The mean MNT increased by habituation. We suggest that habituation reduce the frequency of responses to the initial tactile part of the ramped nociceptive stimulation resulting in a more accurate measurement of MNT.

Acknowledgements

Thanks to the staff at the Danish Cattle Research Centre, Burrehoejvej 49, DK-8830 Tjele, Denmark

References

Herskin MS, Munksgaard L & Andersen JB 2007 Effects of social isolation and restraint on adrenocortical responses and hypoalgesia in loose-housed dairy cows. Journal of Animal Science 85 240-247

Veissier I, Rushen J, Colwell D & de Passillé AM 2000 A laser-based method for measuring thermal nociception of cattle. Applied Animal Behaviour Science 66 289–304

P18(b). Wedge-shaped Blocks, Wood and Flexible, Advance a Good Locomotion Performance

J Maierl[1], A Fiedler[2], D Doepfer[3], J Haas[4], R Höfler[4], H Kellhuber[4], M Moosbauer[4], H Warmedinger[4]
[1]Department of Veterinary Sciences, University of Munich, Germany; [2]Practicing veterinarian, Munich, Germany; [3]FAPM, SVM, UW Madison, USA, [4]Hooftrimmer, Germany
j.maierl@lmu.de

Introduction

Blocks of different material are useful to elevate an affected claw to speed recovery from a lesion.
The aim of this study was to prove the advantage of a wedge-shaped design in wood blocks 130mm (5 1/8´´) long with 23mm (7/8´´) height at heel and 15mm height at the tip (Figure 1a), and flexible blocks (120mm (4 4/5´´) long, 20mm (4/5´´) height at the heel and 15mm (3/5´´) at the tip (Figure 1b) compared to standard wood blocks (130mm (5 1/8´´) long and 22-23mm (7/8´´) high) and standard flexible blocks (120mm (4.725´´) long and 20mm (4/5´´) high).

Materials and Methods

In three dairy herds (125 animals, 120 animals and 62 animals resp.) the hooves were professionally trimmed and different blocks were fixed on a medial hind claw of lame cows (average rounded locomotion score: 3) (Sprecher et al., 1997) (Table 1).
The standard wood blocks were fixed with a fast-setting adhesive (Technovit-2-Bond, Heraeus-Kulzer GmbH, Wehrheim, Germany), the flexible blocks, made of a specially-formulated ethylene vinyl acetate (EVA) of 70 Shore-A hardness, were fixed with a specially-formulated "Super Glue-type" cyanoacrylate adhesive (Walkease, Shoof International Ltd, Cambridge, New Zealand).
Locomotion Score with wood blocks (Figure 2a) was documented on day 0 (before and after fixing the blocks, day 0-1 and day 0-2), on day 20 and on day 44 (before and after removing the remaining blocks, day 44-1, day 44-2) resp. The locomotion score of cows with EVA-blocks was evaluated on day 0 (before and after fixing the blocks) and day 10 (before and after removing the remaining blocks, day 10-1, day 10-2) (Figure 2b).

Results

The wood blocks lost the optimum shape after 20 to 44 days and the locomotion score started to rise again (Figure 2a). Two cows showed ulcers under removed blocks. The flexible blocks were compressed down to about 10mm after 10 days, and the locomotion score remained almost unchanged (Figure 2b).

Table 1 Fixed (day 0) and remaining blocks (day 10 resp. 20 and 44)

	Herd 1		Herd 2	Herd 3
	Standard-shape, wood block,	Wedge-shape wood block,	Standard-shape flexible block, (Walkease)	Wedge-shape flexible block, (Wedgies)
Day 0	18	20	27	15
Day 10	-	-	16	12
Day 20	13	15	-	-
Day 44	13	14	-	-

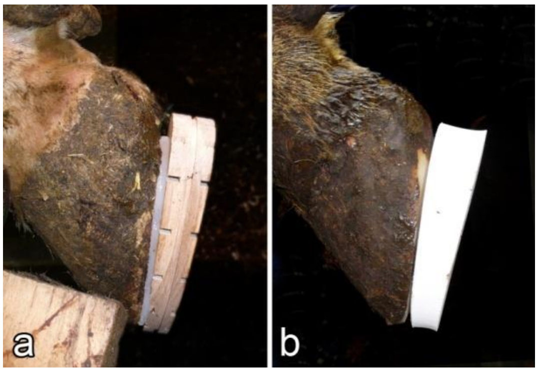


Figure 1 Wood block (a) and flexible block (b), both wedge shaped

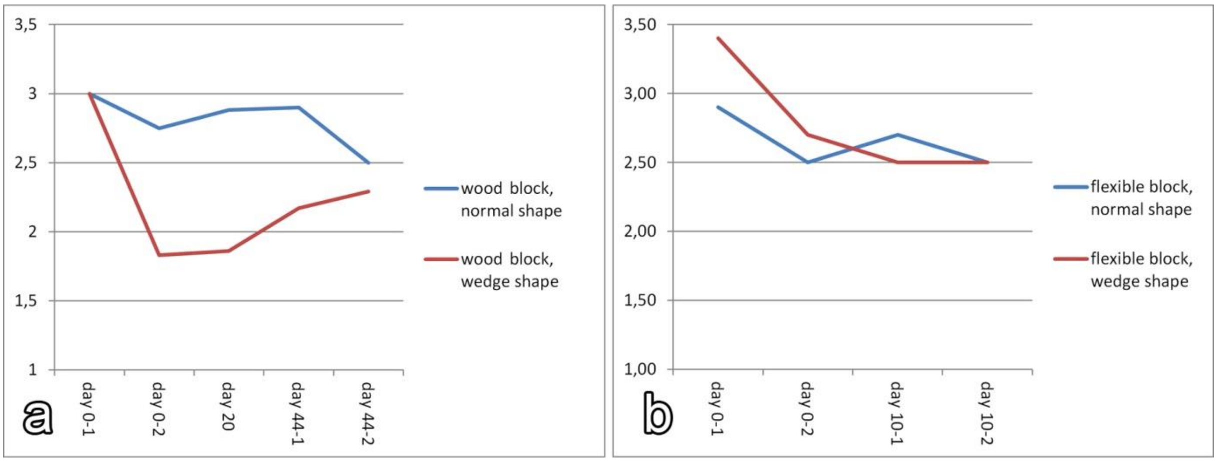


Figure 2 Locomotion score: a) wood blocks; b) flexible blocks

Discussion

Blocks, fixed under one claw when the other claw has to recover, are a perfect solution to reduce pain during healing process. Normal shaped blocks are level with the ground and do not support the recommended heel height (Toussaint Raven, 1985). Compared to the standard blocks the wedge blocks performed better. A supported heel seems to induce a better locomotion performance. The quick-and-easy-to-fix flexible blocks (Walkease, Wedgies) are a good alternative to wood blocks and can heighten the claw for 10 to 20 days. Due to the pressure these blocks lose their height after a while, they give the best support within the first ten days. It is a great advantage that these blocks get lost after 7 to 20 days so it is not necessary for the farmer to remove them himself. Wood blocks have to be removed after three weeks – there is no further improvement and problems could arise because of the lost of shape and structure. If necessary, the block has to be renewed after trimming the hoof.

Acknowledgments

Shoof International Ltd, New Zealand and Heraeus-Kulzer GmbH, Germany have supported this study by supplying the products.

References

Sprecher DJ, Hostetler DE & Kaneene JB 1997 A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 47: 1178–1187.

Toussaint Raven E 1989 Cattle footcare and claw trimming. Farming Press, Ipswich, UK.

Session 6

Treatment of Claw Lesions

and

Case Studies & Descriptive Reports

29. Lameness, pain and pain relief from the dairy farmers' perspective

SV Horseman[1], JN Huxley[2], NJ Bell[3], CS Mason[4], Roe, EJ[5], HR Whay[1]
[1] School of Veterinary Sciences, University of Bristol, Langford House, Langford, Bristol BS40 5DU, UK, [2] School of Veterinary Medicine and Science, University of Nottingham, Sutton Bonington Campus, Loughborough, Leicestershire LE12 5RD, UK, [3] The Royal Veterinary College, Hawkshead Lane, North Mymms, Hatfield, Hertfordshire AL9 7TA, UK, [4] Scottish Agricultural College, Dairy Research Centre, Hestan House, The Crichton, Dumfries DG1 4TA, UK, [5] University of Southampton
Sue.Horseman@bristol.ac.uk

Introduction

Freedom from pain is considered to be an important component of animal welfare. Lame cows have been found to have an increased sensitivity to noxious mechanical stimuli when applied to the lame leg (Whay et al 1997) which can be reduced through the administration of a non-steroidal anti-inflammatory drug (NSAID) (Whay et al 2005). Lame cows show altered lying behaviour (Ito et al 2010), altered feeding behaviour (Gonzalez et al 2008) and reduced milk production (Amory et al 2008). The hyperalgesia experienced by lame cows may be one explanation for these changes. Hyperalgesia may also impact on a cow's affective state. There are, therefore, potential benefits for both the cow and the farmer to managing pain in lame dairy cows. The measures taken to reduce pain in individual lame dairy cows will be largely driven by dairy farmers' perceptions of this pain and ways of managing it. To date there has been little research in this area. Here we present extracts from interviews conducted with dairy farmers in which they discuss these perceptions.

Materials and Methods

Twelve dairy farmers were interviewed in-depth about their experiences of detecting and treating lame cows on their farms. The interviews were conducted face-to-face whilst farmers treated one or more lame cows. The interviewer used a 'semi-structured' approach in which farmers were encouraged to talk about different aspects of lameness detection and treatment, for example the treatment methods they currently used. The specifics of each interview were largely guided by the farmer. The interviews were audio recorded, fully transcribed and analysed to look for key themes.

Results

One of the themes identified during analysis of the transcripts related to farmers' perceptions of the pain associated with lameness and possible methods for reducing that pain. There was some recognition that lame cows were in pain or in some form of discomfort. For example one farmer said whilst examining the claw of a lame cow: "Obviously it's painful, but I'm pressing the back of the heel and it is quite swollen, but this bits normal, and there is quite a lot of pain there still", whilst another said of a cow he was treating: "She's quite tender I think". However, the pain aspect of lameness was rarely directly referred to by farmers during the interviews.

Some aspects of lameness treatment were viewed as potentially painful. One farmer discussed why he didn't use sawdust to clean off claws before treating them stating: "Especially [if they have] digital, if you start rubbing sawdust in there it must be the most painful thing imaginable". Another talked about the foot bathing routine on the farm and said: "Usually [I] just use formalin, [but] if I know there's a bout of digital around I won't put formalin in because that's just cruel". In some cases farmers acknowledged that particular treatments caused discomfort but chose to use them due to their perceived efficacy. One said: "I do treat [digital dermatitis (DD)] with copper sulphate, just topically in the heel. I have found if they are real bad lesions it makes them very uncomfortable for that period after you've treated it but it will cure it", whilst another said of DD lesions: "The biggest secret is cutting it out. I'm not saying it's not cruel, horrible, but unless you get deep enough…leave a scab on the top and you are not doing any good at all".

In contrast some management practices and treatment protocols were adopted largely due to their positive impact on the cow's pain or discomfort. For example, one farmer discussed how applying an orthopaedic block could have a pain relieving effect: "Even if you just pick it up and think well there's obviously something not quite right with that claw, this one's OK, just clean it off so it's clean and rough, stick a block on it, fifty percent of the jobs done and at least the cow's not in pain anymore", whilst another discussed why he placed lame cows on to a straw bed: "Well straight away [I] put [lame cows] in the straw yard obviously so they can lie down, they're comfortable".

For some farmers the use of NSAIDs was an established treatment option for lameness. One farmer said: "It's just something I do…you can tell they're sore or in pain, [a NSAID] is pain relief, it's gotta help, well it does help because they do improve", whilst another stated: "Yeah if it's a really bad case I shall give them [a NSAID] because that's not a milk withdrawal. If it's serious I should give it [a different NSAID]".

In contrast, other farmers had little or no knowledge of the existence of NSAIDs and how they could be used. This lack of knowledge is demonstrated in the following dialogue which took place during one interview:

> Interviewer – "Do you ever use any analgesics in your lame cows?
> Farmer – No, never used that on cows....what does it do exactly?
> Interviewer- It's a pain killer.
> Farmer- So it's not an antibiotic then? It's a pain killer.......No, no, never heard of it".

Another farmer stated: "We don't use injectable pain killers or anything like that. It's maybe something we should do. I would have thought when you're actually doing the treatment it would be good...but there's not anything like that available as far as I'm aware".

Some farmers expressed an awareness of the availability of pain relieving drugs but used them very little for lame cows. Some felt that pain relief was only necessary for severely lame cows and therefore did not use them as they felt their cows were not usually lame enough to warrant using them:

> "I very rarely use [NSAIDs] on a foot problem unless it is really badly swollen ……..I mean I haven't had anything that severe that I've had to use [a NSAID] because I don't let them get to that stage".
> "We wouldn't tend to have anything we would need to treat with pain killer".

Others doubted the benefits of treating lame cows with pain killers, as demonstrated by this conversation:

> Interviewer – "So you don't think [pain relief] would make any difference?
> Farmer- It probably would...but is pain relief through [NSAIDs] for the next four or five days the answer? No, curing the foot is the right answer. I would much rather put a block on...and that would be the pain relief than use [a NSAID] and send her back out or whatever".

On some farms NSAIDs were being used for other conditions such as mastitis but not generally for lame cows:

> "We're using [a NSAID] more now for things like....we haven't used it a lot on lameness. We've used it a bit more for mastitis".

The farmers' use of NSAIDs was often guided by information which they received from their vets. For example one farmer discussed how his vet encouraged the use of pain killers:

> Farmer -"[Our vet is] very keen on using pain killers nowadays
> Interviewer – And do you use them?
> Farmer – Yeah, probably not as much as [our vet] would like us to"

Another farmer discussed how he had to open the dialogue with his vet about pain relief:

> Interviewer – "Is pain relief something the vet is discussing more with you these days?
> Farmer – We've got to do the pushing. They're happy to discuss it. I mean they aren't bad. But we've got to be a bit...we come up with the ideas quite often rather than them".

Finally, the following extract gives an indication why pain relief is sometimes being used on farms for other potentially painful conditions in cows but not for lameness:
"[The vets] rarely tend to use [painkillers] for feet. I don't know why that is but they don't tend to use them that much….. They use it, say they're doing a LDA, not that we get many of those, they use it for that kind of thing, that's more routine, and a severe mastitis, they use it for things like that, but not really as much for feet". When the interviewer asked the farmer whether he ever uses them for lame cows he replied "no, no, because I'm guided by [the vets]".

Discussion

The farmers in this study rarely directly discussed lameness as a potentially painful condition for their cows. However, farmers did discuss actions which they took to reduce pain or discomfort in their cows and the potential pain which could be caused by some treatment methods. In a survey conducted by Huxley and Whay (2007) half of the farmers (500) they questioned stated they would like their cows to receive analgesia either during or after treatment for sole ulcer. This suggests some broader acceptance that lameness and its treatment can be potentially painful. The farmers in this study had varying levels of knowledge about NSAIDs and the possible benefits these may have for lame cows. Whilst there is no evidence that NSAIDs have an impact on lesion resolution in lame cows, NSAIDS modulate the hyperalgesia associated with lameness when combined with treatment (Whay et al 2005) and may therefore have a positive impact on the cows affective state, behaviour and productivity. The farmers in this study were largely guided by their veterinary surgeon in their use of NSAIDS. Some reported that this guidance was lacking. It is of particular concern that some farmers were unaware of the existence of pain relieving drugs. Huxley and Whay (2007) reported that half of farmers they questioned felt that their vets did not discuss pain control enough with them. There is therefore an important role for vets and other herd health advisors to raise awareness of the pain associated with lameness and its treatment and to discuss the benefits of NSAIDs and other methods of pain control with dairy farmers to ensure appropriate uptake on farms.

Acknowledgements
The authors are very grateful to the farmers who took the time to be interviewed. This project was kindly funded by DairyCo (www.dairyco.org.uk / www.ahdb.org.uk) a levy funded, not for profit organisation working on behalf of British dairy farmers and part of the Agriculture & Horticulture Development Board.

References
Amory JR, Barker ZE, Wright JL, Mason SA, Blowey RW & Green LE 2008 Associations between sole ulcer, white line disease and digital dermatitis and the milk yield of 1824 dairy cows on 30 dairy cow farms in England and Wales from February 2003-November 2004. *Preventive Veterinary Medicine* 83**:** 381-391.
Gonzalez LA, Tolkamp BJ, Coffey MP, Ferret A & Kyriazakis I 2008 Changes in feeding behavior as possible indicators for the automatic monitoring of health disorders in dairy cows. *Journal of Dairy Science* 91**:** 1017-1028.
Huxley JN & Whay HR 2007 Attitudes of UK veterinary surgeons and cattle farmers to pain and the use of analgesics in cattle. *Cattle Practice* 15**:** 189-193.
Ito K, Von Keyserlingk MAG, Leblanc SJ & Weary DM 2010 Lying behavior as an indicator of lameness in dairy cows. *Journal of Dairy Science* 93**:** 3553-3560.
Whay HR, Waterman AE & Webster AJF 1997 Associations between locomotion, claw lesions and nociceptive threshold in dairy heifers during the peri-partum period. *Veterinary Journal* 154**:** 155-161.
Whay, HR, Webster AJF & Waterman-Pearson AE 2005 Role of ketoprofen in the modulation of hyperalgesia associated with lameness in dairy cattle. *The Veterinary record,* 157**:** 729-733.

30. Complexities of on-farm clinical trials for the treatment of lameness in cattle

HJ Thomas[1], G Miguel Pacheco[1], NJ Bell[2], C Mason[3], HR Whay[4], O Maxwell[1], SC Archer[1], J Remnant[1], N Bollard[1], P Sleeman[1], JN Huxley[1]
[1]University Of Nottingham, School of Veterinary Medicine and Science, Sutton Bonington Campus, Leicestershire, LE12 5RD; [2]Royal Veterinary College, [3]Scotland's Rural College, [4]University of Bristol
Stxht1@nottingham.ac.uk

Little up-to-date information exists in the scientific literature to inform on the most appropriate treatment interventions for claw horn lesions in dairy cattle. In order to address this issue, a study was planned to test commonly used treatments. It is widely recognised in medicine that the most rigorous way to determine a cause-effect relationship between a treatment and outcome is by conducting a double-blind, randomised controlled clinical trial (RCT). Conducting such a study for lameness treatments in dairy cattle however, reveals many complexities which may in part explain why very few such studies have been conducted previously. This paper will review and discuss the problems identified whilst planning and implementing one such RCT.

When considering treatment of claw horn lesions, it was first necessary to select appropriate cases for inclusion. A wide range of disease can be seen on farms from early onset through to chronic, necrotic lesions. Due regard was also required for ethical concerns regarding non- treatment of cows identified as lame. Identification of treatments for use in the study was also important to ensure protocols developed were both effective and relevant to the clinical situation. Following an expert review process and taking into account practical considerations, treatments selected were a five-stage therapeutic trim, foot block and analgesia. Administering these treatments as part of a RCT protocol however was less than straightforward. Use of a foot block meant that animals with lesions on both claws were necessarily excluded and accounted for a large number of exclusions in the final study. Blinding all operators to the treatments administered was not possible due to the visibility of blocks and medications which required repeat administration and recording.

Use of a negative control group designed to allow a direct comparison of the effects of a treatment intervention with that of no intervention also raised practical and ethical concerns. A positive control was therefore decided upon with all animals receiving a five-stage therapeutic foot trim as standard, the minimum that would be administered in the field. Additional treatments of a foot block, NSAID or combination of both were allocated at random following the therapeutic trim (Table 1).

Table 1. Treatments applied at random following an initial five-stage therapeutic trim

		FOOT BLOCK	
		NO	YES
NSAID	NO	Treatment 1	Treatment 2
	YES	Treatment 3	Treatment 4

The need for fortnightly locomotion scoring on each farm to identify new cases of lameness, accompanying treatments and independent outcome assessment meant that farm selection was made on the basis of proximity to the University of Nottingham and the willingness of farmers to participate in the trial. Locomotion scoring was considered the most practical and effective way of monitoring the outcome to treatment, however this procedure is subjective and therefore required an independent observer in addition to those regularly visiting the farms. Minimum requirements for lameness prevalence, milk recording and digital dermatitis control were also specified therefore variance in the population as a whole may not have been reflected by the narrow geographical location and level of management required.

Acknowledgements
This project was funded by DairyCo (www.dairyco.org.uk / www.ahdb.org.uk) a levy funded, not for profit organisation working on behalf of British dairy farmers and part of the Agricultural & Horticultural Development Board.

31. Interdigital hyperplasia and its implication in dairy cattle lameness

A Kougioumtzis[1], E Tsiamadis[1], GE Valergakis[1], G Arsenos[1], G Banos[1,2]
[1]Laboratory of Animal Husbandry, Faculty of Veterinary Medicine, AUTh, Greece, [2]SRUC, Roslin Institute Building, EH259RG Midlothian, UK
akougiou@vet.auth.gr

Introduction
Interdigital hyperplasia (IH) or fibroma is a fold of hyperplastic skin that protrudes from the interdigital space, caused by over-tension and slow fibrosis of the subcutis of the interdigital skin (Greenough, 2007). This results from skin irritation caused by environmental and conformational factors. There is also a hereditary predisposition in both beef and dairy cattle. In practice, small lesions are not associated with lameness but any enlargement, ulceration or infection could cause mild, moderate or severe lameness. Lameness is of great concern in dairy cattle in terms of animal welfare but also because of its direct and indirect economic losses (Noordhuizen, 2012). Our objective was to investigate the implications of IH on dairy cow lameness throughout a whole lactation.

Materials and Methods
The study was carried out in a large commercial farm located in Northern Greece and included 237 first lactation and 66 second lactation Holstein cows that calved between 2008 and 2010. Cows were locomotion scored weekly on a five-point scale, starting six weeks before calving and throughout lactation. A trained veterinarian, with proficient skills in detecting lameness assessed all cows. Those with a score ≥ 2 were considered lame and were hoof trimmed at the day of observation. The total number of hoof trimmings was 1286. Any lesions were recorded in a designated sheet and when IH was observed it was scored on a scale from one to three. Interdigital hyperplasia lesions scored as "one" were never associated with lameness alone and were not included in the subsequent analysis. Interdigital hyperplasia was treated conservatively (corrective hoof trimming, use of oxytetracycline and bandaging) without surgical removal of lesions. Any other lesions were also treated appropriately.

Results
A total of 1286 cases of lameness were recorded during the study. Interdigital hyperplasia, alone or associated with claw horn disorders/contagious diseases, was present in 346 cases (26.9%), involving 102 cows (33.7%). Details are presented in Table 1. In 84 cases (24.3%), IH was the only lesion recorded; in 65 cases (77.4%) with a score of 2 and in 19 (22.6%) with a score of 3. Mean locomotion score (± st.dev.) associated with IH alone was 2.54±0.55, while it was 2.47±0.53, 2.52±0.58 and 2.53±0.50 for IH with contagious diseases, IH with claw horn disorders and IH with both types of disorders, respectively. Mean locomotion score was 2.48±0.53 for IH=2 and 2.74±0.56 for IH=3. Twenty-two cows (7.3%) had repeated cases of lameness due only to IH.

Table 1. Lameness associated with interdigital hyperplasia (IH)

	Both lactations	1st lactation	2nd lactation
Total cases	346	243	103
IH, only	84	64	20
IH with contagious diseases	81	58	23
IH with claw horn disorders	94	55	39
IH with both contagious diseases and claw horn disorders	87	66	21

Discussion
Interdigital hyperplasia is observed frequently in lameness cases and is often the only cause of it. Regardless of whether IH was found alone or with other lesions, lameness severity did not quite differ. In conclusion, IH seems to be a more serious problem than it is actually thought and should attract more attention regarding its treatment and prevention in the future.

Acknowledgements
The first author acknowledges financial support from the State Scholarships Foundation of Greece.

References
Greenough PR 2007 Bovine laminitis and lameness. First ed. Philadelphia, Elsevier Limited, USA.
Noordhuizen J 2012 Dairy herd health and management. A guide for veterinarians and dairy professionals. Context editions, UK.

32. Toe-Tip Necrosis Syndrome in Feedlot Cattle in Western Canada

CD Paetsch[1], MD Jelinski[1]
[1]University of Saskatchewan, Saskatoon, SK, Canada
chad.paetsch@usask.ca

Introduction
Toe-tip necrosis syndrome (TTNS) has been described as a separation of the sole and dorsal hoof capsule along the white line, with evidence of tissue necrosis. Sequelae include osteitis of P3, osteomyelitis of P2 and P1, flexor tendonitis, pedal cellulitis and embolic pneumonia. Anecdotal reports suggest a greater prevalence in hyper-excitable cattle, and involvement of bovine viral diarrhea virus (BVDV); however, the epidemiology and pathogenesis have not been critically examined. The objective of the study was to describe the epidemiology of toe-tip necrosis in feedlot cattle in western Canada, and identify potential risk factors.

Materials and Methods
The study involved two parts. Part one was a retrospective study of 702 confirmed cases of TTNS. Case records included the number of days on feed (DOF) until death, age class, and source of animals (ranch, auction, etc.). Part two was a case-control study in which veterinary practitioners were instructed to submit the feet of suspected cases and controls, as well as samples of skin and heart tissue. One or more feet from 79 suspected cases and 67 controls were received. The feet were examined grossly and sectioned to confirm the diagnosis of TTNS (Figure 1). A culture swab was taken from the cut surfaces for bacterial isolation. Skin and heart samples were tested by immunohistochemistry (IHC) for BVDV and *Histophilus somni* antigens. The heart was also examined for evidence of a vasculitis.

Results
Of the 702 cases, 55% were yearlings and 45% were calves. The mean (median) interval from arrival to first treatment for TTNS was 18.9 ±1.7 d (12 d) (Figure 2). The mean (median) interval from arrival until death was 42.7 ± 1.7 d (27.0 d). The majority (75.2%) were euthanized due to a lack of clinical improvement. Regarding the source, 545 (77.6%) were derived from auctions, 53 (7.5%) from pastures, and 69 (9.8%) were back-grounded. Deaths occurred in all months of the year but clustered in the fall of the year. The cases had a greater incidence of vasculitis (OR = 2.2, 95% CI 1.03 – 4.58; P = 0.041) and were more likely by IHC to be positive for BVDV (OR = 2.8, 95% CI 1.23-6.36; P = 0.012); no difference was detected between groups in the incidence of *Histophilus somni* immuno-reactivity (P = 0.433). Of the 79 cases, aerobic and anaerobic culture results showed *Escherichia coli, Trueperella pyogenes,* and *Streptococcus* spp. accounted for 66% of the isolates, whereas of the 67 control results, *Corynebacterium* spp., *Streptococcus* spp., and *Enterobacter* spp. predominated 61% of the isolates.

Figure 1: A cross-sectional view of pedal osteitis.

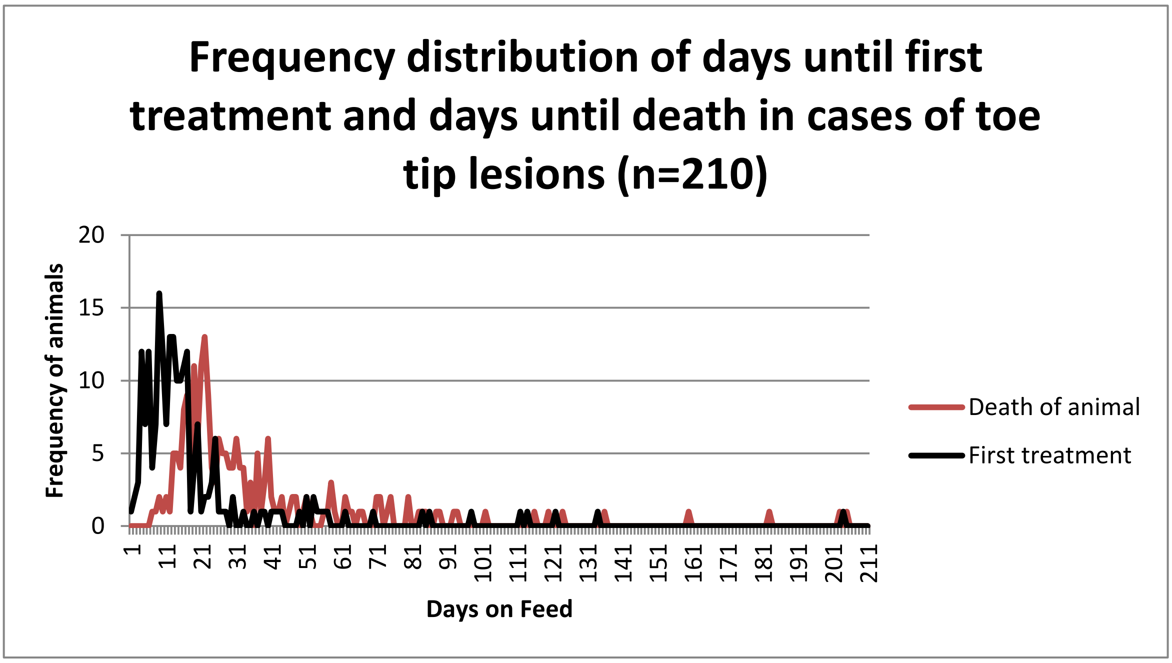


Figure 2: The frequency distribution of days on feed until first treatment and days on feed until death in toe tip lesion animals.

Discussion

The frequency distribution of the cases suggests that the syndrome may be related to transport and/or initial handling. While TTNS clustered in the fall months (October-December), this was probably confounded by the fact that most cattle in western Canada enter feedlots in the fall. We conclude that BVDV is a risk factor for the development of the disease and pathogens isolated reflect common environmental contaminants; however, the influence of cattle behaviour and handling requires further investigation.

33. Practical intervention toe necrosis

M Holzhauer[1]
GD (Dutch Animal Health Service) Deventer, The Netherlands
m.holzhauer@gddeventer.com

Introduction

Lameness and mastitis are the most serious herd related disorders in most dairy herds in Western Europe, related to welfare and economics (Cha and others, 2010). The most important cause of lameness are claw disorders (90%, Toussaint Raven, 1985) and these may be both of infectious (digital dermatitis, interdigital dermatitis/heel horn erosion, interdigital phlegmona) and non-infectious origin (sole haemorrhage, sole ulcer, white line disorder or toe necrosis (TN)). The herd prevalence of TN is estimated > 50% and the cow prevalence of TN is (<2%, distribution; min. 0%, max. 10%; Holzhauer et all, 2009; data from Digiklauw). Although the prevalence is relatively low, both the economic impact (reduced fertility, premature culling) and the affection of welfare (permanent lameness) is considerable.

Methods and Results

Supported by good anaesthesia (local infiltration, nerve blocking or iv), a simple and practical method of *partial* amputation is advised nowadays in our country with a healing percentage of > 90%. This practical method releases lameness and pain and saves the dairy cow for the herdsman. The method will be demonstrated with the help of a photo set and some epidemiological aspects (e.g. risk factors) and complications being discussed.

References

Cha E, Hertl JA, Bar D and Gröhn YT 2010 The cost of different types of lameness in dairy cows calculated by dynamic programming. Preventive Veterinary Medicine 97:1-8.
HolzhauerM, van Bostelen M and van Bostelen T 2009 Internal project on prevalence and risk factors of toe necrosis and non-healing white-line disorders in dairy cows.
Toussaint Raven E 1985 Cattle foot care and claw trimming. Ipswich, UK. Farming Press.

34. Histopathology from samples collected from different claw lesions of five lame cows from one herd in southern Chile

J. Borkert[1], F. Galleguillos[1], C. Sandoval[2]
[1]Borkert y Cía. Ltda., Hoof Trimming Company. [2]Laboratorio Diagnóstico Biovac S.A Investigación & Desarrollo. Osorno, Chile
jborkert@cuidatuvaca.com

Introduction
Lameness caused by infectious aetiology is an extremely painful condition. Pain causes a negative physiological reaction as well as reducing the animal´s incentive to seek food and water. The most frequent clinical signs are raised body temperature and a very rapid drop in milk yield. The reduced milk yield will continue so long as the animal is in pain and the feed intake will decline. There are no similar histopathology studies about this type of lesions in dairy herds in southern Chile.

Objective
Determine through different histopathology stain possible aetiology organisms from samples collected from different claw lesions of five lame cows from one herd in southern Chile.

Material and Methods
A group of five lactating lame cows from one dairy herd in the X region of Chile were attended in April of 2013 and the samples of tissues of different lesions like digital dermatitis, interdigital dermatitis, heel erosion and white line disease were collected by a veterinary doctor. Each tissue was fixed in buffered formol saline and sections stained with hematoxilin – eosin (H & E), Brown & Brenn, Warthin Starry, Peryodic Acid Schiff (PAS). The samples were processed and analyzed in Biovac S.A. Laboratories.

Results

Sample	H & E	Warthin Starry	PAS	Brown & Brenn
Interdigital dermatitis	The middle and basal layers of the epidermis with light neutrophil infiltration.	The middle and basal layers of the dermis and epidermis with moderate quantity of structures with spiral form like Treponema sp.	There is no evidence of fungus organisms	Limited to moderate structures cocoides Gram + (blue stained) in keratinized layers.
Heel erosion	The middle and basal layers of the dermis and epidermis with strong neutrophil infiltration.	The middle and basal layers of the dermis and epidermis with abundant quantity of structures with spiral form like Treponema sp.	There is no evidence of fungus organisms	-------
White line disease	The middle and basal layers of the dermis and epidermis with strong neutrophil infiltration with loss of normal architecture.	The middle and basal layers of the dermis and epidermis with limited to moderate quantity of structures with spiral form like Treponema sp.	There is no evidence of fungus organisms	Moderate structures cocoides Gram + (blue stained) a level dermis
Digital dermatitis	The dermis and epidermis with strong neutrophil infiltration with loss of normal architecture in the dermis.	Epidermis with abundant structures with spiral form like Treponema sp.	There is no evidence of fungus organisms	---------

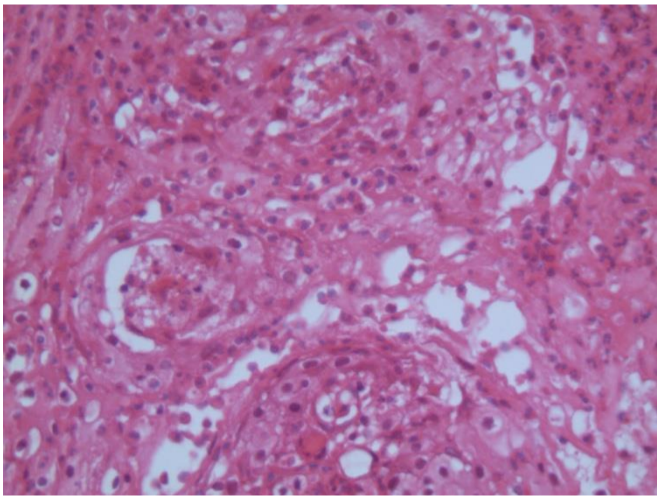


Figure 1. Digital dermatitis. Dermis hematoxilin – eosin 40x. Infiltration of PMN neutrophil.

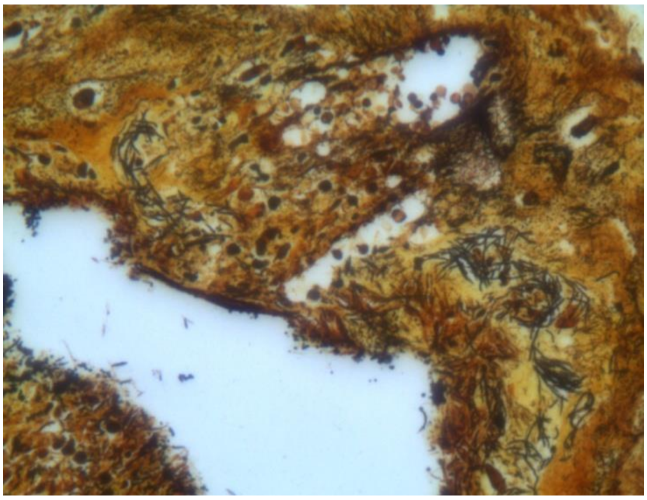


Figure 2. Heel erosion. Epidermis Warthin Starry 63x. Abundant spiral form like Treponema sp.

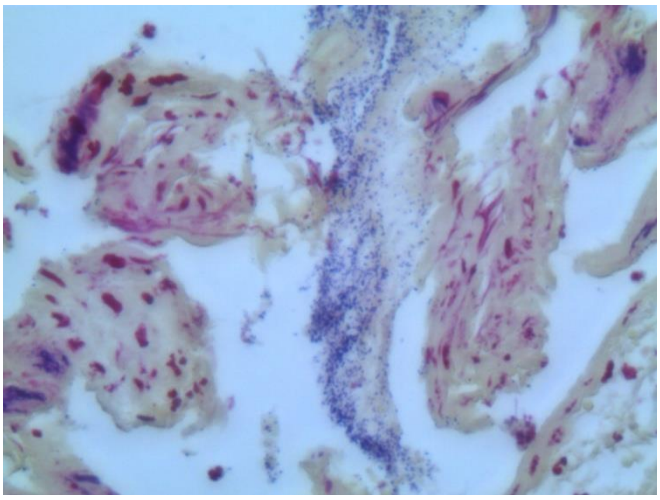


Figure 3. White line disease. Dermis Brow & Brenn 40x. Abundant structures cocoides Gram +.

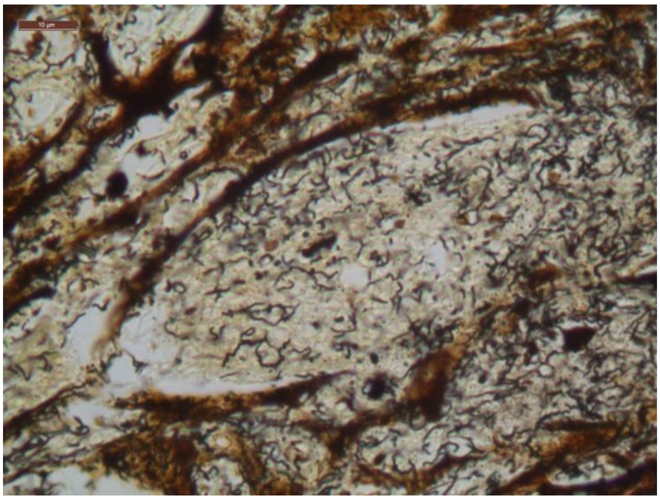


Figure 4. Digital dermatitis. Epidermis Warthin Starry 100x. Abundant spiral form like Treponema sp.

Conclusion

It is possible to observe a neutrophil swelling to layers of the dermis & epidermis. On the samples stained with Warthin Starry it is possible to see spiral forms similar to spirochetes like Treponema sp. From the Brown & Brenn technique it is possible to see cocoides form Gram +. It is necessary develop more research to determine the specific organisms which are involved in the aetiology of the claw lesions and how to isolate these from the lesions correctly in our conditions. This study can form the basis of future research in this area.

35. Bovine Digital Dermatitis and non-healing lesions and toe necrosis in grazing dairy herds in Chile

JP Acevedo[1], RN Chesterton[2], CS Hurtado[3]
[1]Toromiro, S.A, [2]Inglewood Veterinary Services, [3]Laboratorio Diagnóstico Biovac S.A
chesterton@inspire.net.nz

Introduction
In large grazing dairy herds it is common that traumatic lameness is a problem. On farms in this survey in Southern Chile many of the lame cows, with what looked like simple foot injuries, were non-responsive to treatment.
It has been reported that Bovine Digital Dermatitis (BDD) infection associated with a foot lesion may result in a chronic non-healing condition or "non healing (nh) lesion" (Evans et al, 2011). These nh lesions have been reported in UK, Netherlands and US.
BDD is endemic in Southern Chile, and it was suspected that BDD was possibly complicating the usually rapid healing of thoroughly treated claw injuries on these farms.

Aim
To confirm the presence of BDD infected non healing lesions in grazing dairy cattle in Southern Chile and survey its prevalence.

Materials and Methods
Data were collected from 19 herds of pasture fed dairy cattle in Southern Chile. Lesions were designated "BDD secondary infection" when an injury had extensive invasion of deeper tissues under the horn and also a characteristic pungent / sweet smelling weeping wound (Evans et al, 2011).
Nine full depth samples were taken including 5 representative cases of "BDD secondary infection" These were examined histologically and with Warthin Starry stain.

Results

Table 1 Survey of 617 feet treated January – May 2012

Lesion category	% of total lesions seen	% "BDD secondary infection" of this category
White line	41.7%	48.6%
Toe abscess	11.8%	56.0%
Skin BDD	10.0%	-
Axial crack	9.1%	46.4%
Solar ulcer	7.6%	14.9%
Sole injury	4.9%	10.0%
Other	14.9%	

Overall 33.1% of lameness cases were in the category of "BDD secondary infection". The prevalence of lameness from skin BDD ranged from 0.01% to 17.2% between farms.

Histology
In every case there were spiral-shaped bacteria clusters consistent of *Treponema sp*. found.

Discussion
On the farms investigated not only were there new lameness cases, but also a rising number of chronic cases that were slow healing or non-responsive to treatment.

The reports in the literature about "non-healing lesions" caused us to investigate the possibility that the farms were dealing with a secondary invasion of common injuries of white line sole, axial, toe with treponemes. The description of weeping wounds and the characteristic smell suggested the possibility and the histology and silver stain confirmed this.

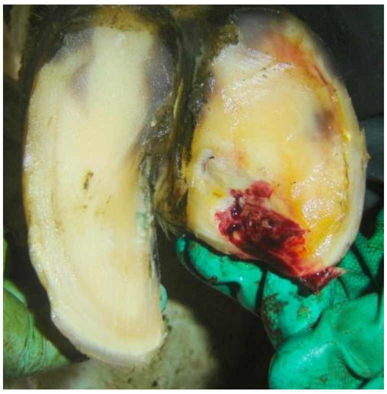


Figure 1 nh White Line case **Figure 2 Toe necrosis case**

Although skin BDD was endemic in these herds there was not a high prevalence when compared to that of housed cows in other countries.
It appears that this presentation of foot injuries with a BDD secondary infection may have been present for quite some time, even in grazing herds, but until recently not recognized as a separate category to “normal”, uninfected lesions. This has caused some confusion. It is necessary now that we more clearly define these types of lesions so that their etiology and epidemiology can be investigated. With a better understanding of the causes of these non-healing lesions, early intervention and more rigorous treatments can be researched.

References

NJ Evans, RW Blowey, D Timofte, DR Isherwood, JM Brown, R Murray, RJ Paton, SD Carter 2011 Association between bovine digital dermatitis treponemes and a range of ‘non-healing’ bovine hoof disorders. Veterinary Record doi: 10.1136/vr.c5487

P19(a). Ultrasound-guided femoral nerve block as a diagnostic aid in demonstrating quadriceps involvement in bovine spastic paresis

C De Vlamynck[a], L Vlaminck[a], S Hauspie[b], J Saunders[b], F Gasthuys[a]
[a]Department of Surgery and Anaesthesiology of Domestic Animals, Faculty of Veterinary Medicine, Ghent University, Belgium, [b]Department of Medical Imaging of Domestic Animals, Faculty of Veterinary Medicine, Ghent University, Belgium
Caroline.DeVlamynck@ugent.be

Introduction
M.quadriceps involvement has been reported as a new pathologic entity in bovine spastic paresis (BSP-Q) (Touati et al 2003). Differentiation between BSP-G (bovine spastic paresis of the gastrocnemius muscle) and BSP-Q affected calves is based on posture or gait analysis. BSP-Q calves demonstrate repeated spastic hyperextension of one or both hind limbs in anterior direction contrary to BSP-G. Increasing numbers of mixed presentations of bovine spastic paresis (BSP-M) in double-muscled Belgian Blue calves are seen nowadays. Depending on the dominant spastic muscles, hyperextension of the affected limb is variably directed complicating differentiation with the other entities.
Tibial neurectomy applied to BSP-Q or BSP-M can aggravate the symptoms. Clear distinction between entities is imperative to avoid BSP-G surgery on unsuitable patients.
As quadriceps activity is solely controlled by the femoral nerve (Budras & Habel 2003), a diagnostic anesthetic technique might be a better tool to identify muscle involvement.
The aim of the study was to evaluate the dorsal paravertrebral injection technique of the femoral nerve in healthy calves (De Vlamynck et al in press). It was hypothesized that the technique could reliably induce femoral nerve paralysis in reversible manner. Diagnostic implementation of the technique is further demonstrated in a BSP-Q and a BSP-M affected calf.

Materials and Methods
The study design was approved by the Ethical Committee for Animal Research of Ghent University (EC 2011-079). Based on bony landmarks and using ultrasound guidance, the femoral nerves of eight healthy calves were blocked with a 4% procaine solution containing blue dye performing a dorsal paravertebral block. Skin sensitivity of the medial thigh was tested 20 minutes after injection. Ultrasound image quality and paralysis status was scored. After euthanasia of the calves, successful location of the injection was confirmed during dissection work. The block was also performed in two patients.

Results
In 69 % of the cases a paralysis effect of the quadriceps muscle was obtained 20 minutes after blocking the nerve. A total paralysis of the quadriceps muscle was obtained in 50% of the cases. All calves presenting total or partial paralysis demonstrated complete loss of skin sensitivity. In 75% of the cases, the blue dye was less than 2 mm perineurally. Clinical use of the technique was demonstrated in two clinical cases with atypical presentations of bovine spastic paresis.

Discussion
Femoral nerve blocking has the potential to be a valid diagnostic method to establish involvement of the quadriceps femoris muscles in young calves suffering from the quadriceps form (BSP-Q) or mixed presentation (BSP-M) of bovine spastic paresis. Actually, no treatment is available for BSP-Q or BSP-M affected animals.

References
Budras KD and Habel RE 2003 In: Bovine anatomy. An illustrated text, 1st edition p 101. Schlütersche GmbH & Co. KG: Hannover, Germany.
De Vlamynck C, Pille F, Hauspie S, Saunders J, Van der Stede Y, Gasthuys F, Vlaminck L In press. Evaluation of three approaches for performing ultrasonography-guided anesthetic blockade of the femoral nerve in calves. American Journal of Veterinary Research.
Touati K, Muller PH, Grulke S, Peters F, Serteyn D 2003 La parésie spastique du quadriceps fémoral: Une nouvelle entité clinique chez le veau de race Blanc Bleu Belge. Annuelle Médicine Vétérinaire 147: 261-265.

P19(b). Necrotic toes: a cross-sectional observational study and proposed route of infection

OCD Atkinson
Dairy Veterinary Consultancy Ltd, Cheshire, UK
owen@dairyveterinaryconsultancy.co.uk

Introduction

Necrotic toes are a less common lesion causing lameness in dairy cows (Hyde, 2011). They cause protracted lameness and are non-healing so although incidence is low, prevalence within a herd can be as high as 5% (personal observation).
Necrotic toes are likely to involve treponemes responsible for digital dermatitis (Evans et al, 2011), and anecdotal experience suggests they appear more commonly on farms with uncontrolled digital dermatitis. The varied external appearances of toe necrosis are unified by osteomyelitis (and possibly osteoporosis) pathology of the distal pedal bone (Blowey and others, 2013) (figure 1).
Various possible aetiologies have been proposed for toe necrosis. Exposure of the solar corium due to toe ulcers or excessive wear is one such possibility, allowing secondary infection with organisms which might lead to a non-healing lesion (Kofler, 1999; Shearer and van Amstel, 2009, Gomez and others, 2011).

Materials and Methods

A survey of necrotic toes amputated by the author during normal clinical practice in a central region of UK was undertaken between 2009 and 2012. A proportion of amputated digits were frozen and sectioned to determine the extent of infection. Digits were not included in the study if lesions involved the lateral wall ("wall ulcers"), as presumably the initial disease in these cases was white line disease.

Results

Thirty nine digits with necrotic toes were included from cows on 14 dairy farms. Thirty six had split axial or dorsal hoof walls. Seven had active digital dermatitis lesions at the coronary band (figure 2). Split walls ranged from obvious dorsal lesions ("sandcracks") to more subtle separations of the axial wall which were harder to detect (figure 3). Frozen sectioned digits (n = 8) consistently showed infection could have originated at the coronary band, even in cases (n = 2) where there was no detectable split wall (figure 4).

Figure 1. showing osteomyelitis of pedal bone

Figure 2. showing digital dermatitis lesion at coronary band above axial wall

Figure 3. showing split axial wall

Figure 4. showing no detectable split axial wall, but a tract connecting coronary band to toe tip

Discussion
It is proposed that damage at the dorsal coronary band, including digital dermatitis lesions, can lead to ingress of bacteria, possibly including treponemes, which are able to track under the hoof wall following the laminae as a line of least resistance, in much the same way (but in the reverse direction) to a white line abscess which erupts at the coronary band. Split walls may develop, possibly due to disruption of normal horn production at the coronary band.
The significance of these observations is that digital dermatitis treponemes could be responsible for both the pedal bone pathology associated with toe necrosis, and also be the initiating lesion in some instances (at the coronary band). Control would include early detection and treatment of digital dermatitis lesions near the coronary band and foot bathing to ensure the skin at the dorsal coronary band is included.

References
Blowey R, Burgess J, Inman R, Evans N 2013 Bone density changes in bovine toe necrosis. Veterinary Record 172, 164-165
Gomez A, Dopfer D, Cook NB, Burgi K, Socha M 2011 Non-healing hoof lesions in dairy cows. Veterinary Record 169, 642
Hyde R 2011 The prevalence and severity of foot lesions in UK dairy cows identified by Category 1 hoof trimmers. Year 3 Dissertation, Nottingham University Vet School.
Kofler J 1998 Clinical study of toe ulcer and necrosis of the apex of the distal phalanx in 53 cattle. The Veterinary Journal, 157, 139-147
Shearer JK and **van Amstel SR** 2009 Toe lesions in dairy cattle in Proceedings of 46th Florida Dairy Production Conference, Gainesville, April, 2009.

P20(a). Case study: evaluation of hoof care management systems over time

EA French[1], M Lopez-Benavides, TC Hemling
DeLaval Inc., 11100 N. Congress Ave., Kansas City, MO, 64153
Lizzy.French@delaval.com

Introduction

When cows are lame, their reproduction, milk production, and welfare are compromised. A major cause of lameness is digital dermatitis (DD), a contagious hoof disease, which can be managed using a consistent and well monitored hoof care routine. A successful hoof care program should carefully consider: selecting an adequate product, frequency of use, hoof bath maintenance, routine hoof trimming, and adequate records. Hoof care products that serve to prevent DD are available, but long term observations to understand the interaction of product properties and hoof care management systems are limited. Presented below are observations made on 2 farms using different hoof care programs and their impact on DD prevalence over time.

Materials and Methods

This observational study was conducted in 2 dairy farms located in Southeastern Washington, USA, and evaluated over 8 months for DD prevalence. Parlour evaluations were made on each farm for prevalence of active DD lesions (Table 1).

Dairy A milks 2000 cows and delivers 4Hooves™ (DeLaval) using 2 automatic hoof baths from either parlour exit. Manual concrete baths are used when formalin is used. An independent hoof trimmer provides maintenance trimming on all animals and on reported lame cows on a weekly basis. Lesions from DD are treated with topical antibiotic packs in a foot wrap.

Dairy B is currently milking 630 Holstein cows and uses 2 automatic hoof baths. The hoof trimmer, an employee of the farm, observes dry and lame cows every other week. Warts are cauterized with a dehorning tool, packed with iodine gauze, and wrapped.

Results

The main deviation in routine was due to the time of year, inventory of hoof care products, and management decisions (Table 1).

Table 1. Overview of hoof care routines being observed at each visit

Visit	Dairy	Cows Scored	Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	A	445	1% FO*	1% 4H**	1% FO	1% 4H	1% FO	1% 4H	1% FO
2	A	425	1% FO	1% 4H	1% FO	1% 4H	1% FO	1% 4H	1% FO
3	A	551	1% FO	1% 4H	1% FO	1% 4H	1% FO	1% 4H	1% FO
4	A	452	1% 4H	1% 4H	1% 4H	1% 4H	1% 4H	1% 4H	1% 4H
1	B	70	1% HM***	1% HM	1% HM	1% HM	1% HM	1% HM	1% HM
2	B	195	1% 4H	1% FO	1% 4H	1% FO	1% 4H	1% FO	1% 4H
3	B	162	1% 4H	1% 4H	1% 4H	1% 4H	1% 4H	1% 4H	1% 4H
4	B	150	1% HM	1% HM	1% HM	1% HM	1% HM	1% HM	1% HM

* Formalin; ** 4Hooves™ (DeLaval); *** HealMax (Agro-Chem Inc.)

Both dairies decreased in prevalence between visit 1 and 2 (Table 2), and increased between visit 2 and 3.

Visit	Date	Ave Temp (ºC)	Precipitation (cm)	Dairy A	Dairy B
				Prevalence, n/100 cows	
1	Aug 2012	21	0,01	7,4	12,9
2	Oct 2012	9	0,08	5,6	8,7
3	Jan 2013	2	0,06	8,2	13,0
4	Mar 2013	6	0,02	7,3	24,7

Table 2. Average temperature, precipitation, and prevalence of digital dermatitis over 8 months.

Dairy A was able to reduce the prevalence of DD between visit 3 and 4 while it increased drastically in Dairy B. Dairy A ceased using formalin before visit 4 due to freezing conditions. Dairy B also had to stop using formalin before visit 3 due to freezing conditions. After the third visit, Dairy B stopped hoof bathing entirely for 2 weeks then switched product.

Table 3. Hoof health management system

	Dairy A	Dairy B
Record keeping	Written and entered electronically	None
Routing hoof trimming	Weekly	Bi-weekly
Cow hygiene	Freestall scraped daily	Freestall scraped 3 times per day
Hoof bath maintenance	2 AFB*, 1 per alley	2 AFB, 1 pre-wash + 1 treatment
Hoof bath volume (L)	200, solution refreshed every 200 cows	200, solution refreshed every 200 cows

* Automatic Foot Bath (AFB, DeLaval)

Discussion

Increase in DD between visit 2 and 3 are correlated with seasonal changes as wetter weather reduced hoof hygiene and hoof dryness. At visit 4, Dairy A had noticeably improved hygiene whereas Dairy B was struggling with hoof hygiene. In addition, Dairy B appeared to have inconsistencies in hoof care management as evident by running out of product and not keeping hoof trimming records (Table 3). The parlor stress level was different between the 2 dairies. On Dairy A, cows were calm during milking, while cows in Dairy B were rushed and agitated. It is apparent that prevalence of DD varies based on the season even with a consistent hoof care routine. Due diligence in following and documenting the hoof bath routine and hoof trimming events is essential to control DD.

References

Britt JS, Berry SL, Shearer JK, Hemling TC, Stevens TB, and Dreher M 1999 A uniform protocol for evaluating response to treatment of papillomatous digital dermatitis lesions. The Bovine Practicioner 33:149-154.

20(b). Case study: Impact of short term increased concentration of a hoofcare product on the prevalence of active digital dermatitis lesions

EA French, M Lopez-Benavides and TC Hemling
DeLaval Inc., 11100 N. Congress Ave., Kansas City, MO, 64153
Lizzy.French@delaval.com

Introduction

Digital dermatitis (DD) is a major infectious disease of dairy cattle hooves in global dairy operations. The painful lesions associated with DD result in lameness. Clinical observations support the use of hoof bath treatments against DD. During DD outbreaks, some farmers increase the frequency and/or dosage of the hoof disinfectant with the intention to minimize the spread of disease. In this study we show the effect on DD prevalence when the dosage and frequency of use of the hoof disinfectant was increased over a 2 week period during a DD outbreak in a commercial dairy farm.

Materials and Methods

The dairy evaluated milks 4500 cows and cows walk through a 380L manual hoofbath which is refreshed every 300 cows. Before the outbreak, cows had walked through a 1% solution of 4Hooves™ (DeLaval Inc) once a day, 3 times per week (Mon, Wed and Fri) for a period of 7 months. When the outbreak occurred, hoofbathing was changed to 2,5% 4Hooves, 5 days per week (Mon-Fri) and for a period of 2 weeks.
For the study, parlour hind hoof evaluations were made on 900 animals before and after the changes in hoofbath management were implemented. Parlour evaluations were made for assessing prevalence of active DD lesions. No animals were treated with antibiotics during the test period. Weather data on ambient temperatures were obtained during the time the trial was collected. Data were analyzed using binomial logistic regression to assess the ability of the different footbath treatments to decrease the prevalence of active lesions.

Results

Prior to the outbreak, DD prevalence was maintained below 10%. At the start of the study (outbreak), there was a 10.6% DD prevalence of active lesions (95 cows affected). After 2 weeks at 2.5% 4Hooves, a 26% decrease in DD prevalence was observed (70 cows affected, 7.8% prevalence, *P=0,042*). During this period the ambient temperature increased from 20.1 to 24.3°C.

Figure 1. Dry lots conditions on test farm

Discussion

Prior to the outbreak DD prevalence was well controlled with the hoofbath treatment protocol. When temperatures rise, it is common in dry lots for cows to congregate in shaded areas. These covered areas are generally wetter and may provide the DD-causing organism the right conditions to infect and colonize the hoof tissue. In this study it was observed that the prevalence of DD decreased when the hoof disinfectant was used at a higher concentration for a short period of time. Increasing the dosage of 4Hooves™ combined with an active hoof care program that promptly treats new lesions will also facilitate reducing the incidence of DD during periods of high risk.

Acknowledgments
Appreciation is extended to Matt Cunningham for his scoring of cows at sampling times throughout the trial.

References

Britt JS, Berry SL, Shearer JK, Hemling TC, Stevens TB, and Dreher M 1999 A uniform protocol for evaluating response to treatment of papillomatous digital dermatitis lesions. The Bovine Practicioner 33:149-154.
Cha E, Hertl JA, Bar D, and Gröhn YT 2010 The cost of different types of lameness in dairy cows calculated by dynamic programming. Preventive Veterinary Medicine 97:1-8.
Dohoo I, Martin W, and Stryhn H 2003 Veterinary epidemiologic research. AVC Inc., pp 706.
Wells SJ, Garber LP, and Wagner BA 1999 Papillomatous digital dermatitis and associated risk factors in US dairy herds. Preventive Veterinary Medicine 38:11-24.

21(a). Toe necrosis and non-healing hoof lesions in commercial dairy herds in Argentina

S Minini[1], F Crowhurst[1], J de Nicolás[1], R Blowey[2]
[1]DeLaval Argentina, Cap. Bermúdez 3895, Olivos, Buenos Aires, Argentina; [2] Wood Veterinary Group, 125 Bristol Road, Gloucester GL2 4NB, UK.
sergio.minini@delaval.com

Introduction

Bovine lameness is an important condition in commercial dairy and beef operations worldwide. Its economic impacts include decreased reproductive performance and milk yield and increased culling rates, milk losses and labour.

One relatively new finding in the field of lameness are the non-healing lesions (NHL) such as toe necrosis (Blowey, 1999; Tozzo, 2000) and wall ulcers (Holzhauer, 2008; Cook and Burgi, 2008). These lesions typically are unresponsive or poorly responsive to standard treatments, have a moist granular appearance on exposed corium and a distinct foetid and pungent smell, and have been associated with *Treponema spp*, the etiologic agent of Digital Dermatitis (DD) (Blowey, 2011; Evans et al, 2011). To date there have been no reports of the findings of this type of non-healing lesions in Argentina.

Materials and Methods

A field study was conducted in three dairy herds, ranging from 300 to 1200 lactating cows in two different dairy regions in the Buenos Aires Province, Argentina. The herdsmen were asked to select lame cows after the morning milking. They were mobility scored by a team of veterinarians and then had their hooves examined. Lame cows with clinical lesions were examined and their hooves trimmed (n=20).

Results

All animals were given a mobility score 3 (scale 0 to 3). The findings included toe necrosis (n=3), non-healing sole ulcers (n=7), non-healing white line disease (n= 3) without clinical evidence of BDD, other lesions such as wire cuttings (n=3) and typical DD lesions (n=4). All of the non-healing lesions observed involved extensive loss of horn and damage to corium. In one particular case the pedal bone was exposed. All non-healing lesions had a characteristic pungent foetid smell and a topical, wet and bright red colored granular appearance.

Lesions	Farm 1	Farm 2	Farm 3	Total/Lesion
Non-healing Toe Necrosis		1	2	**3**
Non-healing White-line Disease	1	1	1	**3**
Non-healing Sole ulcer	1	3	3	**7**
DD	4			**4**
other (wire)	1	1	1	**3**
TOTAL COWS	**7**	**6**	**7**	**20**

Conclusion

To our knowledge this is the first report of non-healing lesions in dairy cows in Argentina, although we are aware of unpublished reports of a recent increase in similar lesions in Uruguay and Chile. Further studies are to be conducted to establish the epidemiology and etiology of the lesions observed in this study and their impact in dairy production in Argentina.

References

Anon 2007. “DairyCo mobility score” In http://www.dairyco.org.uk/non_umbraco/download.aspx?media=1349 Accessed Abr- 29-2013.
Blowey R 1999 in A Veterinary book for Dairy Farmers, published by Old Pond, page 317
Blowey RW 2011 Changing Indications for Digit Amputation. Veterinary Record 169:236-237
Evans NJ, Blowey RW, Timofte D, Isherwood DR, Brown JM, Murray R, Paton RJ, Carter SD 2011 Association between bovine digital dermatitis treponemes and a range of ‘non-healing’ bovine hoof disorders. Veterinary Record 168:214.

Cook N, Burgi K 2008 ‘Hairy attack’: a new lesion affecting the corium of the white line – a case report. Proceedings of the 15th International Ruminant Digit Symposium. Kuopio. page 214.
Holzhauer M 2008 Non-healing white line disorders, a new clinical presentation. Proceedings of the 15th International Ruminant Digit Symposium. Kuopio, page 206.
Tozzo M 2000 Necrotic chronic ulcers in cattle´s digits. Proceedings of 11th International Symposium on Disorders of the Ruminant Digit, Parma, Italy, pages 206-207.

21(b). Digital dermatitis advances on dewclaw area

M Nouri[1], I Nowrouzian, O Dezfulian[2]
[1]Private Veterinary Practitioner, Tehran, Iran; [2] Department of pathobiology, School of Veterinary Medicine, Lorestan University, Khorramabad, Iran.
mnouri2@yahoo.com

Introduction
Bovine digital dermatitis (BDD) is a multifactorial and infectious condition that mostly occurs on the plantar aspect of the rear foot, affecting the skin adjacent to the interdigital cleft or the skin–horn junction of the heel bulbs (Berry, 2001). The aim of this study is to report occurrence of atypical DD lesions on the exposed corium of the dew claw in an endemically infected herd without preventive herd strategies.

Material and Methods
The digit lesion samples included in this study were taken from lame cows examined in the course of veterinary practice in a commercial dairy farm with 400 milking cows in Nazarabad, Iran. One lame cows with affected dew claw of 52 Holstein cows having atypical DD were selected for clinical, grosspathologic and histopathologic purposes.

Results
An 8-year-old Holstein cow presented with signs of moderate lameness in the right hind limb. Examination of the foot revealed two discreet, almost circular and encrusted lesions on the plantar aspect of the pastern and lateral aspect of the dewclaw, which was moist and dark pink with a distinctive odour. Both lesions were prone to bleed and painful when touched. Both lesions showed extensive regional loss of the heel and dewclaw horn (**Figure 1**).
Histologically, the epidermis showed very marked hyperkeratosis with tires of parakeratosis and papilomatosis that in some areas, particularly in the dewclaw, revealed as extensive epidermolysis with evidence of liquifactive necrosis and intense infiltration of neutrophils and lymphocytes. In the heel, the lesion was characterized by the formation of small intraepidermal spongiotic vesicle, which polymorphonuclear cells were prominently accumulated and occasionally lymphocytes were also seen.

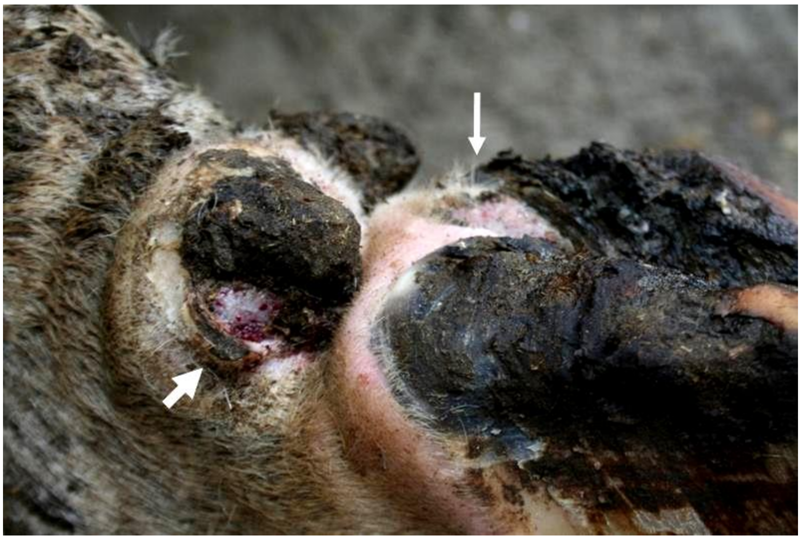


Figure 1 DD lesions were located in the midline skin above the heel bulbs (small white arrow) and lateral aspect of the dewclaw corium (large white arrow). The lesions showed extensive regional loss of the horn with exposed corium.

Discussion
Current evidence indicates that BDD is multifactorial, involving environmental, microbial, host, and management factors (Berry, 2001). All the cattle with lesions were from a farm where BDD was endemic. The environmental conditions were poor, with large volumes of slurry accumulated in the passageways and basis of the concrete bunk during feeding times because of poor building design. Poor hygiene in the cows' environment has been associated with a higher risk of disease (Nowrouzan and Radgohar 2011). Constant

moisture and low oxygen tension are present on the feet (Berry, 2001) and under the attached dried manure (especially, when lesions are small or covered by dirt and manure) of cows in confinement dairies if manure management and hygiene are not adequate. The lesion of the dewclaw corium is associated with secondary infection by the treponemes of BDD, and this disrupts the corium so badly that insufficient claw horn is produced to allow lesion healing.

The clinical, epidemiological and pathological aspects of the disease described in this study are consistent with the condition described as atypical DD. To minimize the development and severity of DD, cows should be reared in environments where the risk of DD is low.

References

Berry SL 2001 Disease of the digital soft tissues. Veterinary Clinics of North America- Food Animal Practice **17:129-135.**

Nowrouzan IJ and Radgohar I 2011 Restrospective study of the correlation between hygiene scores and the prevalence of papillomatous digital dermatitis in dairy cows. In: 16th International Symposium on Lameness in Ruminants, Rotorua, New Zealand, p. 29.

22(a). Clinical, radiographic and computed tomographic findings in three calves persistently infected with Border disease virus

S Frei[1], U Braun[1], M Dennler[2], P Kircher[2], M Hilbe[3], M Schweizer[4], K Nuss[1]
[1] Department of Farm Animals, [2] Department of Small Animals, [3] Institute of Veterinary Pathology, Vetsuisse Faculty, University of Zürich, [4] Institute of Veterinary Virology, Vetsuisse Faculty, University of Bern.
knuss@vetclinics.uzh.ch

Introduction
Border disease virus (BDV) belongs to the genus *Pestivirus* together with subtypes 1 and 2 of bovine viral diarrhoea virus (BVDV-1 and -2) and classical swine fever virus (CSFV). Until recently, pestiviruses were considered to be species-specific, but studies have shown that cattle can be infected with BDV (Krametter-Frötscher et al 2010; McFadden et al 2012; Strong et al 2010; Webb et al 2012).

Materials and Methods
Genotyping was used to identify BDV from three calves that tested positive for pestivirus in the BVDV eradication program. Physical development of all three calves was impaired. One calf died of purulent bronchopneumonia at the age of 5 months and underwent necropsy. Radiographic evaluation in another calf with stifle lameness revealed distinctive bone lesions. This prompted radiographic examination on all calves and computed tomography in two.

Results
Radiography and computed tomography showed various stages of skeletal abnormalities typical of BVDV infection in all of the calves. The main changes were focal radiodensities and radiolucencies in the metaphyses, cortical thickening and transverse curved/parallel lines of increased bone density (‘bone within bone’, ‘growth arrest lines’ (Figure 1)

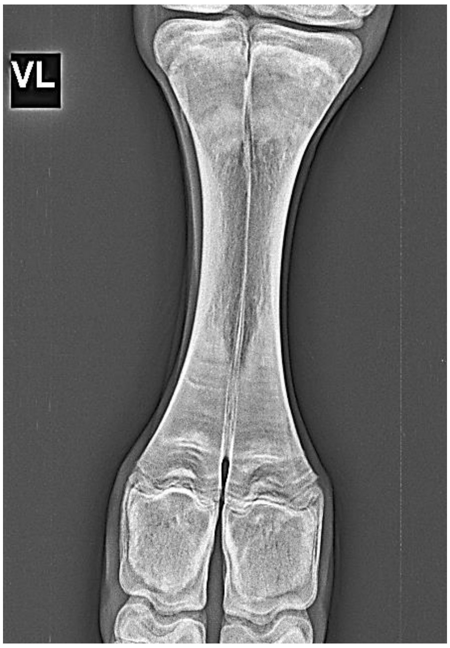


Figure 1 Dorsopalmar radiographic view of the left metacarpal bone of a four-month-old bull calf persistently infected with BDV. There are distinct growth arrest lines (transverse bands in the metaphysis) and bone-within-bone signs (in the distal epiphysis). Histologically, the growth arrest lines consisted of plump, highly interwoven, primary trabeculae (osteopetrosis). Border disease virus antigen was revealed by immunohistochemistry and was detected histologically in osteocytes and in cells of other organs.

Discussion
Border disease virus can cause persistent infection in calves resulting in clinical and radiographic features typical of persistent BVDV infection (Nuss et al 2005; Webb et al 2012). It may therefore be necessary to carry out simultaneous BVDV and BDV eradication programs to effectively eliminate bovine pestivirus infections.

References
Krametter-Frötscher R, Mason N, Roetzel J, Benetka V, Bago Z, Moestl K, and Baumgartner W 2010 Effects of Border disease virus (genotype 3) naturally transmitted by persistently infected sheep to pregnant heifers and their progeny. Veterinarni Medicina 55: 145-153.

McFadden AMJ, Tisdall DJ, Hill FI, Otterson P, Pulford D, Peake J, Finnegan CJ, La Rocca SA, Kok-Mun T, and Weir AM 2012 The first case of a bull persistently infected with Border disease virus in New Zealand. New Zealand Veterinary Journal 60: 290-296.
Nuss K, Spiess A, Hilbe M, Sterr K, Reiser M, and Matis U 2005 Transient benign osteopetrosis in a calf persistently infected with bovine virus diarrhoea virus. Veterinary and Comparative Orthopaedics and Traumatology 18: 100-104.
Strong R, La Rocca SA, Ibata G, and Sandvik T 2010 Antigenic and genetic characterisation of border disease viruses isolated from UK cattle. Veterinary Microbiology 141: 208-215.
Webb BT, Norrdin RW, Smirnova NP, Van Campen H, Weiner CM, Antoniazzi AQ, Bielefeldt-Ohmann H, and Hansen TR 2012 Bovine viral diarrhea virus cyclically impairs long bone trabecular modeling in experimental persistently infected fetuses. Veterinary Pathology 49: 930-940.

P22(b). Acute arthritis outbreaks caused by *Mycoplasma bovis*

M Holzhauer[1], E van Engelen[1], M Gongrijp[1], K Junker[1]
GD Deventer, The Netherlands
m.holzhauer@gddeventer.com

Introduction

Mycoplasms bovis (M. bovis) is in bovine medicine well known as a cause of pneumonia, arthritis and otitis in veal calves and mastitis outbreaks in dairy cows (Maunsell et al., 2011; Fox, 2012). The arthritis is frequently fatal by limited therapeutic possibilities, the difficult accessibility of the process etc. and the very painful aspect of the affliction. Recently The GD (Dutch Animal Health Service) was involved in 14 cases of outbreaks of mycoplasma arthritis in the metacarpal and carpal joint in most times 1 front leg of dairy cows in herds (see photograph I). The outbreaks were reported especially from the Northern region of The Netherlands.

Material and Methods

All herds were investigated during a herd visit by 1 person (MH) and a survey completed by the herd investigator during the visit about the herd situation e.g. herd size, breed, production level, ration, purchase of cattle, professional contacts, other clinical symptoms like mastitis and pneumonia etc. Joint fluid, milk and blood samples (M. bovis serology, Elisa) were collected, the possibilities for further diagnosis and the best plan of approach for the individual herds were discussed.

Photograph A typical presentation of M. bovis arthritis in dairy cows

Results and Discussion

Average herd size of the herds visited at the start of the outbreak was more than 190 cows (average in The Netherlands, 89 dairy cows; CBS 2012). Production level 8150 kg milk in 305 days with normal fat and protein levels. Five herds purchased cattle last year, 9 did not, or had direct contacts with other cattle. Five herds had (mycoplasma related) mastitis problems and 4 herds respiratory problems in calves. None of the herds visited had respiratory problems in dairy cows. Only 2 cases were found of *M. bovis* arthritis and mastitis within the same dairy cow. Diagnoses were based on clinical symptoms, pathological investigation, cultivation and typing of mycoplasma (10x) as the only causing organism. In 1 individual case (herd 15) Streptococcus dysgalactiae ssp. dysgalactiae could be isolated.

The average number of affected animals was 5-10% and in all herds 4-6 weeks after the start of the outbreak no new cases were seen. The average parity and DIM of the affected cows was 3.3 and >100 days (both fresh cows and cows in late lactation). Related to the very limited therapeutic possibilities, the pre-slaughter withdrawal times and the current rules about transportation to the slaughterhouse of seriously lame cows (a lot of these cows stood on 3 legs), about 40% of the cows with arthritis had to be euthanized in the herd. The way of introduction of this infection in these herds and the definitive typing of the *M. bovis* as causative organism is still under investigation.

References

Fox LK 2012 Mycoplasma mastitis: causes, transmission, and control. Veterinary Clinics North America Food Animal Practice Jul;28(2):225-37

Maunsell FP, Woolums AR, Francoz D, Rosenbusch RF, Step DL, Wilson DJ, Janzen ED 2011 Mycoplasma bovis infections in cattle. Journal Veterinary Internal Medicine Jul-Aug;25(4):772-83.

P23(a). Spots and striations of the sole horn

R.Pijl
Fischershäuser 1, 26441 Jever, Germany
r.pijl@t-online.de

Introduction
Over the last three years in Germany a new sole horn lesion has been seen which does not appear to originate from the corium. Black spots and striations are evident in various sites. Often nothing abnormal may be seen when the foot is lifted, though sometimes the changes are evident at once. After initial sole trimming the extent is evident, with horn changes ending before the corium is reached. Rarely the corium and tissues below the white line are also involved. The affected sites extend from the toe over the white line to other parts of the sole. The shape is variable, some striations being straight, others very oblique and curved. The "spots" are mostly in the white line, predominantly in the abaxial area adjacent to the toe.

Figure 1. Pregnant heifer kept on slats with sole of lateral claw, claw tip, axial wall of medial claw, and white line affected by striations and spots

Figure 2. The medial and the lateral both show a striation to the toe. Pijl's rotation is also on the medial claw.

Medial and lateral claws are equally affected, and toe lesions predominate. The axial surface is usually affected with an oblique striation directed axially. Marked inward deviation of the white line is common. Such animals are not repeatedly affected if correct trimming is done, though the inward displacement of the white line persists. Lameness is not seen until the changes reach the corium. The sole thickness is unrelated to development of these changes. Wall and sole are equally involved. The age is not relevant as the overgrown also. By trimming twice a year the cows will mostly not become lame. Due to the variable appearance and distribution of these striations, it is difficult to sensitise the farmer to check for their occurrence. The same applies to trimmers, especially about the occurrence of the black spots. About one third of German farms are affected to a very variable degree, but up to 15% of a herd may have these changes. Trimming must be done very carefully, first removing each striation and spot, and reducing weight-bearing by the affected claw. Great care is required as the lesion often stops just above the surface of the corium. Especial attention is needed in the toe region, as both claws are often affected, so that a block cannot be applied. It is suspected that if the lesions cannot be promptly be removed at trimming, then they may progress to poorly healing lesions of the corium with the development of marked lameness. Our symposia have on several occasions already discussed these changes, especially those involving the white line.

Conclusion
It seems to be we have to deal with a new phenomenon which in practice is very difficult to sensitise the farmer and claw trimmer to. If not recognized in time the corium and tissues are involved and a very sharp lameness can be expected.

P23(b). Manure-Dip-Method (MDM) can change the state of digital dermatitis

M Hiroyuki[1], Y Kazunori[2], I Ryouichi[3]
[1]MH Corporation [2]NOSAI Chiba Hokubu veterinary Clinical Center [3]NOSAI Kushiro Shibecha Veterinary Clinical Center, Japan
manabe@raven.co.jp

Introduction
The state in which treponema can work is very important. It is very important in what state treponema can work. Many researchers tend to say hygiene is very important. So the recommend to keep the cow away from manure. But as long as we raise the cow to earn money, we can't make the cow shed as clean as our living room. On the other hand we see that some miserable cows standing in knee depth manure and mud have healthy hooves. They might have digital dermatitis (DD) on their legs where the depth of manure but not on the hooves. So we tried to use manure to treat acute lesions.

Materials and Methods
The Manure-Dip-Method
1 At first the lesions have to be completely cleaned with compressed air for a minute.
2 Then a half palm of manure on the floor is taken and put in a towel. Then the towel is squeezed to strain it and some is put thoroughly on the DD lesion.
3 The rest of the manure in the towel is put on the lesion to cover it and then wrapped.
4 Five minutes later it is unwrapped and the manure is blown away using compressed air again.
5 Wrap it with a disposable diaper for an hour.

Two cows in a confined cowshed were used. One was treated with manure (MDM) and the other was treated without manure (steps 1 and 5 out of MDM).

Results
With manure trial (MDM) – When the lesion was cleaned and compressed air, it started to bleed and the cow shivered with pain. After covering with manure for five minutes, it stopped bleeding. In addition, pain was significantly reduced. One hour later after the removal of the diaper the lesion was a little wet and still showed slight pain to a finger touch. Six hours later the lesion was almost dry and showed a little aching when pressed.
Without manure trial (steps 1 and 5 out of MDM) – When the lesion was cleaned with compressed air, it started to bleed and the cow shivered with pain as well. One hour later after removal of the diaper the lesion was still bleeding a lot and showed heavy pain to fingertip touch.

Discussion
The lesion exudate serves as a transport medium for a variety of bioactive molecules such as enzymes, growth factors and hormones. The different cells in the lesion area communicate with each other via these mediators, making sure that the healing processes proceed in a coordinated manner. Would exudate also provide the different cells of the immune system with ideal conditions to destroy invading pathogens such as bacteria. After cleaning with compressed air the number of treponemes will be reduced. Then manure returns the state of the lesion back to normal bacterial flora and it can inhibit the encystations of spirochetes.

P24(a). Differing presentations of white line lesions in grazing dairy cattle

RN Chesterton
Inglewood Veterinary Services
chesterton@inspire.net.nz

Introduction

White line separation with abscess formation under the hoof wall (WLD) is the most commonly recorded cause of lameness in dairy cattle in New Zealand (Chesterton et al, 2008). WLD in New Zealand is almost exclusively at the posterior end of the abaxial white line. Very seldom is it seen anterior to this position. However at the heel, the separation appears to follow one of two possible paths. The abscess either separates the abaxial wall or underruns the bulb. This paper is a survey of the subcategories of WLD presentation of 4576 feet treated by the author in grazing cattle in New Zealand. The pattern in Australian grazing cattle is significantly different (Malmo, personal communication) which raises questions about underlying causes.
The aim of this work was to survey the distribution of the subcategories of WLD presentation in grazing dairy cattle in Taranaki, New Zealand and identify patterns.

Materials and Methods

4576 treatments of lame cows for 2002 – 2011 were recorded. Age, digit affected, main lesion, position of WLD abscess and amputations were noted.

Results

Over the last 9 years WLD accounted for 42.7% of the lamenesses treated in this survey (Table 1). In 34.8% of the cases the white line separation was in the last 3 – 4 mm of the white line and the under-running was at the bulb of the heel, see Figure 1. In 61.5% of the cases the separation of the white line was > 5 mm from the caudal end of the white line and the under-running was under the abaxial wall as in Figure 2.

Table 1 Survey of 4576 Lameness Cases in Taranaki, New Zealand 2002 – 2011

	Percent WLD	Position of WLD	Abaxial WLD	Bulb WLD	Amputation		
					Total	Axial	Bulb
All cows	42.7%		61.5%	34.8%	5.6%	7.4%	1.3%
Adults	45.0%	Rear Lateral claw 78.3%	60.1%	36.7%			
		Front Medial claw 10.9%	53.8%	34.2%			
Heifers	34.5%	Rear Lateral claw 36.3%	64.6%	33.3%			
		Front Medial claw 44.3%	84.6%	13.7%			

Figure 1 Bulb

Figure 2 Abaxial Side

Discussion

White line disease is an increasing cause of lameness in pasture fed dairy cattle in New Zealand. From my clinical records of veterinary treatments WLD accounts for a growing percentage of the lamenesses treated. In 1995 – 2000, 37% was white line while in 2005 – 2011 it was 49%.

The literature to date has tended to combine WLD into one broad category in both description and causes. Blowey describes WLD at four positions, abaxial towards the heel being the most common (2008). In New Zealand WLD is almost exclusively the abaxial wall towards the heel, (96.3%) but presents as two distinct directions of underrruning.

In New Zealand underruning the bulb occurs in about 35% of the cases and the abaxial wall in 62% of the cases. In Australia (Malmo, personal communication) 85% underrun the bulb and only 15% the abaxial wall. In front feet in heifers in New Zealand the picture is markedly different to cows but very similar to the picture in Australia. Is this an indication of different environmental conditions?

One consequence of white line separation can be the development of septic arthritis of the pedal joint. Claw amputation of chronic cases is a common treatment. There was a difference in the percentage of amputations after WLD underran the bulb (1.3% resulted in amputation) compared to when the abaxial wall was underrun (7.4%). This suggests that dividing WLD “abaxial towards the heel” into two subcategories and recording this, could lead to further understanding of this condition.

References

Blowey RW 2008 Cattle Lameness and Hoofcare: An Illustrated Guide. Old Pond Publishing. pp 71-89

Chesterton RN Lawrence KE Laven RA 2008 A descriptive analysis of the foot lesions identified during veterinary treatment for lameness on dairy farms in North Taranaki. New Zealand Veterinary Journal 56(3), 130-138.

Malmo J 2013 personal communication

P24(b). A clinical case report of death from Ingestion of formalin foot bath solution

R Blowey
rogerblowey@mailbox.co.uk

Introduction
Although widely used as a foot bath in many countries, including North and South America and the UK, there is currently considerable discussion as to the safety of formalin, both for human and animal health (ECHA 2011). Superficial skin burn has been reported previously (Blowey and Weaver 2011), but to my knowledge this is the first report of death from ingestion.

Materials and Methods
The 200 cow Holstein Friesian dairy herd has had an endemic problem with bovine digital dermatitis (BDD) for many years, and has achieved reasonable control by using 5% formalin foot bath for milking cows (twice daily) , dry cows and precalving heifers (once daily). Following an outbreak in beef cattle originating from the dairy herd, a formalin foot bath was set up such that cattle had to stand in the bath whilst eating at the feed fence. The bath had been in use for several days. It was part filled with water, and then the formalin (40% formaldehyde) was added, finally topped up with water to achieve the correct concentration. It was during the final top up phase that the herdsman saw the animal, a 14mo Belgian Blue cross male, move forward and drink from the foot bath. The animal was driven away, the foot bath filled, and the cattle left to feed. He appeared normal for 48 hours, but then developed progressively increasing abdominal pain, anorexia, rumenal atony, drooling and dejection. Symptomatic treatment was administered (antibiotics and NSAID's) but death followed in 48 hours. On post mortem there was severe necrosis of the lower oesophagus, reticulum and ventral rumen, with a localised (but not generalised) peritonitis. Samples were negative for BVD virus, making a diagnosis of mucosal disease unlikely. There was no visible ulceration in the mouth.

Discussion
As there are many practical examples of aversion to formalin, it is very surprising that this animal should drink it. There was ample fresh water available in the pen, and the animal had been there for several days. The author's on farm experience suggests that if formalin in a foot bath increases above 6 – 7% then cows will be reluctant to walk through, and there have been other instances where placing a foot bath at the end of a long and enclosed passageway leads to cows being reluctant to enter. Illness and deaths have previously been reported in dairy cows drinking antibiotic foot baths, especially those containing lincomycin, a well-known rumen inhibitor, but this appears to be the first reported case of death from voluntarily ingesting formalin from a foot bath. Many European countries have banned formalin on the basis of human health, and this case report and others suggests that animal safety should also be considered, for formalin and for all other foot bath chemicals.

References
R Blowey, D Weaver 2011 in Color Atlas of Diseases and Disorders of Cattle, 3rd Edition, Elsevier, page 116
European Chemicals Agency (ECHA) report of Committee for Risk Assessment (CHL), Based on Regulation (EC) No 1272/2008 (CLP Regulation), Annex VI, Part 2, September 2011
http://echa.europa.eu/view-article/-/journal_content/c89bdb13-09e9-497c-8e73-ddae13a842c8

25(a). Pododermatosis in dairy cattle related to zinc deficiency

M. Holzhauer[1], N. Meertens[1]
[1]GD Deventer, The Netherlands
m.holzhauer@gddeventer.com

Introduction
Two to three times a year the Dutch Animal Health Service (GD) is involved in a herd problem with typical lesions in 10-40% of the cows. The lesions are present at the distal part of the hind legs (see **photograph 1**) mainly and as being suspected to be related to Digital dermatitis lesions, these are treated topically with tetracycline or gel. But these treatments are not successful. Lesions have been diagnosed both in dairy cows and in suckling cows, were multifocal to coalescent hyperkeratotic plaques with crusts on the distal legs near the coronary band and not warm nor painful at palpation.

Photograph 1 Clinical presentation of the typical lesion at the digital skin

Materials and Methods
Last autumn, when we were asked in consultation in a dairy herd in the southern part of the country. The lesion were seen in lactating dairy cows, independent parity and stage of lactation. The ration at that time was mainly maize, fresh grass (pasturing 10 h/day) and concentrate (max 8 kg). Where the origin was still not known, it was decided to take some biopsies of from the border to normal skin of such lesions.

Results
Histo-pathological examination of biopsies taken, demonstrated diffuse epidermal hyperplasia with acanthosis, hypergranulosis, and parakeratotic hyperkeratosis. A mild to moderate and-shaped superficial dermal infiltrate consisting of lymphocytes, plasma cells, some neutrophils and eosinophils was present. The hair follicles and adnexa did not show abnormalities. The histopathological findings, summarized as chronic hyperplastic dermatitis with severe ortho− to parakeratotic hyperkeratosis resembled zinc-responsive dermatosis in other species. Quantitative zinc determination on blood and liver biopsies revealed a decreased zinc concentration in the liver biopsies (considered to be the most reliable parameter) of 3 individual examined animals with typical lesions and > 100 DIM (see table 1). Zinc-sulphate supply in the ration resulted in disappearing of the clinical lesions and (partial) normalization of zinc values in the liver biopsies taken 5 months later of the same animals (see **table 1**).

Table 1 Result of blood and liver biopsies Sept. 2012, March 2013 cows with skin lesions

No. of animal	Blood-samples 09/12		Liver-biopsies 09/12		Liver-biopsies 03/13	
	Cu	Zn	Cu	Zn	Cu	Zn
6226	8.9	17.0				
6240	9.8	12.0	405	112	635	120
6519	9.8	10.9	635	98	620	145
6541	11.2	10.6				
6556	10.8	11.3	458	107	525	115
Reference value unit	7.5 – 18 µmol/L	12 – 23 µmol/L	100 - 600 mg/kg dm	150 - 400 mg/kg dm	100 - 600 mg/kg dm	150 - 400 mg/kg dm

Discussion

As a conclusion, zinc deficiency was the most probable cause of this dermatosis lesions, and must be taken into account in cases of hyperplastic lesions of the digital skin. It might be important to discriminate these lesions from Digital dermatitis.

Session 7

Investigating Infectious Causes of Lameness

36. Detection of Bovine Digital Dermatitis on hoof knives and hands and their removal by disinfection

R. Blowey, L Sullivan[1], N Evans[1], S Carter[1]
[1]University of Liverpool
rogerblowey@mailbox.co.uk

Introduction
Although consistently isolated from skin lesions, the treponemes causing bovine digital dermatitis (BDD) have not been found in the environment, despite extensive testing (Evans et al 2012). The mode of transmission of infection is therefore unknown, although hoof trimmers have been suggested as a risk factor (Wells et al 1999). This project investigated transmission by hoof knives and hands.

Materials and Methods
Samples were taken during routine foot trimming and treatment of lame cows. After each foot was trimmed, the knife was swabbed using a fixed protocol of a single passage across each side of the blade on both sides of the knife. The knife was then rinsed in a DEFRA approved iodine disinfectant (containing 2.5% w/v available iodine), wiped to remove excess disinfectant and then resampled. The presence of gross lesions of BDD, toe necrosis and other related lesions was recorded for each foot. Samples were sent by post and PCR tested in the receiving laboratory.

Results
Of the 16 cattle foot trims from known BDD positive farms where results are available, 100% of the hoof knives were PCR positive for either Group 1, or 2, or 3 Treponemes or a combination. After disinfection, only 4 knives were totally negative to all 3 Treponeme groups, a reduction of only 25%. However, as an incompletely cleaned knife was then used on the next cow, the contamination found after trimming may have been from the cow being trimmed or a residue from a previous cow. There appeared to be a difference in BDD species. Of the 14 knives positive for group 1 Treponemes (*T. medium* like) only 5 (36%) were cleaned by disinfection, Of the 15 knives PCR positive to Group 2 (T*. phagedenis* like), 13 were PCR negative after cleaning, a reduction of 87%. Of the 7 knives positive for group 3 (*T pedis like),* only one was positive after disinfection, a reduction of 86%.
Three cows with no gross lesions of BDD gave positive knife swabs, but this may have been carryover from a previous trim. In the only herd in the practice known to be BDD negative, the knife was negative before and after trimming.
On one farm, the trimmer's hand was swabbed after each cow. The initial vinyl gloves were negative, but positive after 7 of the next 8 cows.

Conclusions
The results show a high proportion of knives and hands carrying BDD, and for *T medium* this was not removed by a simple disinfection. While our results indicate a potential route of transmission, it is not possible to quantify its importance in relation to simple cow-to-cow contact, or perhaps sheep to cow contact. Further work has shown sheep knives to be positive to BDD.
Routine disinfection of knives and hands between animals must be a sensible precaution.

Acknowledgements
Thanks to the farmers for their patience while sampling. The work was part funded by EBLEX, HCC and QMS and DairyCo'

References

Evans NJ, Timofte D, Isherwood DR, Brown JM, Williams JM, Sherlock K, Lehane, MJ, Murray RD, Birtles RJ, Hart CA, Carter SD. Host and environmental reservoirs of infection for bovine digital dermatitis treponemes. Vet Microbiol. 2012 Apr 23;156(1-2):102-9.

Wells, SJ, Garber, LP, Wagner, BA, 1999. Papillomatous digital dermatitis and associated risk factors in US dairy herds. Preventive Veterinary Medicine 38**,** 11-24.

37. A clinical trial of routine foot trimming of sheep on subsequent lameness and English sheep farmers' attitudes towards its findings

EM King[1], R Grogono-Thomas[2] & LE Green[1]
[1] University of Warwick, UK, [2] University of Bristol, UK
Elisabeth.King@warwick.ac.uk

Introduction
In the UK routine foot trimming (RFT) is recommended to help prevent lameness. It was carried out by 76% farmers in 2004. There are no clinical trials investigating the role of RFT in lameness prevention, however RFT has been associated with higher flock lameness prevalence and incidence. Wassink et al (2010) reported that farmers might stop RFT if shown to be ineffective/detrimental. Aim to investigate impact of RFT on lameness using a pilot within farm clinical trial and establish evidence required by farmers to stop RFT.

Materials and Methods
Study 1. A flock of 173 lowland commercial ewes were examined and allocated to RFT or no RFT by stratified random sampling. They were observed biweekly for 7 weeks, re-examined and then re-examined again 3 months post allocation.Study 2. As part of a questionnaire, study 1 trial results were sent to 972 English sheep farmers (Figure 1) who were asked: '*What further evidence would you require to stop*' RFT?

61. In a recent study, on one farm in the UK, a flock of 170 ewes were divided into two equally sized groups. One group received a routine foot trim and the other no routine foot trim. Changes in body condition, foot shape and damage, the level of lameness and foot lesions were recorded over a period of 3 months. Results showed no difference in:
    - the body condition of ewes
    - foot shape or damage
    - the level of lameness or severity of lameness
    - the level of interdigital dermatitis (scald / strip) or footrot

i.e. the routine trim was not detrimental but not beneficial either

Based on these findings, how likely are you to stop *routine* foot trimming?

Figure 1 Inset of Q61 of the questionnaire. The evidence provided to respondents.

Results
Study 1: In the first 7 weeks after RFT the prevalence and incidence of lameness were equal at 17.0% and 8.2 cases/100 ewes respectively by RFT or no RFT. There were 11 ewes where the foot bled when trimmed and 10 /11 of these sheep became lame.
Study 2: 329 (73.3%) respondents used RFT. Farmers using RFT were generally reluctant to stop. Commercial (*cf.* pedigree) and farmers with higher lameness prevalences and larger flocks were less opposed to stopping RFT ($p<0.01$). Overall farmers wanted longer, larger trials by number of sheep and farms, comparing farm type, geography, ground/soil type, season and weather, breed and other lameness management factors before being convinced to stop RFT.

Discussion
The trial indicated that RFT had no beneficial effects but more evidence is required to convince farmers to stop RFT. Further analysis suggested that where RFT resulted in bleeding it was detrimental.

Acknowledgements
EMK was a BBSRC/Pfizer CASE student. We thank University of Bristol, the farmers, and the team at Warwick for their support.

References
Kaler J & Green LE 2009 Farmers' practices and factors associated with the prevalence of all lameness and lameness attributed to interdigital dermatitis and footrot in sheep flocks in England in 2004. Preventive Veterinary Medicine 9: 52-59
King EM 2013 Lameness in English lowland sheep flocks: farmers' perspectives and behaviour. PhD thesis: University of Warwick, UK
Wassink GJ, George TRN, Kaler J & Green LE 2010 Footrot and interdigital dermatitis in sheep: farmer satisfaction with current management, their ideal management and sources used to adopt new strategies. Preventive Veterinary Medicine 96: 65-73.

38. Cross-infection of *Dichelobacter nodosus* between sheep diagnosed with virulent footrot and co-grazing cattle

M Knappe-Poindecker[1], M Gilhuus[2], TK Jensen[3], S Vatn[4], HJ Jørgensen[3] , T Fjeldaas[1]
[1] Department of Production Animal Clinical Sciences, Norwegian School of Veterinary Science, PO Box 8146, 0033 Oslo, Norway; [2] Norwegian Veterinary Institute, PO Box 750, 0106 Oslo, Norway; [3] National Veterinary Institute, Technical University of Denmark, 1870 Frederiksberg, Denmark; [4] Norwegian Sheep Health Service, Animalia, PO Box 396-Økern, 0513 Oslo, Norway
maren.knappe-poindecker@nvh.no

Introduction
Ovine footrot is a contagious disease caused by *Dichelobacter nodosus* (Whittington et al. 1995). *D. nodosus* strains that produce extracellular thermostable proteases may cause virulent footrot in sheep. Strains that secrete thermolabile proteases cause mild footrot in sheep and are also widespread in cattle. The bacterium is categorized in serogroup A-I and M.
In 2008, ovine footrot was diagnosed for the first time in 60 years in Norway. Norway has a tradition of co-grazing cattle and sheep, and a previous study indicated that cross-infection had occurred (Rogdo et al. 2012). The aim of this study was to investigate cross-infection of *D. nodosus* between sheep diagnosed with footrot and co-grazing cattle.

Materials and Methods
Five farms practicing co-grazing of sheep previously diagnosed with virulent footrot and cattle were included in the study. The study population consisted of 200 cows and 725 sheep. The cattle had claw diseases recorded in the autumn at the end of the grazing season and in the spring before the following grazing season. Ten cattle and ten sheep from each farm were selected for bacterial analyses. Swabs were analyzed by PCR, culturing, virulence-testing and serotyping for identification and characterization of *D. nodosus*. Biopsies were analyzed by fluorescent *in situ* hybridization regarding *D. nodosus*. Isolates from farm 1 were analysed by pulsed field gel electrophoresis (PFGE).
Cattle with virulent strains were treated topically with chlortetracycline and Intra Hoof-fit® and retested until negative or slaughtered.

Results
Virulent strains of *D. nodosus* serogroup A were detected in 16 sheep from farm 1, 2, 3 and 5 and in five cows from farm 1 and 2. All five cows had interdigital dermatitis. The symptoms of footrot were severe in farm 1 and 2. The PFGE showed that virulent isolates from sheep and cattle in farm 1 were identical. Three of the cows with virulent isolates eliminated the bacterium the following grazing season. The fourth cow was PCR positive after the grazing season, but tested negative on culture and PCR upon the next sampling. The fifth cow remained infected after the grazing season despite several attempts to treat the infection and was still infected when she was culled the following spring.

Discussion
Detection of virulent *D. nodosus* serogroup A in both sheep and cattle and the results from the PFGE strongly indicates that cross-infection did occur. In farms 1 and 2 all dairy cows and heifers co-grazed for several weeks more than in the other three farms. The results suggest that the number of cattle co-grazing, the length of the grazing season and the severity of the symptoms in sheep influences the risk of cross-infection.

References
Rogdo T Hektoen L Slettemeås JS Jørgsensen HJ Østerås O and Fjeldaas T 2012 Possible cross-infection of Dichelobacter nodosus between co-grazing sheep and cattle. Acta Veterinaria Scandinavica 54: 6.
Whittington RJ and Nicholls PJ 1995 Effects of the severity and duration of lesions on the primary and anamnestic humoral responses of sheep to Dichelobacter nodosus and observations of natural resistance to footrot. Research in Veterinary Science 59: 128-135.

39. Use of histology for the differentiation of digital dermatitis from other infectious disease processes affecting the interdigital skin

L De Vecchis[1], G Sironi[2], NM Vertemati[2], CM Mortellaro[2]
[1] Bovine Practitioner - Cermenate (CO) Italy; [2] Dept. Of Veterinary Science and Public Health – University of Milan Italy
ldevec@tin.it

Introduction

Digital Dermatitis (DD) is usually localized in the back of the foot. Other positions are the interdigital space, associated or not to interdigital hyperplasia and, less frequently, the dorsal skin and close to the dewclawes. The numerous attempts to define and differentiate DD from Interdigital Dermatitis divided different authors among those who believe they are two separate entities and those who considere them a unique and not differentiable condition. It is a common belief among many professionals who work in practical field and it is also reported by some authors (Hernandez and Shearer 2000), that DD affecting the interdigital skin exhibits lower cure rates compared to forms localized in palmar / plantar locations. In addition to this, we found many cases of DD of the interdigital space associated with a subacute / chronic swelling of the coronary region; in these cases, the clinical picture and history often report to another disease: the Interdigital Phlegmon (previous and sudden onset of lameness, swelling, necrotic tissue, interdigital space cracking, antibiotic therapy).

Aim

Evaluate the usefulness of the histological exam to differentiate the DD localized into the interdigital space from chronic/ subacute Interdigital Phlegmon. The hypothesis is that some interdigital skin lesions are sequelae of Interdigital Phlegmon (IP) cases, not completely healed, with insufficient re-epithelialization of the involved area or sub-acute "less invasive" form of IP. Despite an appearance similar to DD these lesions may have, therefore, different origin, evolution, prevention, therapy and prognosis.

Materials and Methods

In 27 Holstein Fresian dairy cows, housed in intensive dairy farms, fed with total mixed ration, we performed 27 biopsies, with sterile biopsy punch (diameter 6 mm) on DD lesions, both in the palmar/ plantar skin location and in the interdigital skin; cases are accompanied by medical history and images of the lesion. The samples were stored in formaldehyde 10% and blinded histological examinations were performed to verify the type of tissue and microorganisms possible presence.

Results

Our preliminary results have shown relatively similar elementary lesions in the different samples but also some differences. Several aspects are described as: strongly marked ulcerative lesions and less proliferative aspects; mild to moderate acanthosis, occasional findings of ballooning degeneration of the spinous layer cells. Presence of bacterial aggregates on epidermal surface, in moderate quantities and mixed morphology (spirillari, filamentous, coccoid). In some cases, the filamentous bacteria tend to be arranged between the intercellular spaces in a sort of reticular structure. Superficial dermatitis with rare lymphocytes and neutrophils. In a few cases, necrotic band of the superficial epidermal layer, colonized by filamentous bacteria and separated from the underlying epidermis, still preserved, composed by a layer of linear degenerate neutrophils, typical necrotic coagulation paintings by Fusobacterium necrophorum.

Discussion

The preliminary histological findings, referred to a first group of bioptic samples, are similar in most cases, to the typical DD findings, so the results currently obtained didn't allow us to distinguish between DD or Interdigital Phlegmon sequelae. Further investigations are required (immunohistochemistry, PCR) to verify our hypothesis.

References

Hernandez J, Shearer JK 2000 Observations from Florida field trials on topical spray treatment of Papillomatous Digital Dermatitis. 11th Symposium on Lameness in Ruminants- Parma, Italy pp 167-169.

40. Immune Response to Digital Dermatitis detected by ELISA Tests

A Gomez[1], K Anklam[1], M Kulow[1], J Rieman[1], K Cooley[1], K Dunbar[1], N Cook[1], D Döpfer[1]
School of Veterinary Medicine, University of Wisconsin-Madison, USA
artgomez01@gmail.com

Introduction

The pathophysiology of Bovine Digital Dermatitis (DD) is still not completely understood. Management practices to eliminate DD have not been defined clearly and partial success in DD control is commonplace in endemically affected cattle operations. One of the reasons for the failure is that clinical foot inspection is labor intensive, demanding special equipment and trained personnel to correctly identify lesions (Stokes et al., 2012; Relun et al., 2011). In addition, differences in the individual cow's responses to DD hinders the development of methods for DD prevention supported by indirect diagnosis such as by ELISA or PCR (Vink et al., 2009; Moe et al., 2010) and the correct use of footbaths and topical treatments. The objective of the study is to show how the immune response against DD develops over time, and the evaluation of an ELISA test as a diagnostic tool for detecting DD.

Material and Methods

A cohort of 141 pregnant Holstein heifers was evaluated 3 times at three month intervals before calving. Clinical hoof evaluation was performed and a serum sample taken during each evaluation. Upon detection of an active DD lesion, topical treatment was applied and additional evaluations in weekly intervals were performed until the lesion was considered inactive (showing a chronic stage or complete skin restoration). Clinical evaluation, including the M-stage classification described by Döpfer et al.(1997), and an ELISA test to measure antibody titers against *Treponema phaegedenis*-like spirochetes were used. For description purposes the animals were classified by the number of clinical cases experienced during the study period as Type I (no active DD cases were observed), Type II (only one active clinical case diagnosed during the study period) and Type III (at least two active clinical cases diagnosed). ELISA test results were converted into SP values and diagnostic test parameters were represented using a Receiver Operating Characteristic (ROC) curve and disease status estimated as predictive probabilities using Bayesian no cut-off value methods (Christensen et al., 2011).

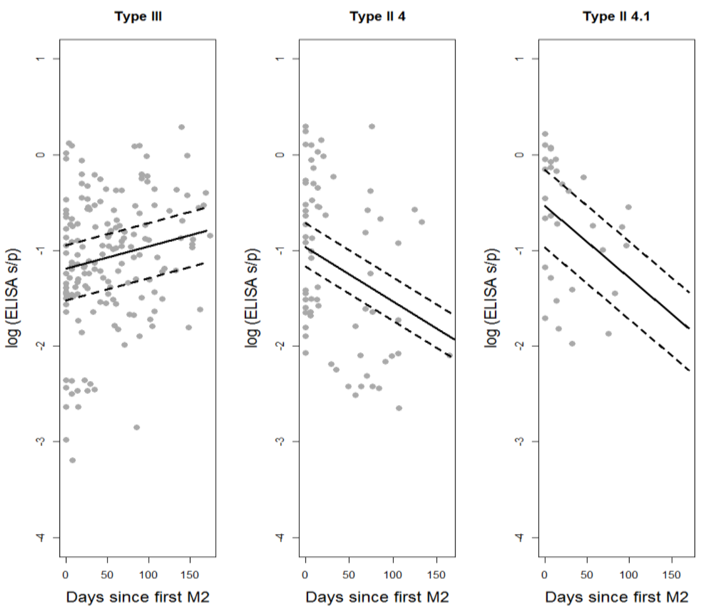


Figure 1. Observed (dots) and predicted (line) antibody titer levels over time from the occurrence of the first clinical acute DD event (M2).

Results

Animals that never experienced a DD event throughout the study kept a constant low level of antibody titers over time. However, an approximate 47% (95% C.I. 17, 76) increase in mean ELISA titers was observed in heifers upon first M2 lesion diagnosis. As can be seen in figure 1, after topical treatment of the first M2 case, antibody titers fade out progressively, achieving mean “normal” levels after 223 days (95%CI, 188, 268) after the first infection. Surprisingly, antibody titers in Type II animals with subclinical lesions observed in subsequent evaluations (Type II 4.1) also waned at a similar rate. In figure 2 a representation of the Sensitivity and Specificity of the test for the range of cut-off points is shown in an ROC curve.

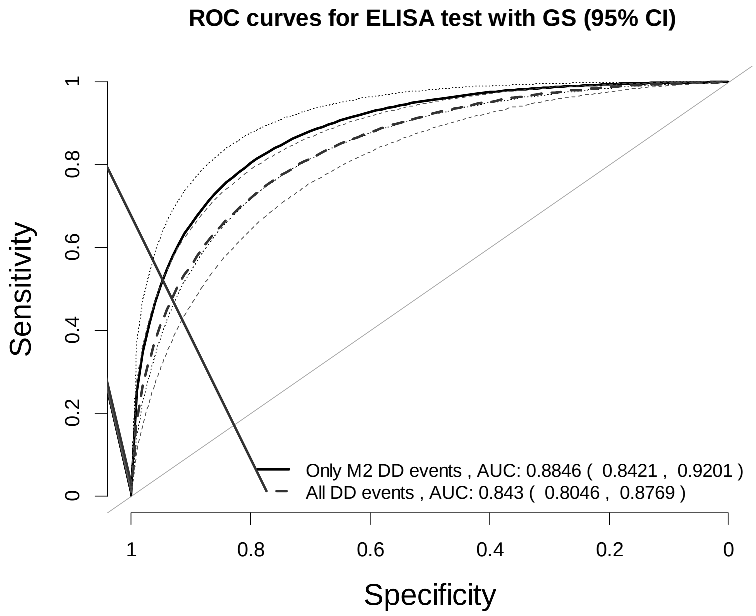


Figure 2. ROC curves (95% CI) for ELISA as a diagnostic test using visual inspection as gold standard (GS). All DD events (dashed line) and only acute M2 DD events were included (continuous line). Area under the curve is showed (AUC).

Discussion
It appears that when subclinical lesions are combined with skin proliferation as in the Type II 4.1 cows the treponemes can hide from the immune system as indicated by the decrease of the ELISA titers over time. This is one of the pathophysiological mechanisms that allow the disease to become endemic in the farm, provided that basic measures of prevention are not able to completely cure active DD lesion events. Also, by means of the current longitudinal study, ELISA tests have shown to be an easy and valid tool to detect DD.

Acknowledgements
We would like to thank Zinpro Inc. for their support

References

Moe KK, Yano T, Misumi K, Kubota C, Yamazaki W, Muguruma M and Misawa N 2010 Analysis of the IgG Immune Response to Treponema phagedenis-Like Spirochetes in Individual Dairy Cattle with Papillomatous Digital Dermatitis. Clinical and Vaccine Immunology 17:376–383
Christensen R, Johnson W, Branscum A, Hanson TE 2011 Bayesian Ideas and Data Analysis: An introduction for scientists and statisticians. Chapman & Hall/CRC Press. Boca Raton, FL, USA
Döpfer D, Koopmans A, Meijer FA, Szakall I, Schukken YH, Klee W, Bosma RB, Cornelisse JL, vanAsten A and terHuurne A 1997 Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. Veterinary Record 140:620–623
Relun A, Guatteo R, Roussel P, and Bareille N 2011 A simple method to score digital dermatitis in dairy cows in the milking parlor. Journal of Dairy Science 94:5424–5434
Stokes JE, Leach KA, Main DCJ and Whay HR 2012. The reliability of detecting digital dermatitis in the milking parlour. The Veterinary Journal 193:679–684
Vink WD, Jones G, Johnson WO, Brown J, Demirkan I, Carter SD and French NP 2009 Diagnostic assessment without cut-offs: application of serology for the modelling of bovine digital dermatitis infection. Preventive Veterinary Medicine. 92:235–248.

41. Digital Dermatitis: A Description of Lesion Progression and Regression of Natural Disease in Holstein Dairy Cattle Over Three Years

A. Krull[1], P. Gorden[1], J. Shearer[1], B. Leuschen[1], HM Scott[1], P. Plummer[1]
[1] College of Veterinary Medicine, Iowa State University, Ames, IA USA
pplummer@iastate.edu

Introduction
Digital dermatitis is an economically important infectious cause of lameness in dairy cattle as well as beef feedlot cattle. Despite 35 years of research, the etiology and developmental process of digital dermatitis has yet to be fully described. The majority of research into the etiology of digital dermatitis has focused on identifying cattle with “classic” lesions either during routine foot trims or at slaughterhouses. This method of research is hampered by the inability to accurately classify lesions as acute versus chronic and does not consider treatment history in the evaluation of the lesion. In the present study we have developed a novel scoring system based on long-term (32 months) longitudinal observation of lesion development. This system has allowed for the identification of changes to the bovine skin consistently recognizable weeks to months prior to “classic” lesion development and lameness.

Materials and Methods
Sixty one adult Holstein dairy cattle were enrolled in the study and allowed to develop digital dermatitis lesions via diversion from the farm’s foot bath and topical treatments. These cattle were followed for up to 978 continuous days and have been examined and photographed every 2-4 weeks to document lesion development. These cows were also monitored for recrudescence and/or reinfection with digital dermatitis over this same time period. Through examination of images prior to development of digital dermatitis, a consistent pattern of development was observed and categorized into six stages.

Results
A consistent pattern of lesion development has been identified from the analysis of more than 7000 photos over the course of 32 months. Histopathologic and microbial metagenomic studies have validated that these morphologic lesions progress through a systematic progression of lesion severity and represent distinct lesion stages. Two years of morphologic lesion progression monitoring on these cows have confirmed that all lesions develop systematically through these described stages. Temporal evaluation of the lesion stages has demonstrated that cows can routinely have early stage “non-active” lesions for weeks to months (some even years) prior to the development of classical digital dermatitis lesions that would be identified in most cross-sectional studies. These early stage cows remain non-lame and in most cases would not be identified without examination of the foot after cleaning. Each “step up” in lesion severity on our scoring system represents an increased risk of developing an active “classical” lesion. Interestingly, a significant number of cows on our study with advanced lesions fail to show significant lameness (ie. locomotion score of 4/5 or more). Locomotion scoring was found to have a low correlation with lesion severity in all but the most severe lesions. Finally, aggressive post-treatment follow up of cows has identified that many cows do not regress back to normal skin following treatment. Many of these treated lesions regress into earlier lesion stages with cows that achieve the lowest lesion scores post-treatment being the least likely to redevelop advanced lesions during the follow-up period.

Discussion
The identification of lesions months prior to the onset of classically described stages of digital dermatitis has allowed us to study lesions at their earliest stages of development. Furthermore, our data suggest that our scoring system may be useful as a prognostic indicator or risk for further lesion development or risk of reoccurrence of advanced lesions. Finally, the evidence suggests that locomotion scoring may not be effective at identifying cows with early stage lesions.

42. *In vitro* Adhesion Assays Challenged by 16 Candidate Chemicals for Bovine Hoof Baths to Prevent and Control Digital Dermatitis in Cattle

MJ Kulow[1], M Cardona[1], S Elliot[1], J Dahm[1], MG Lopez-Benavides[2], M Buchalova[2], C Mateus[2], TC Hemling[2], D Döpfer[1]
[1] University of Wisconsin-School of Veterinary Medicine, Madison, WI, USA, [2] DeLaval, Kansas City, MO, USA
mkulow@vetmed.wisc.edu

Introduction
Bovine digital dermatitis (DD) is an infectious claw disease in cattle that can cause painful ulcerative lesions along the coronary band (Read & Walker 1998). The etiology of DD is still uncertain but it appears to have a strong bacterial component, frequently associated with pathogens such as *Treponemna subspecies*. Control and prevention of DD often involves the use of walk-through hoof baths containing chemicals. Experimental chemical agents are often developed and used during field trials without any pre-testing of their effect against treponemes. The aim of the current project was to develop and implement two *in vitro* adhesion assays challenged by experimental chemicals where adhesion is simulated between treponemes isolated from DD cases and bovine keratinocytes isolated from the horn skin border of cows' feet.

Materials and Methods
Two adhesion assays were conducted in triplicate for 16 chemicals at three inhibitory concentrations (Table 1) using *Treponema phagedaenis*-like strains from DD and bovine keratinocytes of slaughtered cows. Confluent cell monolayers grown in 96 wells micro titer culture plates were used in the assays. For adhesion assay 1, the treponemes were exposed to the chemical for the least amount of time possible (5 to 7 minutes). The chemically challenged treponemes were incubated with the keratinocytes for a total of 30 minutes in a 37°C incubator with 5% CO_2. During adhesion assay 2, the adhesion complex between the treponemes and the cell cultures formed for 30 minutes prior to exposure to the experimental chemical for the least amount of time possible. For each assay, the treponemes were quantified using quantitative real-time PCR and colony-forming unit plate counts, when available, and the number of live keratinocytes per ml was determined using a Trypan Blue Exclusion Assay.

Table 1. The 16 candidate chemicals (DeLaval, Kansas City, MO) used in the adhesion assays; stock concentrations; working concentrations for potential use in hoof baths; concentrations at half the minimum inhibitory concentration (MIC), the MIC, and twice the MIC or minimum bactericidal concentration (MBC)

Chemical	Stock Concentration	Working Concentration	1/2xMIC	MIC	MBC/2xMIC
CuSO4	10%	5%	0.0025%	0.0049%	0.0098%
Chlorocresol	0.40%	0.20%	0.0125%	0.0250%	0.0500%
Lactic Acid	1%	0.50%	0.0078%	0.0156%	0.0313%
Salicylic Acid	0.20%	0.10%	0.0250%	0.0500%	0.0100%
458-56-1	0.80%	0.40%	0.0024%	0.0047%	0.0063%
458-56-2	0.80%	0.40%	0.0042%	0.0084%	0.0104%
458-56-4	0.94%	0.47%	0.0147%	0.0294%	0.0588%
458-56-9	0.80%	0.40%	0.0315%	0.0063%	0.0125%
458-56-8	100%	50%	0.3900%	0.7800%	1.1700%
458-56-7	0.54%	0.27%	0.0169%	0.0338%	0.0675%
458-56-6	1%	0.50%	0.0157%	0.0313%	0.0626%
482-64-3	0.80%	0.40%	0.0032%	0.0063%	0.0125%
482-64-4	0.80%	0.40%	0.0032%	0.0063%	0.0126%
482-64-7	0.80%	0.40%	0.0016%	0.0031%	0.0063%
482-64-8	0.80%	0.40%	0.0032%	0.0063%	0.0126%
482-64-9	1%	0.50%	0.0078%	0.0156%	0.0312%

Results
The concentration of treponemes and keratinocytes were similar for all adhesion assays challenged by the 16 chemicals at all inhibitory concentrations. The treponemes ranged from 10^5 to 10^6 CFU/ml as determined by quantitative PCR and the keratinocytes counts ranged from 10^3 to 10^4 cells/ml. The number of treponemes adhered per live kerationcyte did not show any biologically significant trend for any specific

chemical or MIC concentration when compared to unchallenged adhesion complexes (Figure 1 and 2). All changes in adhesion compared to control assays were detected at significantly lower concentrations of chemicals compared to their respective working concentrations.

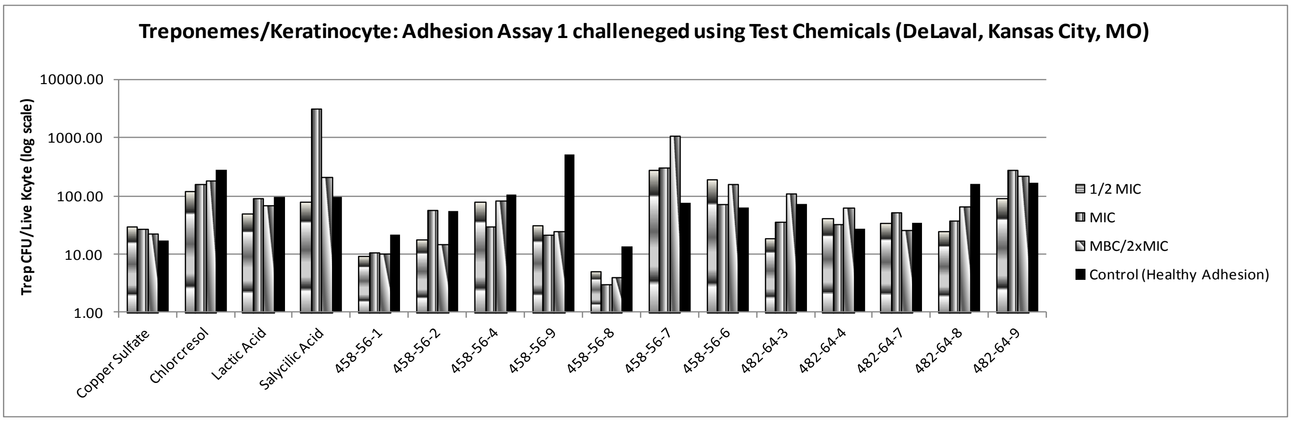


Figure 1. Results from adhesion assay 1: The number of treponemes adhered per live keratinocyte for each chemical at three inhibitory concentrations

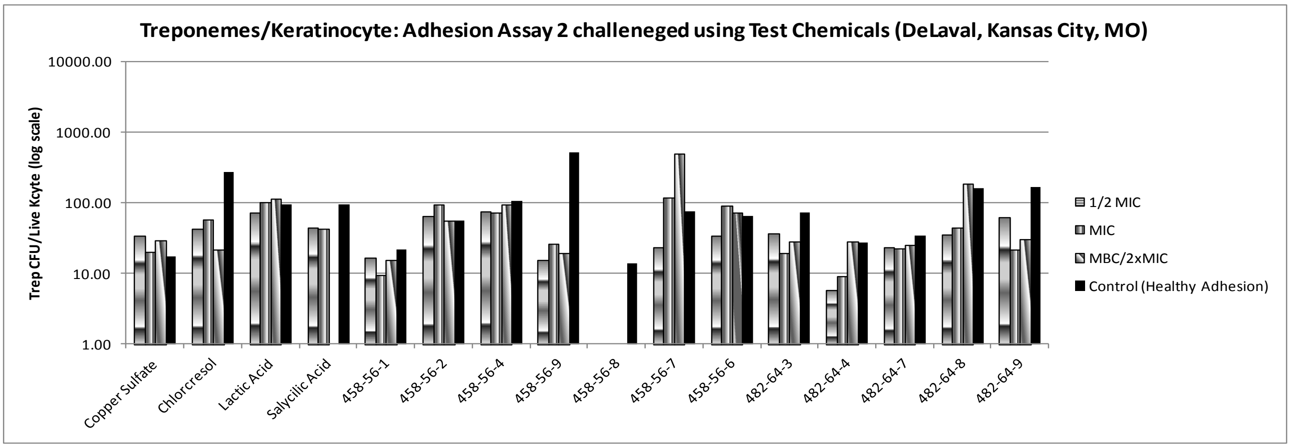


Figure 2. Results from adhesion assay 2: The number of treponemes adhered per live keratinocyte for each chemical at three inhibitory concentrations

Discussion

To improve the interpretation of the adhesion assay, it is necessary to be able to quantify the live treponemes *in vitro* using methods other than genomic DNA quantification. The lack of any noticeable trend in data between chemicals and varying concentrations may be due to the limitations and conditions of the assays along with the unknown impacts of the microbial morphology changes of treponemes on the assays (*Döpfer et al 2012*) and their interactions with bovine epithelial skin layers.

Acknowledgements

Funding for this study was provided by DeLaval (Kansas City, MO, USA).

References

Döpfer D, Anklam K, Mikheil D, Ladell P 2012 Growth curves and morphology of three Treponema subtypes isolated from digital dermatitis in cattle. The Veterinary Journal 193: 685-693

Read DH, Walker RL 1998 Papillomatous digital dermatitis (footwarts) in California dairy cattle: clinical and gross pathologic findings. Journal of Veterinary Diagnostic Investigation10: 67-76.

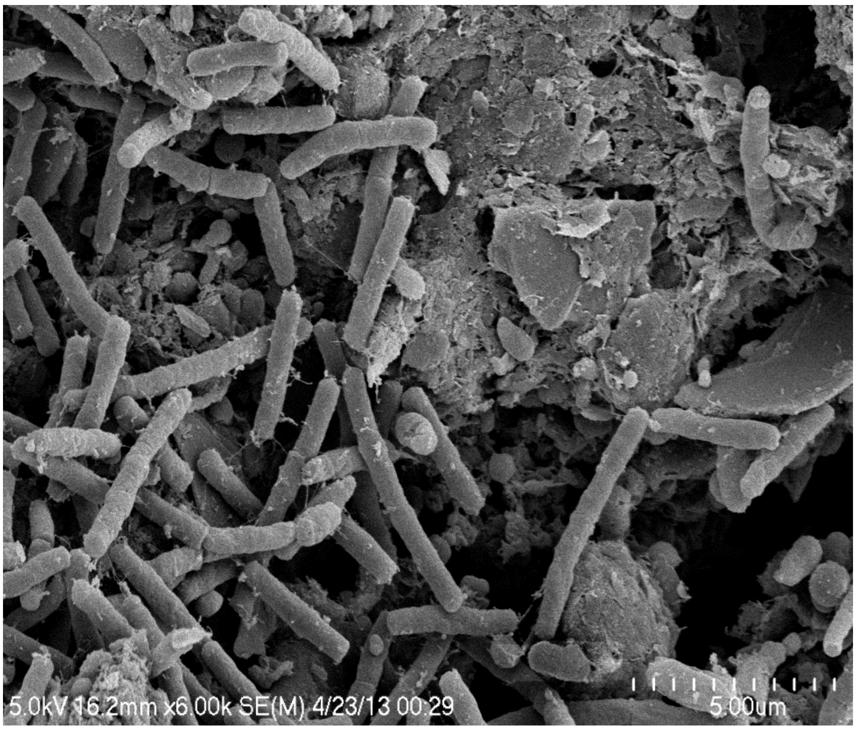
P25(b). Comparison of ultrastrulctural damages caused by pathogenic bacteria in ***stratum corneum*** of hoof tissue of sheep

S Azarpajouh[1]
[1]Animal Science, University of Missouri- Columbia, Missouri, USA.
sa7q9@mail.missouri.edu

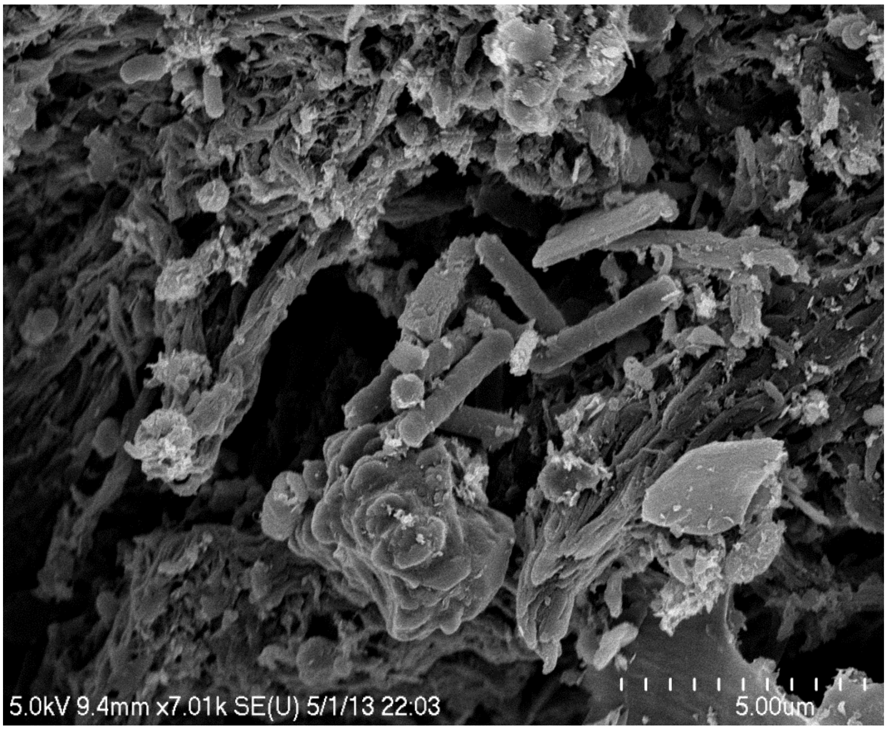
Introduction
Bacterial invasion of the *stratum corneum* causes degenerative process and dissociation of epidermal cells following edema and extravasation. *Dichelobacter nodosus,* the main cause of ovine footrot, penetration into the *stratum corneum* requires the adhesive activity of type IV fimbriae and is accompanied by sinus formation (Egerton, 1989). Generally, black-pigmented hooves are hardier than white-colored hooves; therefore the objective of this study is to compare the ultrastructural changes caused by bacterial infection in the epidermal layer of different pigmented hooves.

Materials and Methods
The white and black-pigmented hoof tissues collected after hoof trimming were cut using a metal cork borer measuring 1 mm^3. The samples were boiled for 3 minutes, microwaved for 5 minutes and then examined with Wolfe® StereoPro™ Stereomicroscopes. The bacteria stock *(D. nodosus)* stored at -80°C in a PBS solution was revived by transferring to nutrient broth-based culture tube and incubated at 37°C in cell incubator overnight. The samples and the bacteria were transferred to the beef broth medium and incubated at 37°C in cell incubator for 6 days. No bacteria were inoculated in the control groups. After primary fixation with 2.5% glutaraldehyde and post fixation with 1% Osmium tetroxide, the specimens were dehydrated using a series of graded ethyl alcohol (70% for 15 min, 95% for 15 min, and 3 changes of 100% for 10 min each) and then dried using a commercially available critical point drying apparatus. The specimens were mounted on aluminum stubs with adhesive tabs and sputter coated for 3 minutes. Finally, using a scanning electron microscope (SEM) images were taken from the specimens.

Results
Sinus formation (shown by white arrows) was observed in both white and black- pigmented hoof tissues (pictures 1 & 2). In addition, some bacteria were observed in both white and black-pigmented hoof tissues in control group which can be the normal inhabitant of external and internal environment. There was no significant relationship between the tissue pigment and the ultrastractural changes in tissue.



Picture 1. White-pigmented hoof tissue invaded by D. nodosus



Picture 2. Black -pigmented hoof tissue invaded by *D. nodosus*

Discussion

Sixty images were taken by SEM from both treatment and control groups. Presence of the bacteria which are normal hoof inhabitant can be avoided by collecting the tissue samples from the deeper parts of the hoof. Further SEM study is required using the hoof tissue samples collected from the animals suffering from footrot to compare the ultrastructural damages in different footrot scores.

Acknowledgments

The assistance from the staff of the Electron Microscopy Core in University of Missouri- Columbia is gratefully acknowledged.

References

Jashamy Al, Jasni S 2008 Ultrastructural Changes of the Skin Stratum Basal Layer and Basement Membrane in Ovine Footrot Disease. Annals of Microscopy 8, 36-41.
Egerton JR, Yong WK, Riffkin GG 1989 Footrot and foot abscess of ruminants. Boca Raton, Fla CRC Press 52.

P26(a). Prevalence of *Treponema sp.* in bovine digital dermatitis-associated white line disease and sole ulcers

S Sykora[1], G Auersperg[1], J Kofler[2], J Dietrich[2], J Reichert[2], S Brandt[1]
[1]Research Group Oncology, Equine Clinic, Department of Companion Animals & Horses, [2]Clinic for Ruminants, Department of Farm Animals and Veterinary Public Health, University of Veterinary Medicine, A - 1210 Vienna, Austria
sabine.brandt@vetmeduni.ac.at

Introduction

“Non-healing white line disease” (nhWLD) and “non-healing sole ulcer” (nhSU) seem to occur frequently in bovines affected by digital dermatitis (BDD) – a common disease which is likely to be caused by treponemal infection (Cook and Burgi 2008, Holzhauer 2008; Blowey et al 2011, Evans et al 2011). Recent findings obtained by molecular biological analyses of affected tissue specimens are suggestive for *Treponema sp*. also having a role in the pathogenesis of BDD-associated WLD and SU (nhWLD-BDD, nhSU-BDD) (Evans et al 2011; Holzhauer & Pijl 2011; Van Amstel et al 2011). Using PCR, we have addressed this assumption by screening a series of nhWLD lesions and nhSU derived from BDD-affected versus WLD tissue derived from BDD-free dairy cows for the presence of *Treponema* and *Tannerella ssp*.

Material and Methods

Tissue samples were obtained from 42 nhWLD-/nhSU-BDD lesions, from 25 “classical” BDD lesions (control group 1), and from 15 WLD lesions obtained from BDD-free cows (control group 2). Following DNA extraction using a commercial kit (DNeasy blood & tissue kit; Qiagen, Hilden, Germany), sample-derived DNA isolates were successfully tested for PCR compatibility by routine beta-actin PCR (Brandt et al 2010) and then subjected to amplification reactions using four different primer pairs recognizing in sum presumably all *Treponema* and *Tannerella ssp.* (Sykora et al, in press). Amplification products were visualized by gel electrophoresis, then gel-purified using a Qiaex II gel purification kit (Qiagen) and identified by bidirectional sequencing (VBC biotech, Vienna, Austria).

Results

All BDD-type lesions (25/25) scored positive for one (2/25) or several (23/25) *Treponema sp.,* with *T. pedis* being present in 100% of lesions. *T. medium* DNA was detected in 16/25, canine oral treponemes in 10/25, *T. refringens* in 4/25, *T. phagedenis* in 3/25 and *T. denticola* in 2/25 isolates. *Treponema sp*. were also found in 41/42 nhWLD-/nhSU-BDD lesions, which mostly revealed multiple infections (35/42). *T. pedis* (38/42), *T. medium* (28/42) and canine oral treponemes (27/42) were predominantly detected from the lesions. Rarely detected species (1-2/42) comprised *T. putidum*, *phagedenis*, *denticola*, *vincentii* or *refringens*, and *Tannerella forsythia* in one case. Although treponemal DNA was also detected in 100% of WLD lesions derived from BDD-free individuals, with *T. pedis* constituting the prevailing species (11/15), *T. medium* was only detected in 1/15, and canine oral treponemes were only found in 3/15 WLD lesions. In contrast, presence of *T. refringens* DNA was noted for 7/15 lesions. Other detected species corresponded to *T. bryantii* (2/15), *T. denticola* (2/15) or *T. calligyrum* (1/15).

Discussion

Treponemal DNA was detected from virtually all lesions, i.e. in 81/82 cases, no matter whether the tissue material analysed was derived from BDD, nhWLD-/nhSU-BDD, or WLD. Interestingly, and somewhat unexpectedly, *T. pedis* predominated in all types of lesions, yet, the significance of this finding remains unclear. It is possible that *T. pedis* constitutes a highly virulent *Treponema* species, which may have a causal role in different types of digital disease. Alternatively, the detected omnipresence of *T. pedis* in the investigated tissue specimens represents an opportunistic infection. *T. medium* and canine oral *Treponema* taxons were frequently found in BDD, as shown previously (Brandt et al 2010), and also in nhWLD-/nhSU-BDD, yet only in one case of BDD-free WLD, suggesting that these *Treponema* species may account for the chronicity of these types of disease, yet only have a minor or no role in the pathogenesis of WLD/SU. Divergencies to previous findings (Evans et al., 2011a) are very likely due to the use of PCR primers recognising a broader sprectrum of *Trepomema sp*. *T. bryantii* was detected in two WLD lesions. This saccharolytic spirochete commonly resides in the bovine rumen (Evans et al., 2011b), where it interacts with cellulolytic bacteria, so that a pathogenic involvement in WLD seems rather improbable. In contrast, the observed and almost exclusive presence of *T. refringens* and *T. calligyrum* in WLD is interesting. These two species are closely related to *T. pallidum*, which causes and particularly accounts for the chronic progression of syphilis. They considerably differ from phylogentic groups 1 (including *T. medium*) and 4 (including canine oral *Treponema* species) (Paster and Dewhirst 2006). In depth investigations will reveal their putative role as pathogenic agents for digital infections

References

Blowey R Evans N Carter S 2011 The involvement of digital dermatitis treponemes in non-healing bovine hoof lesions. 16th Symposium and 8th Conference of Lameness in Ruminants, p.18, Rotorua, New Zealand.

Cook NB Burgi K 2008 “Hairy Attack” A New Lesion Affecting the Corium of the White Line - A Case Report. In: 15th Symposium and 7th Conference of Lameness in Ruminants. p 214-215, Kuopio, Finland.

Evans NJ Blowey RW Timofte D Isherwood DR Brown JM Murray R Paton RJ Carter SD 2011 Association between bovine digital dermatitis treponemes and a range of 'non-healing' bovine hoof disorders. Veterinary Record:168: 214-217.

Evans NJ Brown JM Murray RD Getty B Birtles RJ Hart CA Carter SD 2011b Characterization of novel bovine gastrointestinal tract treponema isolates and comparison with bovine digital dermatitis treponemes. Applied and Environmental Microbiology: 77: 138–147.

Holzhauer M 2008 Non-Healing White Line Disorders, a New Clinical Presentation. In: 15th Symposium and 7th Conference of Lameness in Ruminants. p 206, Kuopio, Finland.

Holzhauer M Pijl R 2011 Non-Healing White Line Lesion, advanced experience. In 16th Symposium and 8th Conference of Lameness in Ruminants. p 149, Rotorua, New Zealand.

Paster and Dewhirst 2006 The phylogentic diversity of the genus Treponema. In: Pathogenic Treponema. J.D. Radolf & S.A.Lukehart (Eds.). Caister Academic Press, Norfolk, UK, pp.9-18.

Van Amstel S Shearer J Cooper VL 2011 Clinical presentation, treatment approach and histopathology of atypical digital dermatitis lesions. In: Proceedings 16th Symposium and 8th Conference of Lameness in Ruminants. p 26, Rotorua, New Zealand.

P26(b). Optimization of *in vitro* Growth Conditions and DNA Extraction from *Treponema phagedenis* Isolated from Bovine Digital Dermatitis Lesions

A Krull[1], P Plummer[1]
[1] College of Veterinary Medicine, Iowa State University, Ames IA USA
pplummer@iastate.edu

Introduction
Bovine digital dermatitis is a leading cause of lameness in the US dairy industry where it also represents a significant welfare issue. Our group and others have demonstrated that, along with a number of other organisms, *Treponema* spp. can be cultured from a large percentage of these lesions. As part of our ongoing effort to better understand the role that *Treponema* spp. plays in this disease process, we are using a combination of culture-dependent and independent methods to better understand the physiology and metabolism of these bacteria. *Treponema* spp. are fastidious and their growth in broth media has traditionally been difficult, thus hindering the ability to grow sufficient organisms for DNA purification to be used in downstream sequencing or genetic modification. Quantification of growth has traditionally been problematic due to the organisms' tendency to swarm subsurface on solid media making colony counting difficult. This study details the systematic evaluation of different culture conditions on the growth and replication of *T. phagedenis* isolated from digital dermatitis lesions of cattle as well as the use of flow cytometry to accurately quantify bacterial numbers.

Materials and Methods
The impact of oxygen concentration (anaerobic, 2% oxygen, 5% oxygen, aerobic), inclusion of fetal calf serum (5,10,15%), shaking, and incubation temperature were tested in broth culture of the organism. Three *T. phagedenis* isolates obtained from digital dermatitis lesions were grown under varying conditions for 6 days with daily OD readings as well as quantification and analysis using flow cytometry and Live/Dead staining. At log phase growth, DNA extraction was completed using several commercially available kits along with modifications recommended from research in other Treponema species.

Results
Under optimal growth conditions, broth cultures reached greater than 1.0×10^8 bacteria per ml of broth in 96 hours. Although total bacteria numbers and optical density continued to rise past 96 hours, the total number of live cells decreased past 96 hours. Therefore, log phase should be considered 72-96 hours, followed by a short stationary phase, and cells entering death phase by 120 hours. Growth of *Treponema phagedenis* under microaerophilic conditions yielded growth similar to strictly anaerobic conditions. DNA extraction from these cultures was optimized with respect to commercially available kits, amount of starting material, and optional Proteinase K and RNase options. As a result of this optimization, cultures consistently yielded greater than 20ug of high quality DNA.

Discussion
The results indicate that modifications to the traditional culture techniques employed for this organism result in enhanced growth and that using these techniques large quantities of high-quality DNA can be obtained in less than 4 days. The ability to *T. phagedenis* to grow as well or better under microaerophilic oxygen concentrations is a novel finding that has the potential to increase the ability to cultivate previously uncultivable *Treponema* species. These findings lay the foundation for an improved ability to cultivate this organism for use in challenge experiments and for the development of improved tools for genetic manipulation of *Treponema* spp.

P27(a). Clinical and histomorphological study of invasive bovine digital dermatitis toward the corium of heel and sole

P Memarian[1], M Nouri[1], I Nowrouzian[2], SM Ghamsari[2]
[1] Iranian Arad Pajouh Veterinary University Center, Tehran, Iran; [2] Department of Clinical Sciences, Faculty of Veterinary Medicine, the University of Tehran, Tehran, Iran.
mnouri2@yahoo.com

Introduction

Papillomatous Digital Dermatitis (PDD) is a multifactorial, superficial dermatitis of the digital skin of cattle and can be a cause of lameness in large numbers of dairy cows. PDD mostly occurs on the plantar aspect of the rear foot, affecting the skin adjacent to the interdigital cleft. This is a clinical and histomorphological study of invasive digital dermatitis toward the corium of heel and sole.

Material and Methods

The recorded data of 115 lame cows out of 410 holstein milking cows were studied clinically and histomorphologically at one large dairy in Gharchack during a 3 month period. These lame cows were selected by means of a visual locomotion score (Sprecher Method). At the milking parlor, the lesions were identified by using the" Diagnosis Gold Standard" introduced by experts at the Liverpool Symposium in 1990.

Results

Atypical clinical presentation of DD were confirmed on 28 cases out of 53 identified as sole hoof lesions. These lesions were usually situated on the corium under loose horn and noted in association with abaxial zones 2 and 3 (8 cases), zones 4 and 5 (5 cases), and also zone 6 (15 cases) were the other sites which the extension of digital dermatitis were demarcated. The lesions were histomorphologically characterized by hyperkeratotic epithelium overlying dense zone of necrosis and pyogranulomatous inflammation in association with exuberant granulation tissue and proliferation of blood vessels.

Discussion

Recently, ‘non-healing claw lesions’ have been reported in the USA, UK, Netherlands and Iran. All studies suggested the potential involvement of bovine digital dermatitis, and that they considered it to be a ‘new’ lesion (Cook and Burgi, 2008; Holzhauer and Vos 2008; Evans et al., 2011; Nouri and Ashrafi, 2012). Current evidence indicates that BDD is multifactorial, involving environmental, microbial, host, and management factors. The environmental condition of this farm was poor, with large volumes of slurry accumulation. Poor hygiene in the cows’ environment has been associated with a higher risk of disease (Nowrouzan and Radgohar 2011). From the histopathological descriptions, it appears that the formation of exuberant granulation tissue is an important response to infection associated with digital dermatitis. Based on the results of this study it can be inferred that the atypical clinical presentation of digital dermatitis, introduced by Van Amstel (2011) as "Hairy Attack", can play a significant role in the persistence of "PDD" at the herd level.

References

Cook N and Burgi K 2008 ‘Hairy attack’: a new lesion affecting the corium of the white line – a case report. proceeding of the 15th symposium on lameness in ruminants, Kuopio, Finland, pp. 214.
Evans NJ, Blowey RW, Timofte D, Isherwood DR, Brown J M, Murray R, Paton RJ, Carter SD 2011 Association between bovine digital dermatitis treponemes and a range of ‘non-healing’ bovine hoof disorders, Veterinary Record 168: 214-7.
Holzhauer M, Vos J 2008 Non-Healing White Line Disorders, a New Clinical Presentation, proceeding of the 15th symposium on lameness in ruminants, Kuopio, Finland, pp. 206.
Nouri M and Ashrafi-Helan J 2012 Clinical and gross pathologic findings of complicated vertical fissures with digital dermatitis in a dairy herd, Veterinary Research Forum 3: 291-295.
Nowrouzan IJ, Radgohar I 2011 Restrospective study of the correlation between hygiene scores and the prevalence of papillomatous digital dermatitis in dairy cows. In: 16th International Symposium on Lameness in Ruminants, Rotorua, New Zealand, pp. 29.

P27(b). Morphologic and metagenomic development of bovine digital dermatitis in US dairy cattle

A Krull[1], JK Shearer[1], P Gorden[1], V Cooper[1], B Leuschen[1], HM Scott[1], PJ Plummer[1]
[1] College of Veterinary Medicine, Iowa State University, Ames IA, USA
pplummer@iastate.edu

Introduction
The key goal of this project was to develop a validated means of staging the temporal development of digital dermatitis lesions in order to allow us to test the hypothesis that specific consortia of microorganisms could be associated with each stage of lesion development and that these populations changed with lesion stage.

Materials and Methods
Sixty-one adult Holstein cows were followed over a 32-month period with each animal being tabled for evaluation every 2-4 weeks while on study. All animals were diverted around the footbath while on study and were not treated for DD. Pictures and biopsies were obtained on a regular basis. Histopathologic examination of biopsies was performed by a "blinded" pathologist. In addition silver staining was performed to evaluate for the presence or absence of spirochetes in each biopsy. In order to evaluate the microbial population associated with each stage of lesion development we performed two complementary means of culture independent next generation sequencing based microbial community profiling, shotgun metagenomics and 16S amplicon phylogenomics.

Results
Observations collected as part of the study led to the development of a six-stage lesion scoring system and demonstrated that these lesions scores represent a linear scale of severity and that lesions develop through a systematic series of stages that could be morphologically differentiated. The temporal development of these lesions can occur over a prolonged period of time (upwards of 1 year in the absence of treatment intervention) and specifics of that data will be presented in a separate abstract presented at this meeting. Histopathologic evaluation of the lesions reveals that there is a relationship between morphologic lesion severity and histopathologic lesion severity. Additionally, the presence of spirochetes is correlated with the severity of the lesion with very few early stage lesions showing evidence of spirochetes.
The shotgun metagenomics analysis yielded 4,250,000 DNA reads following quality filtering and demultiplexing. Likewise, the MiSeq phylogenic run yielded approximately 15,000,000 DNA sequences. Data analysis included quality filtering, sorting samples by barcode followed by OTU calling and designation of taxonomy. Comparison of the microbial consortium present in each lesion stage demonstrates that each stage represents a uniquely different microbial consortium as hypothesized. Analysis of Similarity (ANOSIM), a widely used multivariate method in community ecology, was used to compare whether the Bray-Curtis distances within the same category of the samples is significantly different from those among different categories of the samples. Statistically significant differences do exist ($p<0.001$) and pair-wise comparison of the stages demonstrates statistically different populations between all stages ($p< 0.025$).

Discussion
These findings are significant in that they provide the first detailed temporal assessment of lesion development and the culture independent assessment of the microbial community present in each stage. The fact that the morphologic staging of these lesions were predictive of their stage of development, their histopatholgic findings, the presence of spirochetes by histopathology and their microbial community profile validates that this staging system can be used for future studies with confidence. The culture independent sequencing data starts to provide key insights into the development of these lesions and suggest that bacterial communities predominate the lesions. Both histopathology and metagenomics methods suggest that while spirochetes are abundant in advanced lesions their relative abundance is much more limited in early disease lesions. The implications of this finding, along with the potential role of other early stage colonizers in the initiation of this disease process are being explored.

Session 8

Pathology and Patho-physiology of Inflammatory Foot and Joint Conditions

43. Polysynovitis in cows with grain induced rumen acidosis

AM Danscher[1], M Ranch-Nielsen[1], PH Andersen[1]
[1]University of Copenhagen, Department of Large Animals Sciences, Denmark
ad@sund.ku.dk

Introduction
Acute rumen acidosis induced by oligofructose overload has been associated with development of polysynovitis in dairy heifers (Danscher et al., 2010). However, oligofructose overload does not model herd feeding conditions well. The aim of this study was to investigate whether rumen acidosis induced with grain under herd like feeding conditions was associated with polysynovitis.

Materials and Methods
Eight Danish Holstein dry cows were fed a conventional TMR with forage-to-concentrate (DM) ratio of 78:22. Acidosis challenge was conducted in four animals by substituting 45% of TMR DM with wheat/barley pellets. Rumen pH was measured continuously (eCow) and time below pH 5.6, and 5.2 were calculated. Locomotion scoring was performed on two control and two SARA/acidosis days. Cows were euthanized after two days acidosis challenge. From each cow synovial fluid was obtained by arthrocentesis from 7-9 limb joints and synovial membrane was excised from 3-5 of these joints and processed for histology. Synovial fluid total white blood cell count (WCC), differential count, and total protein concentration was obtained, and synovial membrane samples were scored semiquantitatively for presence of neutrophils and fibrin.

Results
Average duration of rumen pH below 5.6 and 5.2 increased in acidosis cows (493 and 304 min/d) compared to controls (0 min/d) ($P < 0.05$). Locomotion score and total protein concentration in synovial fluid did not differ between groups. Average synovial fluid WCC was 2.68 (±2.48) bill/L with 61% neutrophils in acidosis cows and 0.03 (±0.01) bill/L with 4% neutrophils in controls (Fig. 1 and 2). Moderate/severe infiltration of neutrophils in subintima was observed in 37% of synovial membrane samples from acidosis cows and in 6% from control cows. Infiltration of neutrophils/exudation of fibrin to the joint lumen was moderate/severe in 32% of acidosis samples and 0% of controls (Fig. 3).

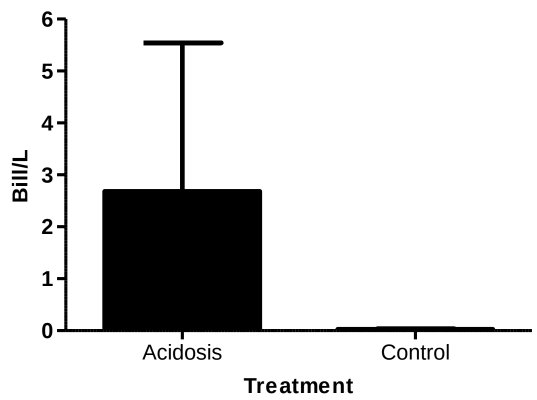


Figure 1. Synovial fluid total white blood cell count in limb joints from 4 cows with grain induced rumen acidosis (n=32) and 4 control cows (n=32)

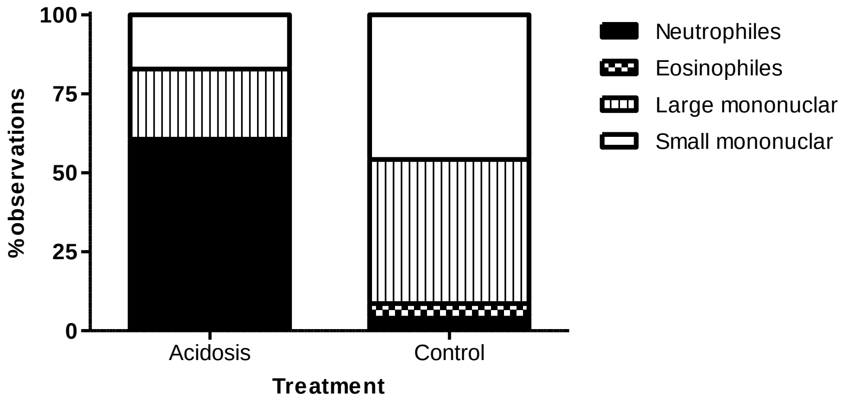


Figure 2. Synovial fluid differential white blood cell count in limb joints from 4 cows with grain induced rumen acidosis (n=25) and 4 control cows (n=11)

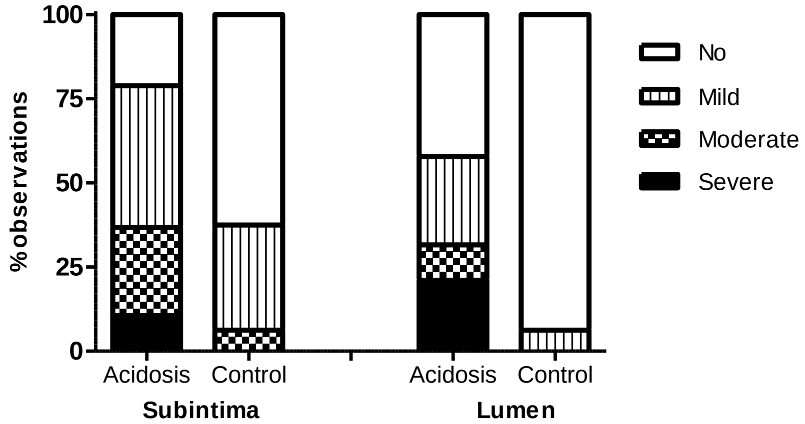


Figure 3. Infiltration of neutrophils and exudation of fibrin into the subintima and lumen of limb joints from 4 cows with grain induced rumen acidosis (n=19) and 4 control cows (n=16)

Discussion

This study documents for the first time development of polysynovitis after experimental grain induced rumen acidosis under herd like feeding conditions. The signs were mild but highlight the inflammatory and systemic nature of rumen acidosis. Clinically, aseptic arthritis and tenosynovitis has been associated with both rumen acidosis (Dirksen, 2002) and laminitis (Andersson and Liberg, 1980). No signs of lameness or laminitis were observed in the current study, thus a pathogenetic link between acidosis/polysynovitis and laminitis cannot be shown. However, as joint inflammation can cause pain and lameness which impact welfare and production, it is a relevant focus of future research.

Acknowledgements

This study was supported by the Danish Research Council (FTP).

References

Andersson L, Liberg P 1980 Blood serum and synovial fluid in bovine laminitis and arthritis, with particular reference to the protein composition. Acta Veterinaria Scandinavica 21: 567-577

Danscher AM, Enemark HL, Andersen PH, Aalbaek B, Nielsen, OL, 2010 Polysynovitis after oligofructose overload in dairy cattle. Journal of Comparative Pathology 142: 129–138

Dirksen G 2002 Krankheiten der Bewegungsorgane. In: Innere Medizin und Chirugie des Rindes 4th Edition G Dirksen, H-D Gründer, M Stöber (eds) pp 753-1029 Parey Buchverlag, Berlin, Germany

44. Testing potential trigger factors (lipopolysaccharides, thermolysin) of bovine and equine laminitis in an *ex vivo / in vitro* model

N Reisinger[1], S Schaumberger[1], M Penner[1], S Hessenberger[1], G Schatzmayr [1]
[1]BIOMIN Research Center, Tulln, Austria
nicole.reisinger@biomin.net

Introduction
Although a lot of research has been conducted in the field of laminitis, the pathogenesis is still not fully understood. Endotoxin and exotoxins are discussed as potential trigger factors (Katz & Bailey 2012, Mungall *et al* 2001, Nocek 2012). Animal experiments are time and cost intensive, and are associated with pain and stress for the animal. Therefore, we used an *ex vivo/in vitro* model to test the influence of these toxins on bovine claw and equine hoof explants.

Material and Methods
Hooves (n=12) and claws (n=12) were obtained from the slaughter house, and explants were prepared as described by Pollitt (1996). Explants were cultured with 1 ml culture medium (D-MEM) in 24 well plates at 37°C and 5% CO_2 for 24 or 48 hours. Different concentrations of lipopolysaccharides (LPS) of *Escherichia coli* O55:B5 (2.5-200 µg/ml) and thermolysin from *Bacillus thermoproteolyticus rokko* (10-100 µg/ml) were added to the explants. After incubation, explants were tested for their integrity as described by Pollitt *et al* (1998). Viability of explants was tested with the WST-1 assay.

Results
LPS (Table 1) and thermolysin (Table 2) led to concentration-dependent separation of equine and bovine explants except bovine explants incubated for 48 hours with LPS. Number of intact explants in the control group of bovine claws was lower than in equine hooves. All explants were viable after incubation for 24 and 48 hours. Bovine explants showed a higher viability.

Table 3. Results of integrity tests of equine and bovine explants incubated with LPS (2.5-200 µg/ml) for 24 and 48 hours.

Lipopolysaccharides of *Escherichia coli* O55:B5

	Equine hoof explants		Bovine claw explants	
	24 hours	48 hours	24 hours	48 hours
Medium	0%	0%	22%	11%
2.5 µg/ml	17%	0%	17%	72%
5 µg/ml	94%	33%	22%	67%
10 µg/ml	100%	50%	22%	56%
20 µg/ml	100%	100%	44%	56%
40 µg/ml	100%	100%	44%	67%
100 µg/ml	100%	100%	67%	61%
200 µg/ml	100%	100%	78%	78%

Table 4. Results of integrity tests of equine and bovine explants incubated with thermolysin (10-200 µg/ml) for 24 and 48 hours

Thermolysin from *Bacillus thermoproteolyticus rokko*

	Equine hoof explants		Bovine claw explants	
	24 hours	48 hours	24 hours	48 hours
Medium	0%	0%	3%	17%
10 µg/ml	100%	100%	11 %	-
20 µg/ml	100%	-		-
25 µg/ml		100%	39%	-
50 µg/ml	-	100%	72%	-
100 µg/ml	-	100%	81%	100%

Discussion
Higher concentrations of toxins were necessary for separation of bovine explants. This might indicate a higher sensitivity of horses to LPS and thermolysin in the *in vitro/ex vivo* model. However, bovine explants seemed to be more sensitive to dissection and cultivation process compared to equine explants. More bovine control explants separated compared to equine explants. Lower viability of equine explants can be

explained due to longer transportation time of equine hooves compared to bovine claws. Our *ex vivo/in vitro* model showed a putative role of endo- and exotoxins in the pathogenesis of bovine and equine laminitis. Furthermore, this model can be used to test other potential trigger factors.

References

Katz LM & Bailey S 2012 A review of recent advances and current hypothesis on the pathogenesis of acute laminitis Equine Veterinary Journal 44:752-761.
Pollitt, CC 1996 Basement membrane pathology: a feature of acute equine laminitis Equine Veterinary Journal 28(1): 38-46.
Pollitt CC, Pass MA &Pollitt S 1998 Bastimastat (BB-94) inhibits matrix metalloproteinases of equine laminitis Equine Veterinary Journal 26:119-124.
Mungall BA, Kyaw-Tanner M & Pollitt CC 2001 In vitro evidence for a bacterial pathogenesis of equine laminitis Veterinary Microbiology 79:209-223.
Nocek JE 1997 Bovine acidosis: Implications on laminitis Journal Dairy Science 80:1005-1028.

45. Serum glucose and some biomarkers of inflammation in bovine lameness in Southwestern Nigeria

OT Lasisi[1], OD Babajide[1]
[1] Department of Veterinary Medicine, University of Ibadan, Ibadan, Nigeria
taiwo.lasisi@ui.edu.ng

Introduction

Bovine lameness has continued to be one of the single most important health problems. Cows suffering lameness disorders have reduced milk yield, lower reproductive performance, and decreased longevity. The determination of prevalence or incidence of lameness is commonly used for the purposes of making comparisons or estimating economic losses. Early and prompt diagnosis of bovine lameness using various stress factors and biomarkers of inflammation has been found to reduce economic losses to the farmers.

Cytokines are especially important as mediators of inflammatory responses. Interleukin-1 (IL-1) and tumor necrosis factor (TNF) have been documented and associated with lameness. Measuring the concentrations of acute-phase proteins has been applied in other diseases of cattle. However, little is known about these proteins with regard to limb diseases of cattle in Nigeria. The objective of this study was to determine the values of serum glucose and some biomarkers of inflammation in three breeds of Nigerian cattle.

Materials and Methods

This survey involved 1,500 cases of lameness in cattle of both sexes and different ages, in various settlements in the south-western part of Nigeria. The bovine population comprised of 900 Sokoto Gudali, 500 White Fulani and 100 Red Bororo breeds of cattle with clinical presentations indicative of lameness based on visual locomotion score ≥ 3 between May 2012 and May 2013. Blood samples were collected once via the jugular vein into anticoagulant and plain tubes, when the clinical signs of the disease were accessed by visual locomotion scoring. Serum glucose and serum amyloid A (SAA) were determined using technicon rapid colorimetric wave auto-analyser. The serum C-reactive protein (CRP), tissue necrosis factor (TNF-α), interleukins 1 and 6 (IL 1&6) were determined high performance liquid chromatography. The haematological parameters were evaluated using standard laboratory techniques. Data obtained was analysed using descriptive statistics and analysis of variance (ANOVA).

Results

There was neither age nor sex disposition to lameness in the cattle population. A significant fall in serum glucose levels was observed in all the lame cattle across the three breeds. There was significantly higher ($p<0.05$) concentrations of C-reactive protein (CRP), Serum Amyloid-A (SAA), Interleukins (IL 1 & 6), Tissue necrosis factor (TNF-α) in all the lame cattle. Marked neutropeania was observed among the lame cattle.

Discussion

This study has indicated that serum glucose and inflammatory biomarkers could serve as baseline information for prompt diagnosis of bovine lameness. The monitoring of serum concentrations of inflammatory markers can be a valuable complement to the clinical assessment of the treatment course and in the intensive care of lameness of cattle and its complications.

Acknowledgements

The authors are grateful to Mrs. Iyabo Adetiba, Mr. Lekan Lateef and Mr Basil for their technical assistance.

References

Ballou SP, Lozanski G 1992 Induction of inflammatory cytokine release from cultured human monocytes by C-reactive protein. Cytokine 4 361–368

Conner JG & Eckersall PD 1988 Bovine acute phase response following turpentine injection. Research in Veterinary Science 44 82–88

Eckersall PD, Young FJ, McComb C, Hogarth CJ, Safi S, Weber A, McDonald T, Nolan AM, Fitzpatrick JL 2001 Acute phase proteins in serum and milk from dairy cows with clinical mastitis. Veterinary Record 148 35–41

Lasisi OT, Olufunmilayo IG 2011 Blood Glucose Levels, Total Serum Proteins and Erythrocyte Indices in Three Nigerian Breeds of Cattle. International Journal of Biotechnology and Biochemistry. Volume 7 Number 3 (2011) pp. 331-337

Session 9

Treatment of Infectious Diseases Associated with Lameness

46. Comparison of the effect of salicylic acid and tetracycline for treatment of digital dermatitis

N Schultz[1], N Capion[1]
[1] Ribe-egnens Dyrlæger, Ribe, Denmark, Faculty of Health and Medical Sciences, University of Copenhagen, Denmark
nyc@sund.ku.dk

Introduction

Digital dermatitis (DD) is considered to be one of the most important causes of lameness in commercial dairy herds worldwide. Topical application of oxytetracycline has been reported to be one of the most effective treatments of DD (El-Ghoul and Shaheed, 2001; Manske et al., 2002). Salicylic acid has been used for topical treatment of DD in Denmark since the first cases in the late 1980´s. The efficacy has never been evaluated scientifically. The purpose of this study is to evaluate the effect of treatment of DD with salicylic acid in a bandage, compared to chlortetracycline spray.

Materials and Methods

A total of 201 DD-lesions from 173 cows from 4 commercial Danish dairy herds were evaluated (M0-M4, Döpfer et al., 1997) at day 0 during routine hoof trimming. The lesions (stage M1-M4) were randomly assigned to one of the groups: 98 lesions in the tetracycline group; chlortetracycline spray (Cyclo Spray Vet, Scanimal Health) applied two times for three seconds with 30 seconds interval, and 103 lesions in the salicylic acid group: 10 g of salicylic acid powder in a bandage. Three days after hoof trimming the bandages were removed during milking. On day 14 and day 34 the hoofs were washed with a pressure hose in the milking parlour during milking, and the lesions were scored for lesions stage and signs of pain (0: No signs of pain 1: Pain raises foot for > 2 sec).

A change to M0 was defined as healing, and a change from M2 or M4 to M1 or M3 was defined as improvement.

Results

Healing rates did not differ significantly between treatment groups by day 3 and 14. By day 34 the healing rate was 5 times better ($P<0.05$) for the salicylic acid group than for the tetracycline group, with healing rates of 13.6 % and 3.1 % respectively. By day 3, the rate of improvement was 2.5 times better ($P<0.05$) for the tetracycline group. By day 34 the overall positive effect (healing and improvement) was 1.75 times better ($P=0.05$) for the salicylic acid group. Lesions from the tetracycline group were 2.2 times more likely ($P=0.09$) to be painful by day 14.

Discussion

This study is the first to evaluate the effect of salicylic acid in the treatment of DD. Except for day 3, treatment with salicylic acid was more effective compared to chlortetracycline. The overall positive effect (healing or improvement) of salicylic acid one month after treatment were almost twice as good for salicylic acid as for chlortetracycline. The healing rate (complete healing) was low for both chlortetracycline and salicylic acid, 5.1 % and 13.6 %, respectively. Salicylic acid should be considered as a useful alternative to chlortetracycline as it appears more efficacious and helps reduce the use of antibiotics.

Acknowledgements

The author wishes to thank the farmers, hoof trimmers and E-vet for sponsoring salicylic acid and dressing material.

References

Döpfer D, Koopmans A, Meijer FA, Szakáll I, Schukken Y H, Klee W, Bosma R B, Cornelisse J L, van Asten AJAM and ter Huurne AAHM 1997 Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. Veterinary Record 140: 620-623
El-Ghoul W & Shaheed BI 2001 Ulcerative and papillomatous digital dermatitis of the pastern region in dairy cattle: Clinical and histopathological studies. Deutsche Tierarztliche Wochenschrift 108: 216-222
Manske T, Hultgren J & Bergsten C 2002 Topical treatment of digital dermatitis associated with severe heel-horn erosion in a Swedish dairy herd. Preventive Veterinary Medicine 53: 215-231.

47. Effect of a tea tree oil and organic acid footbath solution on digital dermatitis in dairy cattle

AC Smith[1] CL Wood[2], KJ McQuerry[2], JM Bewley[1]
[1]Department of Animal and Food Sciences, University of Kentucky, Lexington, KY 40546, [2] Department of Statistics, University of Kentucky, Lexington, KY 40506
jbewley@uky.edu

Introduction
The industry standard to treat digital dermatitis is a copper sulfate footbath (Speijers et al., 2012; Cook et al., 2012; Logue et al., 2012). However, copper sulfate may reach the soil and may eventually cause toxic effects to the environment and have a negative impact on the cow (Blowey, 2005; Bolan et al., 2003). Provita Hoofsure Endurance (Provita Eurotech Limited, Omagh, Northern Ireland) is a biodegradable footbath solution containing organic acids, tea-tree oil, and wetting agents without the negative environmental concerns of copper sulfate. The objective of this study was to quantify changes in digital dermatitis frequency when using Provita Hoofsure Endurance and copper sulfate in a split footbath in three commercial dairy herds.

Materials and Methods
This study was conducted from January 5, 2012 to May 21, 2012 in three commercial Kentucky dairies with 120, 170, and 200 milking Holstein cows. Footbath solutions were delivered using a split footbath (ItraBath, InterCare, Veghel, The Netherlands) with each side measuring 32.5 cm wide by 233 cm long allowing for 80 L of solution per side. Cows were exposed to the footbath solutions once daily during the same five milkings each week with no footbath used on the other two days. No pre-baths were used and no treatment measures were used for any cow during the study. A 5% copper sulfate solution was used on one side and 3% Provita Hoofsure Endurance on the other side. During the first nine weeks of the study, a 3% Hoofsure Endurance solution for the left hooves and a 5% copper sulfate solution for the right hooves. During the second nine weeks of the study, a 3% Hoofsure Endurance solution for the right hooves and a 5% copper sulfate solution for the left hooves. Rear hooves were scored for digital dermatitis once before the study started and then every three weeks for the remainder of the study. The scoring system consisted of five stages (M0 to M4, Döpfer et al (1997). The MIXED procedure of SAS® was used to develop models to describe digital dermatitis scores with cow within herd × parity as subject using a first order autoregressive co-variance structure.

Table 1. Overall raw digital dermatitis frequency after exposure to an organic acid and tea tree oil or copper sulfate footbath solution[1,2,3]

Score	Hooves with digital dermatitis (n, % of hooves with digital dermatitis)	Hooves without digital dermatitis (n, % of hooves with digital dermatitis)
Baseline	325 (57%)	245 (43%)
Score 1	241 (42%)	329 (58%)
Score 2	254 (45%)	316 (13%)
Score 3	221 (39%)	349 (61%)
Score 4	192 (34%)	378 (66%)
Score 5	169 (30%)	401 (70%)
Score 6	172 (30%)	398 (70%)

[1] Hooves were scored every 3 weeks by the same observer.
[2] The scoring system used is comprised of five stages (M0 to M4, Döpfer et al 1997). Digital dermatitis frequency defined as any score other than an M0.
[3] Hooves exposed to a 3% Provita Hoofsure Endurance (Provita Eurotech Limited, Omagh, Northern Ireland) solution, a biodegradable solution containing organic acids, tea-tree oil, and wetting agents in a split footbath or a 5% copper sulfate solution in a split footbath.

Results and Discussion
The frequency of infected hooves was reduced from 57 and 57% to 31 and 29% for left and right rear hooves, respectively. Thus, digital dermatitis incidence reduced by approximately 50% across the three herds during the study. Least squares means (LSMeans) from the Mixed Model to describe mean digital dermatitis scores are presented in Table 2. LSMeans are means adjusted for other factors in the model. Mean digital dermatitis score for hooves exposed to copper sulfate was 0.40 ± 0.03 with a mean digital dermatitis score for Provita Hoofsure Endurance of 0.43 ± 0.03 ($P = 0.14$). Performance of the two footbath solutions was comparable throughout the study. No significant differences were observed between the

copper sulfate and Provita Hoofsure Endurance. Thus, the Provita Hoofsure Endurance performed as well as the industry standard, copper sulfate for reduction of digital dermatitis.

Table 2. LSMeans digital dermatitis scores from mixed model for factors affecting digital dermatitis score in a study of three herds using two footbath solutions within a split footbath

Footbath solution[2]						
	Tea-tree oil and organic acid			Copper sulfate		
LSMeans digital dermatitis score	0.43 ± 0.03^{a}			0.40 ± 0.03^{a}		
Hoof[3]						
	Left			Right		
LSMeans digital dermatitis score	0.43 ± 0.03^{a}			0.40 ± 0.03^{a}		
Parity[4]						
Hoof	1			≥2		
LSMeans digital dermatitis score	0.31 ± 0.04^{b}			0.52 ± 0.03^{a}		
Herd						
Herd	A		B		C	
LSMeans digital dermatitis score	0.27 ± 0.03^{b}		0.30 ± 0.05^{b}		0.67 ± 0.03^{a}	
Scoring[5]						
	1	2	3	4	5	6
LSMeans digital dermatitis score	0.47 ± 0.03^{b}	0.54 ± 0.03^{a}	0.46 ± 0.03^{b}	0.38 ± 0.03^{c}	0.31 ± 0.03^{d}	0.33 ± 0.03^{cd}

[1] The scoring system used is comprised of five stages (M0 to M4, Döpfer et al 1997). Digital dermatitis frequency defined as any score other than an M0.
[2] Hooves exposed to a 3% Provita Hoofsure Endurance (Provita Eurotech Limited, Omagh, Northern Ireland) solution, a biodegradable solution containing organic acids, tea-tree oil, and wetting agents in a split footbath or a 5% copper sulfate solution in a split footbath.
[3] Left or right rear hoof
[4] Parity categorized as Parity 1 or Parity ≥ 2.
[5] Hooves were scored every 3 weeks by the same observer.

Acknowledgments
The authors would like to thank the producers who participated in this study and Provita Eurotech Limited (Omagh, Northern Ireland) for providing the financial support and product to conduct this study.

References
Blowey R 2005 Factors associated with lameness in dairy cattle. In Practice (0263841X) 27(3) 154-162.
Bolan NS, Khan MA, Donaldson J, Adriano DC & Matthew C 2003 Distribution and bioavailability of copper in farm effluent. Science of The Total Environment 309(1–3) 225-236.
Cook NB, Rieman J, Gomez A & Burgi K 2012 Observations on the design and use of footbaths for the control of infectious hoof disease in dairy cattle. Veterinary Journal 193(3) 669-673.
Logue DN, Gibert T, Parkin T, Thomson S & Taylor DJ 2012 A field evaluation of a footbathing solution for the control of digital dermatitis in cattle. Veterinary Journal 193(3) 664-668.
Speijers MHM, Finney GA, McBride J, Watson S, Logue DN & O'Connell NE 2012 Effectiveness of different footbathing frequencies using copper sulfate in the control of digital dermatitis in dairy cows. Journal of Dairy Science 95(6) 2955-2964.

48. Evaluation of a treatment regime for Digital Dermatitis-associated white line lesions and sole ulcers (“non-healing” bovine hoof disorders) in dairy cows

J Kofler [1], J Reichert [1], J Dietrich [1], S Sykora [2], C Auersperg [2], S Brandt [2]
[1] Department of Farm Animals and Veterinary Public Health, Clinic for Ruminants, [2] Research Group Oncology, Clinic for Horses, Department of Companion Animals & Horses, University of Veterinary Medicine, A - 1210 Vienna, Austria
Johann.Kofler@vetmeduni.ac.at

Introduction
In the past years, several authors have described “non-healing bovine hoof lesions” affecting cows in herds with a high prevalence of bovine digital dermatitis (BDD) (Blowey 2008; Cook and Burgi 2008, Holzhauer 2008; Evans et al 2011). Samples of diseased tissue subjected to PCR assays were strongly associated with BDD treponemes (Evans et al 2011; Holzhauer & Pijl 2011; Van Amstel et al 2011). It has been reported that debridement followed by a topical dressing of antibiotic and copper sulphate (Cook and Burgi 2008) plus parenteral long-acting cephalosporin treatment (Evans et al 2011) yielded promising results in early lesions. Others described the successful use of salicylic acid (Holzhauer & Pijl 2011) or dexamethasone and oxytetracycline powder (Van Amstel et al 2011).
The aim of this study was to evaluate a new treatment regime consisting of extensive local surgical debridement and removal of the infected corium.

Material and Methods
BDD-associated white line disease (lesions) (nhWLD-BDD) and sole ulcers (nhSU-BDD) (n=42) were clinically identified as severely painful claw horn lesions of topical granular appearance, exuding a typical BDD-associated pungent smell in a total of 35 cows of three farms where BDD is endemic.
A sample of involved corium tissue was taken during debridement of each lesion and stored at −20°C for downstream PCR analyses.
The topical treatment of severe chronic nhWLD-BDD and nhSU-BDD lesions consisted of functional claw trimming, application of a wooden block on the partner claw and retrograde intravenous anaesthesia. Then the separated wall or sole horn around the lesion including the infected corium layer was carefully removed with a hoof knife and by surgical excision. The wound was treated with tetracycline spray and a dressing was applied to protect the wound from the contaminated environment. The same regime was performed in early lesions, but an ice-spray was applied topically for removal of the infected tissue.
On day 0 before, and days 10, 18 and 28 following initial treatment, all lesions were photographed and underwent a control examination addressing the appearance of the lesions, wound healing, lameness and the degree of new horn formation.

Results
The prevalence of BDD-associated white line lesions (nhWLD-BDD) and sole ulcers (nhSU-BDD) in the three farms was 2.1%, 14.9% and 32.9%. Ten days after the first surgical treatment, 9/42 lesions were completely covered by new horn tissue. After 18 days, 16/42, and after 28 days 27/42 showed the same progress. Within the study period of 28 days, 64.3% of nhWLD-BDD and nhSU-BDD lesions had completely regressed. The other cases showed good progress in healing. The size of the lesions and the locomotion score had significantly decreased, but lesions were not yet covered by new horn.

Discussion
In two thirds of treated nhWLD-BDD and nhSU-BDD lesions, the investigated therapeutic regime proved successful and effective as long as a protective bandage covered the wound. The other cases required prolonged treatment due to the larger initial size of the lesions. Use of a protective bandage during the entire healing process seems to be essential so as to avoid contamination and re-infection of the wound by bacteria and most notably BDD-associated treponemes in endemically infected herds and achieve complete healing.

References
Cook NB Burgi K 2008 “Hairy Attack” A New Lesion Affecting the Corium of the White Line - A Case Report. In: 15th Symposium and 7th Conference of Lameness in Ruminants. p 214-215, Kuopio, Finland.

Evans NJ Blowey RW Timofte D Isherwood DR Brown JM Murray R Paton RJ Carter SD 2011 Association between bovine digital dermatitis treponemes and a range of 'non-healing' bovine hoof disorders. Veterinary Record:168: 214-217.
Holzhauer M 2008 Non-Healing White Line Disorders, a New Clinical Presentation. In: 15th Symposium and 7th Conference of Lameness in Ruminants. p 206, Kuopio, Finland.
Holzhauer M Pijl R 2011 Non-Healing White Line Lesion, advanced experience. In 16th Symposium and 8th Conference of Lameness in Ruminants. p 149, Rotorua, New Zealand.
Nouri M Ashrafihelan J 2011 Digital dermatitis as a complication of claw fissures in a dairy herd in Nazarabad, Iran. In: 16th Symposium and 8th Conference of Lameness in Ruminants. p 163, Rotorua, New Zealand.
Van Amstel S Shearer J Cooper VL 2011 Clinical presentation, treatment approach and histopathology of atypical digital dermatitis lesions. In: Proceedings 16th Symposium and 8th Conference of Lameness in Ruminants. p 26, Rotorua, New Zealand.

49. The effect of AgroN in reducing digital dermatitis and heel horn erosion in Danish dairy cows

K Bach
Faculty of Health and Medical Sciences. University of Copenhagen
kurtbach@sund.ku.dk

Introduction
Digital dermatitis (DD) and heel horn erosion (HHE) are two of the most common problems in Danish dairy herds. The aim of this study was to evaluate the effect of AgroN used in footbaths and spread manually on the floor to reduce digital dermatitis and heel horn erosion. AgroN is a compound of inorganic acids. *Treponema* is considered the predominant pathogen in the DD complex. The enzyme activity of this bacterium is optimal at a pH level of 8.5 and it can produce ammonia and hydrogen sulphide (Blakemore and Canale-Parola, 1976). Hydrogen sulphide is a potent oxygen binder and a study by Lai and Chu (2007) indicates that *Treponema* is an obligate anaerobic bacterium that produces hydrogen sulphide in order to survive in atmospheres, which are not completely free of oxygen. Ammonia has a high pH value when it is concentrated. In higher concentration it can lead to tissue damage and subsequently increased risk of bacterial infection. AgroN is a compound of inorganic acids and it is thought to reduce or prevent DD and HHE because it binds to ammonia and hydrogen sulphide. AgroN contains iron (Fe) that neutralizes hydrogen sulphide and thus increases the oxygen sensitivity of *Treponema*. Another compound in AgroN (containing sulphate) will react with ammonia. This should inhibit the ammonia evaporation and the pH value in the slurry should be reduced.

Materials and Methods
This study was conducted as a field trial in four Danish dairy herds. All farms had loose-housing systems with cubicles and herringbone milking parlours. AgroN was spread two times per week in the holding pen and 0-1.5 m from the feeding table during the whole study period. The cows should also walk through a footbath with AgroN two times per week.
All the farms were visited four times. Digital dermatitis and lameness were evaluated on the hind hooves in a trimming chute at the first and the last visit on the farms and during milking on the second and third visit. HHE were only evaluated in the chute on the first and last visit. Furthermore lameness and the level of ammonia between the hooves were evaluated. Digital dermatitis was evaluated on 391 cows and heel horn erosion was evaluated on 437 cows.

Results
Improvement was defined as a change from active at first registration to cured or healing at fourth registration whereas exacerbation were defined as a change from sound or healing at first registration to an active lesion at fourth registration. The only statistical significant effect of AgroN on digital dermatitis were seen in one herd and this were a negative effect on right hind leg between registration 1 and 4 and a positive effect on both hind legs between registration 2 and 3.
The prevalence of heel horn erosion either increased or stayed at the same level during the study. In two herds the increase was statistically significant.

Conclusions
This study showed that AgroN used in footbaths and spread manually on the floor has no significant effect to reduce either DD or HHE.

Acknowledgements
Thanks to the master students (now DVM) Tine Frederiksen and Trine Månsson for the good work.

References
Blakemore, RP, Canale-Parola, E (1976) Arginine catabolism by *Treponema denticola.* Journal of Bacteriology, 128 (2), p. 616-622.
Lai, Y, Chu, L (2007): Novel Mechanism for conditional aerobic growth of the anaerobic bacterium *Treponema denticola*. Appl. Environ. Microbiol., 74 (1), p. 73-79.

50. Suspected chemical burn on the digital skin of dairy cows following foot bathing with 5% formalin solution

S Dyson[1], T Armstrong[2], T Allen[2], N Allen[3], A Davies[4], NJ Bell[1]
[1]The Royal Veterinary College, Stinsford Farmhouse, Kingston Maurward College, Stinsford, Dorchester DT2 8PY; [2]Provita Eurotech Limited, 21 Bankmore Road, Omagh, County Tyrone, Northern Ireland BT79 0EU; [3]Kingston Maurward College, Stinsford, Dorchester DT2 8PY; [4]Synergy Farm Health Ltd, West Hill Barns, Evershot, Dorset DT2 0LD
njbell@rvc.ac.uk

Introduction
Formalin foot bathing protocols are commonly used in the UK for the prevention and control of digital dermatitis (Bell 2004). The human health dangers of formalin are well recognised, but the risks to cow welfare are seldom reported. This paper describes a suspected reaction to a standard foot bathing regime during a trial in which formalin was used as a positive control.

Materials and Methods
Eighty-five high yielding, lactating Holstein-Friesian dairy cows were enrolled onto a foot bathing trial comparing a commercially available foot bathing product (Hoofsure Endurance; Provita, Northern Ireland) with a positive control (Formalin containing 38% formaldehyde; Kilco, UK). Prior to the study all cows were treated with a licensed topical antibiotic (Terramycin spray; Zoetis) for three successive days on two successive weeks. Cows were walked through foot baths containing water to become accustomed to the split- design concrete footbath. The footbaths were filled to 15cm using 120litres of solution in both left and right foot wells. The left footwell was made up with 5% formalin while the right contained 2% Hoofsure endurance. Each day cows passed through newly made up, clean solutions. Foot bathing started 22nd April 2013, soon after turnout, and cows passed through the solutions each milking.

Results
The trial was stopped on the 10th day when cows refused to enter the parlour and refused to walk through the foot bath. Swelling of the hind pastern, in some instances extending proximal to the tarso-metatarsal joint, was observed affecting the left hind foot in 86% of the milking herd (vs 4% right hind). Very few cows had visibly affected forelimbs, although it had been observed that many cows chose to place both forefeet in the right footwell. Many cows were mildly lame and skin of the left hind feet was visibly darkened compared with the right. By day 21 twenty one cows (25%) were showing evidence of skin slough and 45 (53%) had deep dermal fissures around the pastern and/or coronary band. Granulation tissue was visible beneath the skin slough. Despite the reaction, more lameness was recorded in the contra-lateral hindlimb at this stage. The climatic conditions during the 10 days of foot bathing were warm, breezy and dry, with cows standing on clean concrete and clean tracks for some time after footbathing.

Discussion
Formaldehyde is a hazardous chemical excluded from the list of approved EU biocides (Anon 2013) due to its possible carcinogenic properties. Chemical burns due to formalin are described in standard texts (Greenough 2012) but the authors are unaware of any case reports describing the presentation and the conditions in which they occurred. Anecdotal reports suggest they are more likely to occur when conditions are warm and dry (personal communication, R. Blowey). While evidence is lacking, the authors suspect the lack of previous exposure to formalin and the warm, drying wind during the trial may have been contributing factors.

References
Anon 2013 Existing active substances for which a decision of non-inclusion into Annex I or Ia of Directive 98/8/EC has been adopted (26/2/13). http://ec.europa.eu/environment/biocides/pdf/list_dates_product_2.pdf [29/5/13]
Bell NJ Assessment of prevalence, treatment and control of lameness-related disease in dairy heifers on 30 farms in Southwest Britain. In: Zemljic B (ed) *Proceedings of the* 13th Symp. Lameness in Ruminants pp 39-40.
Greenough PR 2012 Preventive Procedures in Cattle Lameness, The Merck Veterinary Manual. http://www.merckmanuals.com/vet/musculoskeletal_system/lameness_in_cattle/preventive_procedures_in_cattle_lameness.html [29/5/13]

51. A foot bath design for large grazing herds

RN Chesterton
Inglewood Veterinary Services
chesterton@inspire.net.nz

Introduction

Footbathing is an essential part of Bovine Digital Dermatitis (BDD) control (Blowey 2010). In large herds footbaths are often underutilized if they affect cow-flow through the milking parlor. In many herds contamination of the footbath quickly reduces the effectiveness of the solution. The discovery of a BDD problem on dairy farms in Chile provided an opportunity to design foot baths for large outdoor grazing herds. The aim of this study is to first identify the problems of the existing footbaths on the farms. Then to design a permanent foot bath that could be easily built into an existing facility.

Materials and Methods

The first step was to observe and video cow flow through the existing baths to identify possible causes of poor cow flow and excessive contamination.
A footbath was then designed and trialed on 15 farms. Farm managers were asked to rate the cow flow. Cow flow through the new baths was videoed on 9 farms and defecations counted to estimate contamination.

Results

Eight design features causing poor cow flow through the existing footbaths were noted:

- A step down into footbaths built below the level of the walking surface.
- A step down out of footbaths built up above the level of the walking surface.
- Sloping gradients into or out of footbaths
- Slippery walking surfaces before, in or after footbaths
- Metal or plastic floors of portable footbaths
- Rounded top on the nib wall surrounding footbaths
- Footbaths built on a diversion from the usual exit pathway
- Narrow single-cow-width baths

All the features above that affected cow flow also caused increased contamination. Four other design features causing increased contamination were noted:

- Baths longer than 3 metres, or baths with a water pre-bath, became more contaminated.
- Small volumes relative to the size of the herd.
- Footbaths positioned at the entrance to the cowshed
- Small drain outlet resulting in poor cleaning

Figure 1 Design of new footbaths

The resulting new design criteria are as below.

1) Construct in the exit race
2) The footbath is part of the exit race itself
3) Wide footbaths – at least 1.5 metres wide.
4) The length must be at least 2.5 metres and a maximum of 3 metres.
5) The floor of the bath must be the same level as the approach and exit concrete.
6) 20 cm concrete block walls.
7) The solution depth : 8 - 10 cm minimum (ref)
8) Tops of the blocks flat with only the sharp edges ground off.
9) The volume of the bath allows for one litre per cow in the herd.
10) 10 - 12 cm drain hole in the lowest corner

On the 15 farms, thirteen managers rated cow flow as “good”, two managers as “average” and none as “poor”. On 9 farms the average percentage of cows defecating into the footbath was 3.2% (ranging from 1.4% to 5.8%).

Discussion

Farmers, even if they understand the need, are often reluctant to use footbaths because of the effect on cow flow out of the dairy. There were a surprising number of reasons identified that were causing a reluctance of cows to walk through existing footbaths in this study. When these were addressed the result was reasonable cow flow and minimal contamination. Contamination was a low enough level that the bath solution was able to be used twice in consecutive milkings.

This design is cheap to build on an existing concrete track, or can be easily included in the design of a new shed.

References

Blowey RW 2010 Non-healing hoof lesions in dairy cows, Veterinary Record doi: 10.1136/vr.

P28(a). Metaphylactic use of gamithramycin to control footrot in a flock of New Zealand Romney sheep

R Grogono-Thomas[1], DC Barrett[1]
School of Veterinary Sciences, University of Bristol, Langford House, Langford, Bristol BS40 5DU
R.Grogono-Thomas@bristol.ac.uk

Introduction

In 2012, The University of Bristol had the opportunity to replace an ageing cross-bred sheep flock with a younger purebred New Zealand Romney flock. The new flock would be managed as far as possible as a closed flock and it was decided to use this opportunity to try and create a footrot-free flock.
If successful, the metaphylactic use of antibiotics can remove the need for repeated treatment of individual animals and over time the overall level of antibiotic usage could potentially be reduced (Baggott and others 2011).
Gamithromycin (Zactran; Merial Animal Health Ltd), was used under the prescribing cascade as there are reports of its effective use in eradicating footrot from large flocks in Denmark and Germany (Stamphoj 2011) and H Strobel 2011 pers. Comm. An alternative macrolide, Tilmicosin (Micotil; Elanco Animal Health) is licensed for the treatment of footrot, but not for flock level control programmes, there are also human safety concerns from accidental self-injection of this product which had to be considered in using the product on a University farm. Other products are also licensed to treat footrot; but none were considered likely to be effective at eradicating *Dichelobacter nodosus.*

Materials and Methods

All sheep were removed from the farm in July 2012, although cattle remained on the grazing. The 100 new sheep were purchased "in-lamb" and arrived on farm in December 2012, all animals were sound and feet were free of footrot lesions. On arrival, eight randomly-selected animals had swabs taken from the interdigital space. The swabs were processed to extract the DNA and then a 16S PCR run to identify any *Dichelobacter nodosus* present and a multiplex PCR to identify serogroup (Table 1)
All animals were then treated with a single subcutaneous injection of 6mg/kg gamithramycin (Zactran; Merial Animal Health Ltd) and put onto "clean" pasture.
Subsequently any lame animals were swabbed as above. In March 2013, six sheep showed transitory lameness while grazing and became sound on housing (there was evidence of soil balling). In June 2013 nine animals showed varying degrees of lameness.

Results

All PCR results were negative from 13 swabs taken in March 2013

Table 1. PCR results from non-lame sheep sampled pre-treatment in December 2012

Sheep Number	*D. nodosus* 16S PCR	*D. nodosus* fimbral PCR Serogroup
22587	-	-
23026	-	-
23157	-	-
23292	-	-
23690	-	-
23729	-	-
23784	+	H, I
23800	-	-

Table 2. PCR results from lame sheep sampled in June 2013

Clinical signs of Footrot	Sheep No	*D. nodosus* 16S PCR	*D. nodosus* fimbral PCR Serogroup
No	23189	-	
No	23129	-	
Yes	22784	+	H
Yes	23761	-	-
Yes	29367	+	H
No	22917	-	
No	22434	-	
No	23734	-	
No	23617	-	

Discussion

A single dose of 6mg/kg gamithromycin to all sheep on arrival, combined with an extended sheep free period on the farm was not successful in establishing a footrot free flock over an extended period of time. Sheep may be sound for considerable periods of time as demonstrated in this work and then under suitable environmental conditions, or host immunity, *D. nodosus* proliferates to cause clinical disease. The identification of serogroup H in both pre and post-treatment samples supports the hypothesis that the organism was probably maintained in the incoming animals rather than being reintroduced. Gamithromycin presumably therefore did not eradicate *D. nodosus* from all animals in the flock.

Acknowledgements
We would like to thank Mrs Debbie Langton who ran the PCR tests and Velcourt who manage the sheep flock.

References

Baggott D., Casartelli A., Fraisse F., Manavella C., Marteau R., Rehbein S., Wiedemann M. Yoon S. (2011) Demonstration of the metaphylactic use of gamithromycin against bacterial pathogens associated with bovine respiratory disease in a multicentre farm trial. Veterinary Record Vol 168, pp241

Stamphoj I (2011) Whole flock eradication of footrot with gamithromycin and PCR. Proceedings of the Sheep Veterinary Society Vol 35, pp67

P28(b). Polyurethane Wound Dressing on Digital Dermatitis

A Fiedler[1], J Haas[2], R Hoefler[2], H Kellhuber[2], M Moosbauer[2], H Warmedinger[2], D Doepfer[3] J Maierl[4]
[1]Practicing veterinarian, Munich, Germany [2]Hooftrimmer, Germany [3]FAPM, SVM, UW Madison, USA
[4]Department of Veterinary Sciences, University of Munich, Germany
dr.andrea.fiedler@t-online.de

Introduction

The control of digital dermatitis (DD) takes a lot of time and effort during the sequence of operations on many dairy farms. The use of antibiotics, even though applied in a targeted low local dosage, should be reduced to a minimum. Alternatively, the use of a polyurethane wound dressing shows very good healing results in skin lesions and potential in supporting the natural healing process of acute, painful lesions caused by DD. Based on the principles of moist wound healing (Winter 1962), the wound dressing covers the wound surface quite like a scab substitute. The moist environment below the dressing serves as a reaction chamber for immune cells and provides a transport medium for the body's own regeneration processes. Usually, treatment with such dressings is accompanied by significant pain reduction.

Materials and Methods

For this study, a dairy livestock farm with HF-cattle (125 dairy cows) was selected. According to the farmer, a large number of animals had DD lesions. Animals were professionally trimmed during the first visit. The findings and stages of DD lesions were documented according to a scoring system (M0, no DD; M1, suspicious; M2, acute; M3, healing; M4, chronic) (Doepfer 2009). A polyurethane wound dressing (Mortella Heal, Dr. Kenndoff GmbH, Hamburg, Germany) was used to treat digital dermatitis (M2 to M4).
The polyurethane "plaster" was attached to the lesion with an additional cushioning pad under a self-adhesive bandage thus ensuring full contact between lesion and wound dressing, since the self-adhesive function fails on hairy cattle skin. The polyurethane wound dressing was used 51 times in total, 45 feet scored M2, five feet scored M3 and one foot scored M4. The second examination and assessment of the findings in a trimming chute took place after removal of the bandages 10 days later. After another 26 days all of the animals were inspected from behind in the milking parlor using a mirror pushed under the heels. Visible lesions were documented.

Results

Some of the bandages showed slurry contamination at the edges around the ankle after 10 days. The polyurethane wound dressing and the skin below appeared to be slightly smeary but not contaminated. The healing area was very smooth and covered with a whitish, moist, but not moveable skin layer and was painless (Figures 1 and 2). Any remaining DD areas obviously had not been covered by the slightly shifted wound dressing (Figure 3).

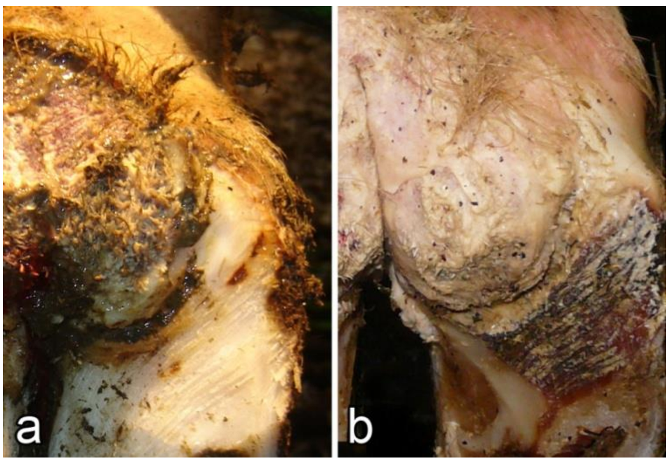


Figure 1. DD-lesion before (a: day 0) and after treatment with a polyurethane dressing (b: day 10)

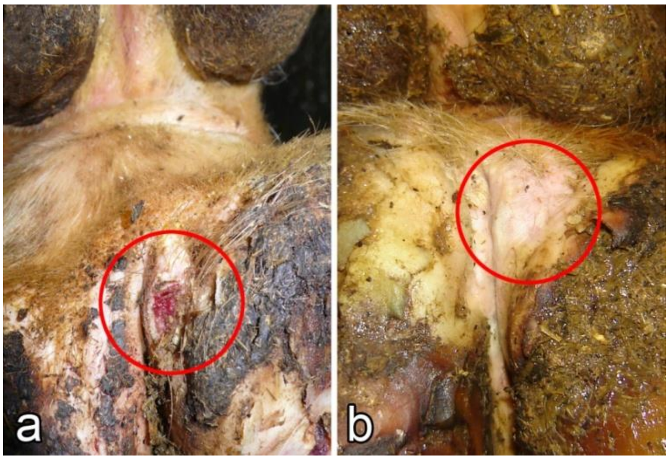


Figure 2. DD-lesion before (a: day 0) and after treatment with a polyurethane dressing (b: day 10)

In the parlor on day 36: Seven feet could not be assessed, as the relevant area of the ankle and the bulb as well as changes in the interdigital cleft were not visible. Six feet showed no visible lesions (M0), four just small whitish suspicious stages (M1). Sixteen showed the typical dark crusting of the healing stage of Dermatitis digitalis (M3), 13 were classified as acute M2, one foot was documented with resting stage (M4).

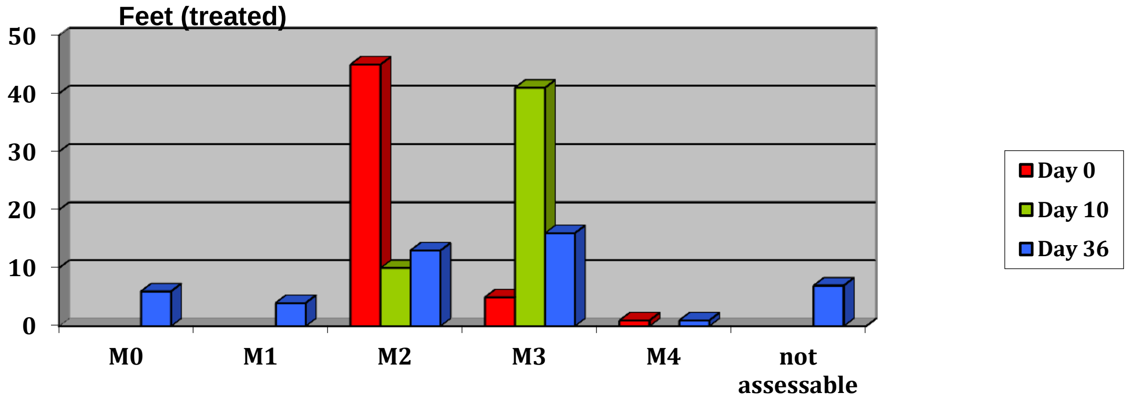


Figure 3. Feet with DD-lesions before treatment (day 0), after removals of the bandages (day 10) and at day 36; DD-stages M0–M4

Discussion

The focus of this study was on fast wound closure, aiming to restore painlessness and economic efficiency through healing of DD lesions in diseased cattle. Based on successful healing of chronic wounds in humans (Sherman 2003) polyurethane wound dressings were used on DD lesions. M2 lesions showed a successful healing process after treatment with the polyurethane wound dressing (see Figure 3). The use of similar wound dressings on teat injuries clearly showed positive results (Kenndoff et al., 2010). The fixation of the wound dressings onto the lesions of Dermatitis digitalis with its surrounding, partly hairy skin was assessed as difficult. It is feasible, however, using cushioning pads and careful bandaging.

Acknowledgments

Dr. Kenndoff GmbH & Co. KG, Hamburg, Germany, has supported this study by supplying the polyurethane wound dressing.

References

Doepfer D 2009 Digital dermatitis. The dynamics of digital dermatitis in dairy cattle and the manageable state of disease. pp 1–5 in CanWest Veterinary Conference, Banff, AB, Canada. http://www.hoofhealth.ca/Dopfer.pdf.

Kenndoff J, Hoefler R & Eller G 2010 Milking Bandage. XXVI World Buiatrics Congress, Santiago, Chile.

Sherman RA 2003 Maggot therapy for treating diabetic foot ulcers unresponsive to conventional therapy. Diabetes Care 26 (2), pp 446-451.

Winter GD 1962 Formation of the scab and rate of epithelization of superficial wounds in the skin of the young domestic pig. Nature 193, pp 293-94.

P29(a). Efficacy of a Biocidal Product in Foot Bathing

A Fiedler[1], J Maierl[2], D Doepfer[3], M Eise[4], S Shao[5], H Kuechenhoff[5]
[1]practicing veterinarian, Munich, Germany, [2]Department of Veterinary Sciences, University of Munich, Germany, [3]FAPM, SVM, UW Madison, USA [4]DLG e.V., Frankfurt, Germany, [5]Statistical Consulting Unit, Department of Statistics, University of Munich, Germany
dr.andrea.fiedler@t-online.de

Introduction

Digital dermatitis (DD) has a high impact on animal welfare and causes appreciable economic losses (Brunijnis et al., 2010). Attempts have been undertaken to control the disease by applying biocidal products for veterinary hygiene control which is legally possible according to EU Biocides Directives. The use for therapeutic purposes, however, is strictly prohibited.
The objective of this study was, in comparison to the so called gold standard formalin (Teixeira et al., 2010), to test the efficacy of a commercial foot bath using a registered biocidal product (4Hooves, DeLaval) to prevent relapses of digital dermatitis after hoof trimming and topical treatment.

Materials

In a farm with 1550 cows about 270 with comparable milk yield, recently inseminated, were selected. Prior to the start of the study a 5% formalin solution was used twice weekly. About 90 animals were randomly allocated to each of three groups. After trimming and topical treatment (salicylic acid containing paste, bandage for 5 days) of all visible DD lesions the trial started five days later (see Table 1). To improve hoof disinfection by the biocidal product in the foot bath, Group 1 and 2 included a pre-cleaning foot bath (containing HC40, DeLaval). Control group 3 was pre-cleaned with water for the first part of the study, then foot bathing was stopped completely in this group.

Table 1. Study Design: Usage of Footbaths during Trial

group (90 cows each)	before period 1	period 1 (day 0 to day 65)	period 2 (day 66 to day 130)
group 1	hoof trimming (day -5) evaluation of all DD stages medical treatment of acute DD lesions (day -5 to day 0)	2 days a week: pre-cleaning (HC40) + foot bathing (4Hooves, 1%)	
group 2		5 days a week: pre-cleaning (HC40) + foot bathing (4Hooves, 1%)	
group 3 (control)		2 days a week: pre-cleaning (water) + foot bathing (formalin, 4%)	no pre-cleaning no foot bathing

Method

The evaluations were done 3 times during the trial in a trimming chute and once in the milking parlor (rotary). Lesions were scored due to severity and size according to a modified scoring system (Doepfer, 2009).
The focus of this study was on the significance or rather the non-significance (null hypothesis) of a group-effect on the response variable "Score", calculated according to the stages of dermatitis digitalis lesions. The Linear Mixed Model was applied for each phase to account for individual effects. Significance-level was set to p-value < 0.05.

Results

On day -5, the overall prevalence of DD stages M1-M4 was 66.1% and the prevalence of acute lesions (M2) was low (10-20%). Evaluation of acute DD lesions in the milking parlor five days after topical treatment (day 0, see table 1) revealed that topical treatment was successful; none of the treated lesions were in an acute state.
During the first part of the study the prevalence of acute DD remained less than 15% in all groups. There was no statistically significant difference between formalin and the biocidal product. In the second part of the study the control group 3 – now without foot bath – showed an increasing prevalence of acute DD (Figure 1).

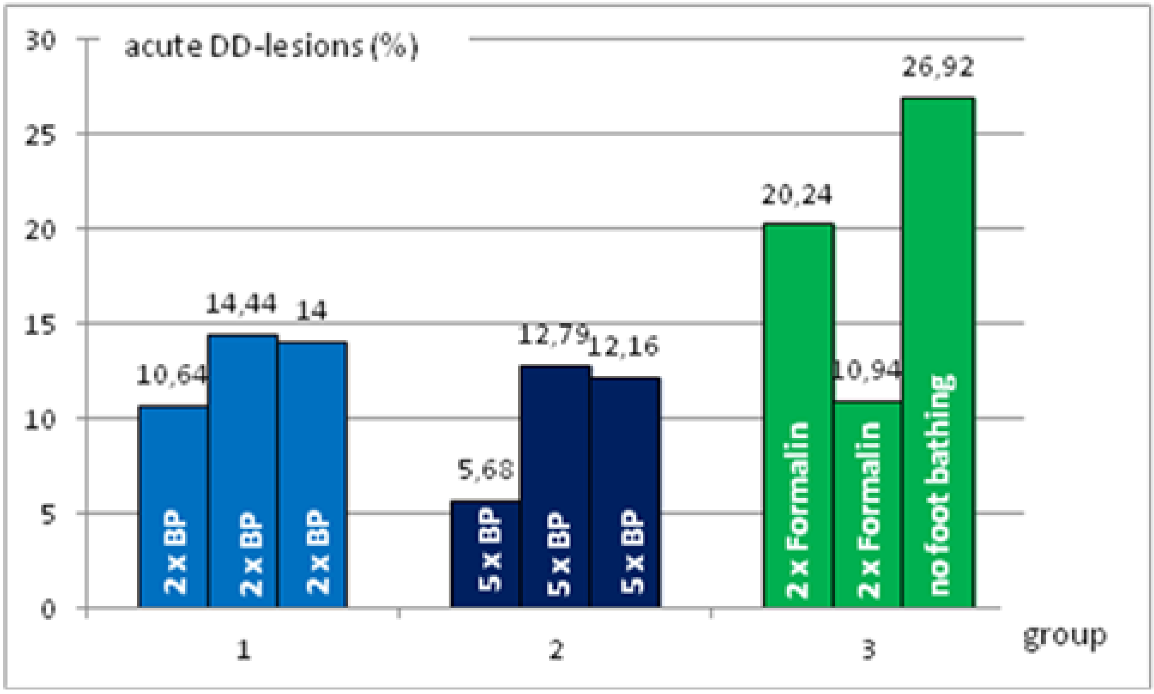


Figure 1. Acute DD-lesions in groups 1, 2 and 3 on day -5, after first part of study (day 65) and after second part of study (day 130); 2xBP: biocidal product twice weekly, 5xBP: biocidal product five times weekly

Discussion

Hoof trimming and topical treatment as well as good housing and feeding conditions are of fundamental relevance to control infectious hoof diseases. In addition biocidal products in hoof baths should decrease the count of bacteria at the hooves to control claw health, in particular the prevalence of digital dermatitis. The focus of this study was on group-effects on digital dermatitis. A statistically significant difference between the groups could not be proved. In the present study the biocidal foot bath product combined with a pre-cleaner showed its efficacy in controlling the prevalence of acute digital dermatitis over 130 days, compared to formalin.

Acknowledgements

Thanks go to the professional hoof trimmers (VgK e.V.) and the students of Veterinary Medicine, LMU Munich. DeLaval has supported this study by supplying the biocidal products.

References

Brujinis MRH, Hogeveen H, Stassen EN 2010 Assessing economic consequences of foot disorders in dairy cattle using a dynamic stochastic simulation model. Journal of Dairy Science 93 (Issue 6): 2419-2432.

Doepfer, D 2009. Digital dermatitis. The dynamics of digital dermatitis in dairy cattle and the manageable state of disease. Pages 1–5 in CanWest Veterinary Conference, Banff, AB, Canada. http://www.hoofhealth.ca/Dopfer.pdf.

Teixeira AGV, Machado VS. Caixeta LS, Pereira RV, Bicalho RC 2010 The efficacy of formalin, copper sulfate, and a commercial footbath product in the control of digital dermatitis. Journal of Dairy Science 93: 3628-3634.

P29(b). Antimicrobial susceptibility testing of *Dichelobacter nodosus*

S Frosth[1], E Bagge[1], K Ekström[1], H Ericsson Unnerstad[1], M Pringle[1]
[1] National Veterinary Institute, SVA, SE-75189 Uppsala, Sweden
marit.pringle@sva.se

Introduction

Reports on antimicrobial susceptibility in *Dichelobacter nodosus* are scarce because of the fastidious nature of this anaerobic bacterium and the difficulties in isolation. Susceptibility tests have been performed with variants of agar dilution (Gradin & Schmitz 1983; Jimenez *et al* 2004) but no approved standardized method is available. In this study agar dilution was used to test the antimicrobial susceptibility for a set of field isolates.

Materials and methods

The *D. nodosus* isolates in the study were mainly from clinical submissions from sheep in herds with clinical signs of footrot (n=39) but isolates from sheep in herds without footrot (n=4) were also included. The tests were performed on fastidious anaerobe agar with 10% horse blood (FAA). Enrofloxacin, erythromycin, penicillin and tetracycline were added to the agar in twofold serial dilutions. As control strains *Staphylococcus aureus* ATCC 29213 and *Bacteroides fragilis* ATCC 25285 were used. Direct colony suspensions from FAA plates (*D. nodosus* three days old cultures and *B. fragilis* over night) and blood agar plates (*S. aureus* over night) were used as inoculum. For *D. nodosus* and *B. fragilis* an inoculum of 2 µl of a suspension with the density 0.5 McFarland (appr. 10^5 CFU per spot) was used and for *S. aureus* a tenfold dilution lower (appr. 10^4 CFU per spot). The agar dilution tests were incubated for four days in anaerobic jars at 37°C. The MIC (minimum inhibitory concentration) was read as the first concentration with a marked reduction in appearance of growth as compared to that of growth on the control plate. The tests were made in duplicate and read by the same person. The *D. nodosus* type strain, CCUG 27824, was included in nine test rounds.

Results

Of 172 read MICs 155 were within 2 twofold dilution steps when the first and the second tests were compared. The majority of the varying results were MICs of erythromycin and penicillin but for the *D. nodosus* type strain most variation was seen for enrofloxacin and penicillin. The MICs for the field isolates are presented in table 1.

Table 1 Distribution (%) of MICs of four antimicrobial agents for 43 isolates of *Dichelobacter nodosus*

Substance	**Distribution** (%) **of MICs**[a] **(**mg/L)										
	≤0.004	**0.008**	**0.016**	**0.03**	**0.06**	**0.12**	**0.25**	**0.5**	**1**	**2**	**4**
Enrofloxacin			5	44	33	16	2				
Erythromycin			14	12	23	30	19			2	
Penicillin		2	35	14	21	2	26				
Tetracycline						14	30	40	14		2

[a] White fields denote range of dilutions tested for each substance. MICs above the range are given as the concentration closest to the range. MICs equal to or lower than the lowest concentration tested are given as the lowest tested concentration.

Discussion

In Sweden the main treatment of ovine footrot is through footbaths with zinc sulfate and relocation of the animals to uncontaminated surfaces, aggressive footrot is however treated with antibiotics parenterally. The drug most often used is tetracycline both for systemic and local treatment.

One purpose of this study was to investigate if penicillin, which would be a better choice from an antimicrobial resistance point of view, could be a choice for treatment of footrot. However besides a low MIC, clinical trials are needed to show if penicillin is effective against footrot.

Despite the difficulties in interpreting the results for erythromycin and penicillin for some of the isolates the majority of the MICs were within the method error when the test was repeated. Elevated MICs of erythromycin and tetracycline was only found for one isolate. In conclusion the majority of the *D. nodosus* isolates were susceptible to the tested antimicrobial agents.

Acknowledgments
The study was supported by the Swedish Farmer´s Foundation for Agricultural Research.

References
Jimenez R, Piriz S, Mateos E and Vadillo S 2004 Minimum Inhibitory concentrations for 25 selected antimicrobial agents against *Dichelobacter nodosus* and *Fusobacterium* strains isolated from footrot in sheep of Portugal and Spain. Journal of Veterinary Medicine B 51:245-248
Gradin JL and Schmitz JA 1983 Susceptibility of *Bacteroides nodosus* to various antimicrobial agents. JAVMA 183:434-437.

P30(a). Water footbath, automatic flushing and disinfection to improve bovine claw health. Four controlled studies during two housing seasons

T Fjeldaas[1], RB Larssen[1], KE Bøe[2], M Knappe-Poindecker[1]
[1] Department of Production Animal Clinical Sciences, Norwegian School of Veterinary Science, PO Box 8146, 0033 Oslo, Norway, [2] Norwegian University of Life Sciences, PO Box 5003, 1430 Ås, Norway
terje.fjeldaas@nvh.no

Introduction
Disinfecting footbaths are used to treat and prevent interdigital dermatitis (ID) and heel horn erosion (E). Many disinfectants are, however, disadvantageous for the environment, and washing of the feet has been introduced. The aim of the study was to investigate the effect of tap water footbath, footbath with copper sulfate, automatic tap water flushing and automatic water flushing followed by disinfection.

Materials and methods
All four trials were performed as controlled studies in a free-stall dairy herd with 50 Norwegian Red cows who had been suffering from ID and E. At trimming before and after each trial hind claw diseases were recorded. The hardness of the claw horn was measured by Shores durometer on four points (Borderas et al. 2004). The animals were separated in comparable study- and control groups, considering ID, E, parity and days in milk. Guided by a transponder-regulated gate all cows in the study groups were led through a footbath or an automatic washer twice daily after milking, while the cows in the control groups were left untreated. The study treatments are shown in Table 1. In each trial the therapeutic and preventive effects of treatments on ID and E were analysed by Fischers Exact test.

Table 1. Study treatments for all trials

Trial	Study group	Control group
1 Oct 19 2010 → Jan 27 2011	A (N=20) Water footbath – cleaned and filled with tap water after every milking	B (N=19) No footbath
2 Jan 27 2011 → May 5 2011	A1 + B1 (N=22) 7% $CuSO_4$ disinfectant bath every 2. week – new solution every 3. day	A2 + B2 (N=18) No footbath
Herd at pasture		
3 Oct 25 2011 → Jan 30 2012	C (N=22) Automatic water flushing (0.8– 1.0 litre) in Bovibooster after every milking	D (N= 19) No flushing
4 Jan 30 2012 → May 2 2012	C1 + D1(N=23) Water flushing / 5 ml 50 % Hoof Smart® Bath solution (glutaraldehyd) per cow after every milking	C2 + D2 (N=23) No flushing or disinfectants

Results
For cows walking through tap water footbath in trial 1 there was a positive combined therapeutic and preventive effect on ID ($p<0.05$) versus controls. Cows walking through copper sulfate had an improvement of ID ($p<0.05$) after versus before trial 2, and for these cows there was a preventive effect on E ($p<0.01$) versus controls. No difference in ID or E was revealed between the study- and control groups during trial 3 and 4.
Cows footbathed in copper sulfate had harder claw horn after versus before trial 2 compared to the controls ($p<0.05$). Cows flushed with tap water had softer claw horn after versus before trial 3 compared to the controls ($p<0.05$).

Discussion
No benefit of automatic flushing partly agrees with Thomsen et al. (2012) who did not find a significant effect of only water flushing.

References
Borderas TF Pawluczuk B de Passille AM Rushen J 2004 Claw hardness of dairy cows: relationship to water content and claw lesions. Journal of Dairy Science 87(7):2085-2093.
Thomsen PT Ersbøll AK Sørensen JT 2012 Short communication: Automatic washing of hooves can help control digital dermatitis in dairy cows. Journal of Dairy Science 95(12):7195-9. doi: 10.3168/jds.2011-5171. Epub 2012 Oct 11.

P30(b). Farmers favourite footbath additives

CJ Jennings[1, 2], MHM Speijers[1], S Doherty[1], NE O'Connell[2]
[1] Agri-Food and Biosciences Institute, Large Park, Hillsborough, N. Ireland, [2] Institute for Global Food Security, School of Biological Sciences, Queen's University Belfast, N. Ireland
catherinejennings@hotmail.co.uk

Introduction

Digital dermatitis (DD) accounts for 20-25% of all cases of lameness in dairy cows (Laven, 2003). Footbathing is commonly used by farmers to control DD, however the choice of solutions and additives used is often based on anecdotal evidence. This research aimed to gain a greater understanding of solutions and additives being used in footbaths by Northern Ireland dairy farmers. In addition, the effectiveness of adding vinegar to $CuSO_4$ within different footbathing frequency regimes in controlling DD was also assessed.

Materials and Methods

Survey: Two hundred and fifty-seven dairy farmers (from throughout NI) were interviewed at cattle markets and an agricultural show using a set questionnaire. A number of questions were asked including those about farm size and location, frequency of footbathing and solutions and additives used.
Footbathing trial: Lactating dairy cows were allocated to either four times weekly (n=56) or twice weekly (n=55) footbathing over a 10 week period. During the study, the cows walked through a water bath followed by a split 'treatment' footbath with a different solution in each side. The left side contained a 2% $CuSO_4$ solution and the right side contained a 2% $CuSO_4$ solution acidified with vinegar. Digital dermatitis was scored on the hind claws during milking on a weekly basis using a 5-point nominal scale (Döpfer *et al*. 1997). The data were analysed using a Wald test with a binomial distribution (GenStat 12).

Results

Farmers from all six counties of N.I. were represented and most had a herd size of between 51-100 cows. The majority of dairy farmers surveyed (79%) used a footbath to control DD. The most commonly used solution was $CuSO_4$, however 74% of farmers were unaware of the concentration they used. Of all footbath users, 32% used $CuSO_4$ alone, 32% used it in rotation with another solution and 13% mixed it with another solution. Interestingly, 48% of those using $CuSO_4$ add a surfactant to the solution. (31% add salt, and 26% add fairy liquid). Of those using additives, 60% followed advice from other farmers, while 6% followed advice from a vet.
In the footbathing trial, frequency (either twice or four times weekly) was not statistically significant in determining the probability of the animal having a DD lesion (classified as M1-M4). This was also true of the solution used, indicating that acidifying the $CuSO_4$ with vinegar did not improve efficacy of the solution. (See Table 1)

Discussion

This research underlines the importance of anecdotal knowledge transfer within the N.I. farming community. Many producers use additives with copper sulphate solutions in the apparent absence of much scientific evidence to support their use. While it was visibly evident that acidifying $CuSO_4$ solution with vinegar made the powder dissolve more readily (See Fig. 1), it did not make the 2% solution more effective in controlling DD at either footbathing frequency. The prevalence of active lesions in this herd was low, however, and further research should be conducted with higher prevalence herds.

Acknowledgements

We gratefully acknowledge staff at the Dairy Unit at AFBI for facilitating the trial, the farmers for completing the surveys and the markets for granting us access.

References

Dopfer DA, Koopmans FA, Meijer I, Szakall YH, Schukken W, Klee RB, Bosma JL, Cornelisse AJAM van Asten and AA ter Huurne 1997 Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and *Campylobacter faecalis* Vet Rec 140(24):620-3.
Laven RA 2003 Technical Report No 02/T3/07 Milk Development Council Cirencester.

P31(a). Footbathing for control of interdigital dermatitis in sheep

MHM Speijers[1], D Irwin[1], RA Annett[1], AF Carson[1], A Gordon[2]
[1]Agri-Food and Biosciences Institute (AFBI), Agriculture Branch, Hillsborough, Northern Ireland, UK,
[2]AFBI, Biometrics Department, Newforge Lane, Belfast, Northern Ireland, UK
Mari.Speijers@afbini.gov.uk

Introduction

Most outbreaks of lameness in sheep are caused by interdigital dermatitis (scald and/or footrot). One of the control strategies that can be used is footbathing with antibacterial solutions. Formalin or zinc sulphate have been recommended (Winter, 2008). However, both solutions have disadvantages, namely health concerns or labour implications, respectively. Furthermore, the Farm Animal Welfare Council (FAWC, 2011) indicated a knowledge gap in relation to pain-free footbath formulations for the prevention and treatment of scald. Therefore, the aim of this study was to investigate the effectiveness of copper sulphate or a commercial footbathing solution on the control and/or prevention of interdigital dermatitis in ewes and lambs.

Materials and Methods

Ewes (n=43) and lambs (n=75) affected by interdigital dermatitis (ID) were randomly allocated to one of two treatments: 1) footbath with 5% copper sulphate, and, 2) footbath with 2% acid-based commercial solution, on two farms. An equal number of ewes and lambs unaffected (control) by ID were also allocated to one of these two treatments. Interdigital dermatitis was scored using a 5-point nominal scale as described by Conington et al. (2008), which takes into account the stage of lesion development. Scoring was carried out on all feet of all animals before treatment and 4 weeks after treatment. For each animal, the lesions were scored as "healed" when lesions were improving on all feet and as "not healed" when one or all feet had lesions that either got worse or did not improve. Data were analysed using a regression analysis with a binomial distribution and logit-link function in GenStat, with farm, animal type (i.e. ewe or lamb), and footbath solution, as fitted terms.

Results

Farm had a significant effect on the "healing" of interdigital dermatitis lesions (0.90 ± 0.035 vs. 0.48 ± 0.073, P < 0.001). There was no difference in healing of interdigital dermatitis between lambs or ewes, with 0.73 ± 0.044 and 0.75 ± 0.060, respectively (P = 0.821). There was also no significant effect of footbathing solution on healing (P = 0.138), with 0.79 ± 0.047 and 0.68 ± 0.053 of animals healed for the copper sulphate and commercial treatments, respectively. Overall footbathing reduced the number of animals with interdigital dermatitis, but did not prevent new infection (Table 1).

Table 1. The proportion of sheep either affected or unaffected by interdigital dermatitis (ID) before and at four weeks after treatment with either 5% copper sulphate or 2% commercial footbath solution

Footbathing treatment		**Copper sulphate**	**Commercial**
Sheep affected by ID at start	At start	1.00	1.00
	After 4 weeks	0.34	0.58
Sheep unaffected by ID at start	At start	0.00	0.00
	After 4 weeks	0.06	0.05

Discussion

The results indicate that farm factors, other than footbath solution per se, are also important determining the effectiveness of footbathing on interdigital dermatitis control. Furthermore, results indicated that footbathing does not prevent the disease (re-)occurring.

Acknowledgements

Funding resources are the Department of Agriculture (DARD) for Northern Ireland and AgriSearch. The authors are grateful to participating sheep farmers and staff at AFBI.

References

Conington J, Hosie B, Nieuwhof GJ, Bishop SC, & Bünger L 2008 Breeding for resistance to footrot – the use of hoof scoring to quantify footrot in sheep. Veterinary Research Communications 32, 583-589

FAWC 2011 Opinion on Lameness in Sheep. Farm Animal Welfare Council, March 2011, London, UK

Winter AC 2008 Lameness in sheep. Small Ruminant Research 76, 149–153.

P31(b). Time and soil interaction in the germicidal efficacy of 4Hooves^{TM}

M Buchalova, A Skender, I Patel
DeLaval Inc, 11100 N Congress Ave, Kansas City MO 64153, USA
maria.buchalova@delaval.com

Introduction

The use of hoof baths is a common practice to prevent digital dermatitis on dairy farms. Because cows deposit urine and manure as they walk through the hoof bath, the efficacy of the active components present in sanitizers could be compromised. In previous *in vitro* studies 4Hooves^{TM} achieved maximum efficacy in the presence of 20% manure against *S. aureus* and *E. coli*. Additional *in vitro* studies of 4Hooves^{TM} against treponemas in the presence of 20% manure determined very low MIC and MBC at 5ppm and 10ppm of the active ingredient, resp, confirming thus an excellent efficacy under high soil conditions. On-farm studies showed that the hoof bath product 4Hooves^{TM} would tolerate manure and soil for about 200 cows. However, for small farms with fewer animals, the farmer may opt to keep the hoof bath solution unchanged for a few days before reaching the 200 cows recommendation.
To determine the efficacy of the product after continuous exposure to manure over several days, we investigated the antimicrobial efficacy of 4Hooves^{TM} after contact with manure for up to 7 days.

Materials and Methods

Several 1% solutions of 4Hooves^{TM} (DeLaval) were prepared with hard water (300ppm $CaCO_3$). The solutions were then contacted with different amounts of fresh manure from the field with authentic fecal bacteria. At 24hour intervals, aliquots of solutions were sterile filtered, and placed in the freezer until the end of the seven day study. All solutions were then tested using a modified EN1656 test under heavy soil conditions and against 4 organisms.

Results

In this study we show that 4Hooves^{TM} retains its antimicrobial efficacy even after prolonged contact with manure and organic soil. Results in Table 1 indicate that 4Hooves^{TM} has excellent residual germicidal efficacy when exposed to various levels of manure challenge for extended periods of time. The germicidal efficacy of the quaternary ammonium compounds present in 4Hooves^{TM} is not compromised by exposure to non-sterilized manure of up to 15% solids and for up to 7 days.

Conclusion

Field recommendations for product usage should take into account the inevitable soiling of the hoof bath due to manure deposition. Timely refreshing of hoof bath solutions will ensure adequate germicidal activity is maintained. This study shows that, for small farms, having the same hoof bath solution over a couple of days will be satisfactory and that the efficacy of the product is not lost.

References

Buchalova M, Lindell KH, Skender A, Lopez Benavides MG, 2011. Germicidal efficacy-in-use of hoof bath products in: 16th Symposium and 8th Conference on Lameness in Ruminants, 28 February–3 March, Rotorua, New Zealand p154.

Hartshorn RE, Thomas EC, Anklam K, Lopez-Benavides MG, Buchalova M, Hemling TC, Döpfer D, 2013. Short communication: Minimum bactericidal concentration of disinfectants evaluated for bovine digital dermatitis-associated Treponema phagedenis-like spirochetes, Journal of Dairy Science 96, pp 3034-3038.

Chemical disinfectants and antiseptics - quantitative suspension test for the evaluation of bactericidal activity of chemical disinfectants and antiseptics used in veterinary field - test method and requirements (phase 2, step 1). 2000. pp 1-31 in EN 1656.

Table 1. Efficacy of 4Hooves™ against specific bacteria following exposure to manure for 0 to 7 days

%Manure	Day	Log Reduction (EN1656), 5min, RT, Heavy Soil			
		S. aureus	*P. aeruginosa*	*E. hirae*	*P. hauseri*
0	0	**6.10**	**6.10**	**6.27**	**5.94**
5	0	**6.10**	**6.10**	**6.27**	**5.94**
10		**6.10**	**6.10**	**6.27**	**5.94**
15		**6.10**	**6,10**	**6.27**	**5.94**
5	1	**6.10**	**6.10**	**6.27**	**5.94**
10		**6.10**	**6.10**	**6.27**	**5.94**
15		**6.10**	**6.10**	**6.27**	**5.94**
5	2	**6.10**	**6.10**	**6.27**	**5.94**
10		**6.10**	**6.10**	**6.27**	**5.94**
15		**6.10**	**6.10**	**6.27**	**5.94**
5	3	**6.10**	**6.10**	**6.27**	**5.94**
10		**6.10**	**6.10**	**6.27**	**5.94**
15		**6.10**	**6.10**	**6.27**	**5.94**
5	4	**6.10**	**6.10**	**6.27**	**5.94**
10		**6.10**	**6.10**	**6.27**	**5.94**
15		**6.10**	**6.10**	**6.27**	**5.94**
5	5	**6.10**	**6.10**	**6.27**	**5.94**
10		**6.10**	**6.10**	**6.27**	**5.94**
15		**6.10**	**6.10**	**6.27**	**5.94**
5	6	**6.10**	**6.10**	**6.27**	**5.94**
10		**6.10**	**6.10**	**6.27**	**5.94**
15		**6.10**	**6.10**	**6.27**	**5.94**
5	7	**6.10**	**6.10**	**6.27**	**5.94**
10		**6.10**	**6.10**	**6.27**	**5.94**
15		**6.10**	**6.10**	**6.27**	**5.94**

P32(a). Comparison of hoof bath solutions for the prevention and control of digital dermatitis in dairy cows

D Döpfer[1], U Desranleaux Dandurand[2], A Desrochers[3], A Letellier[2], S Quessy[2], A Bourgeois[4], C Frenette Dussault[5], M Allard[2]
[1] UW-Madison, USA, [2] Laboratoire M2, Canada, [3] Université de Montréal, Canada, [4] Clinique Vétérinaire de Sherbrooke, Canada, [5] Université de Sherbrooke, Canada
dopferd@vetmed.wisc.edu

Introduction
Digital dermatitis (DD) is a widespread and costly disease in dairy herds. Hoof baths are commonly used to prevent DD and many products have been used as hoof bath solutions. Among them are copper sulfate (CuSO4) and formalin that upon exposure can be hazardous to human health and the environment. There is a need to find and test new chemicals that are less toxic than CuSO4 and formalin. A solution comprising thymol, Thymox, is a biocide with antimicrobial activity. *In vitro* studies showed that the Thymox inhibited the growth and killed treponemes isolated from DD at concentrations lower than the working concentration of 1% in hoof baths (Table 1). We hypothesized that Thymox hoof baths will be effective in preventing DD in endemically affected cows housed in free stall barns.

Table 1 *In vitro* efficacy on *Treponema*

	Thymox	CuSO4
Working concentration in hoof baths	1%	5%
MIC at Minimal exposure time with 20% manure	0.004 %	0.019 %

Materials and Methods
Four dairy farms (650 cattle) were enrolled in this field trial. The feet were evaluated at week 0, 6 and 12. The M-stages were used to record the stages of DD lesions: M0 no lesions, M1: small focal lesions (<2cm in diameter), M2: acute active lesions (>2cm in diameter), M3: healing lesions and M4: chronic lesions (Berry et al 2012). Farm 1 went through a 5% CuSO4 hoof bath 3x / week once per day, while the other three farms adopted Thymox at 1%. Locomotion and hygiene were also scored in this study. The number of transitions between the M-stages were counted and transformed into a probability matrix able to predict the relative frequencies of the M-stages after prolonged periods of time.

Results
The multi-states model showed that CuSO4 on farm 1 was associated with significantly less M2 lesions compared to all three farms on Thymox, at the same time significantly less healing stages M3 were to be expected on the Thymox farms. The number of normal legs without signs of DD was significantly lower on farm 2 and higher on farm 4, while early M1 stages were significantly higher on farms 2 and 4 compared to farm 1. The number of M4 stage was significantly lower on farm 4 only when compared to farm 1 (Figure 1).

Discussion
Chronic lesions (M4) are the long-term reservoirs of DD and the precursors of active lesions. Increased chronic lesions become a problem under the impact of risk factors such as bad hygiene. It is extremely common that test products result in more chronic lesions compared to CuSO4, which was not observed with Thymox. In this study, the Thymox product was associated with the prediction of equal or less chronic lesions, and in one farm, significantly more normal legs. This work is an example of a long-term study that yields results able to show effects of the hoof bath solutions on DD. It is strongly advised to take these long-term effects into account when adopting new hoof bath agents. Finally, early detection and prompt topical treatment of active M2 lesions are essential for the success of a hoof bathing strategy.

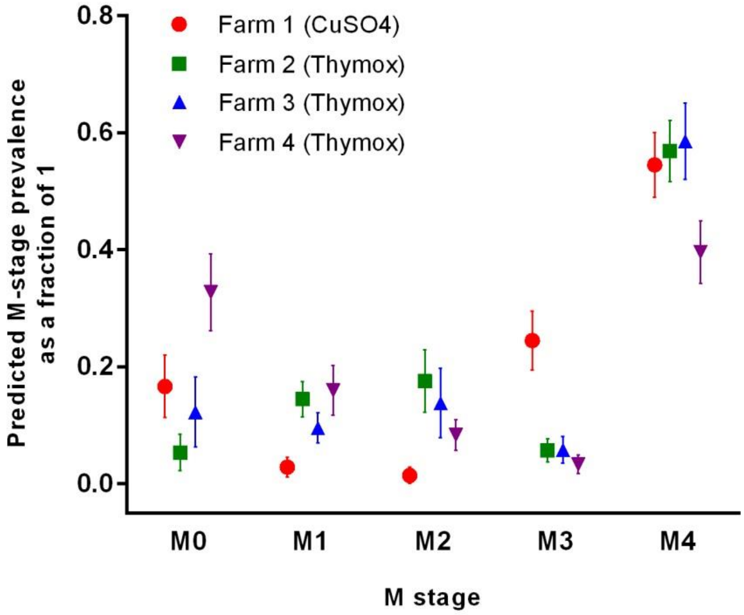


Figure 1. Long-term prediction of M stages for each farm.

Acknowledgment
Thanks to Agriculture and Agri-Food Canada (Agricultural Innovation Program).

Reference

Berry SL, Read DH, Famula TR, Mongini A & Döpfer D 2012 Long-term observations on the dynamics of bovine digital dermatitis lesions on a California dairy after topical treatment with lincomycin HCl. Vet J. 193:654-658.

P32(b). Treatment effect of Agron and salicylic acid on digital dermatitis – preliminary results

N Capion[1], OL Nielsen[1], EK Larsson[1]
[1] Faculty of health and Medical Sciences, University of Copenhagen, Denmark.
nyc@sund.ku.dk

Introduction
Bovine digital dermatitis (DD) is an infectious disease, with *Treponema spp.* as the predominant agent. One of the most commonly used topical treatments is oxytetracycline. There is however, an interest in using non-antibiotic products for treatment of DD, primarily due to the risks of antibiotic residue in milk and meat, soil contamination and the risk of antibiotic resistance.
The objective of this study was to evaluate the effect of Agron (manure acidifier) and of salicylic acid over a 30-day period in the treatment of DD.

Materials and Methods
DD lesions from cows were clinically scored in a trimming chute in a commercial dairy herd at day 0. Cows with M2 or M4 lesions (Döpfer et al., 1997) were randomly assigned to two treatment groups. Treatments were either salicylic acid powder (SA) in a bandage for 2 days, or Agron 20% solution (AS) applied every third day for 30 days. Lesions were examined by visual inspection (M stage), palpation (pain), and photographed at day 6, 14, 21 and day 30. At day 0 a biopsy was obtained from the center of the lesion and a second biopsy was obtained at the point of clinical healing or at day 30 (day H). Lesions were considered healed when scored as M0. Lesions were considered improved when scored as M3.
Biopsies were formalin fixed, paraffin wax embedded, sliced and stained using the Levaditis method (silver stain). The amount of *Treponema spp* was evaluated. The amount was scored as either none-, small-, moderate-, or severe amount of *Treponema spp*.

Preliminary Results
Thirty DD lesions were included in the study. Fourteen were treated with SA (7 M2 and 7 M4) and 16 were treated with AS (6 M2 and 10 M4). Treatment with salicylic acid powder resulted for M2 in 5/7 healed and 1/7 improved lesions. For M4, 2/7 healed and 2/7 improved. Treatment with Agron solution resulted for M2 in 2/7 healed and 4/7 improved. For M4 lesions, 3/10 healed and 6/10 improved. Fisher`s exact test revealed absence of difference between treatment groups. Levaditis staining of biopsies taken at day 0 showed 64% with a severe amount of *Treponema spp*. while 36% had moderate amount. The results from day H are shown in Table 1.

Table 1. The amount of *Treponema spp.* in samples from cows treated for digital dermatitis taken day H. The samples are grouped according to treatment

Treatment	None	Small	Moderate
Salicylic acid (SA)	60 %	40%	0
Agon Solution (AS)	67 %	33%	0

Discussion
Based on the results salicylic acid and Agron solution seems to be valid non-antibiotic treatment options for DD. Due to the relative short trial period the risk of self-healing, reinfection and reoccurrence are relatively limited, but the possibility exists.

Acknowledgements
Special thanks to the farmer and Jan Wyhe-Storgaard and Flemming Schmidt for sponsoring the product and also for the cooperation at the trial days.

References
Döpfer D, Koopmans A, Meijer F A, Szakáll I, Schukken Y H, Klee W, Bosma RB, Cornelisse JL, van Asten AJAM & ter Huurne AAHM 1997 Histological and bacteriological evaluation of digital dermatitis in cattle, with special reference to spirochaetes and Campylobacter faecalis. Veterinary Record 140: 620-623.

P33(a). Clinical efficacy of tulathromycin administration in sheep with foot rot – preliminary results

CB Rebelo[1], KM McLennan[1], M Corke[1], M Holmes[1], F Constantino-Casas[1]
[1]Department of Veterinary Medicine, University of Cambridge
cjr65@cam.ac.uk

Introduction
Ovine foot rot is a chronic and infectious disease causing lesions of the hoof and severe lameness, suggesting that foot rot is a very painful disease with significant adverse consequences on the welfare of sheep. In the United Kingdom, foot trimming and topical antibacterials are commonly used by farmers to treat foot rot. Tulathromycin is a semi-synthetic macrolide antimicrobial agent used for treatment of bacterial respiratory disease in cattle and pigs, with long-acting properties (Nowakowski et al. 2004) that may present an efficient tool in the treatment of ovine foot rot. Macrolide antibiotics are safe to use in sheep, with tilmicosin already having a license. Nevertheless, there is no data in sheep regarding the efficacy or safety of tulathromycin, therefore its use is currently off-label.

Materials and Methods
Eighteen male and twenty five female sheep (n= 43) from 4 different farms were enrolled in the study. All animals were identified by ear tag and assessed for foot rot (n1=30 diseased, n2=13 control (sheep without footrot)) by clinical examination, and did not receive any pre-treatment medications or vaccinations. Sheep diagnosed with foot rot were treated with a single-dose of tulathromycin 2.5 mg/kg body weight by subcutaneous injection, and observed 7 days later and 90 days later. Treatment also included meloxicam and foot trimming of overgrown hooves (day 7). Clinical signs of foot rot were recorded for all four feet of each animal. Lesion scores and gait scores were assessed for every sheep on each observation day for both diseased and control animals, using respectively a foot rot scoring scale (Egerton and Roberts 1971) and a locomotion scale (Ley et al. 1989).

Results
A Spearman's rank correlation between lesion and lameness scoring (rs=0.71, *p*=0.00) across the three time frames demonstrate that these values are highly correlated (Figure 1).

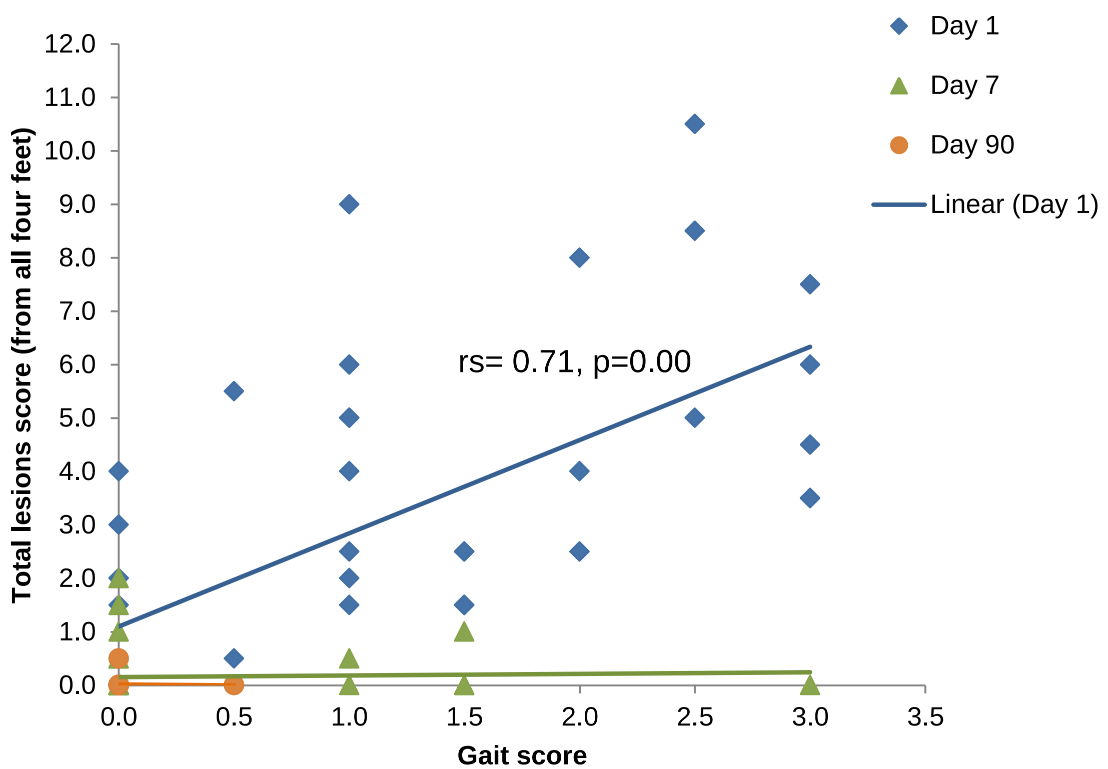


Figure 1. Correlation between gait score and foot lesions scores in sheep on day 1, 7 and 90

Results confirm that the vast majority of the diseased animals (97.7%) show reduction of their foot lesions scores after administration of tulathromycin, and consequently reduced lameness scores.

Discussion

The study indicates that after the administration of the injectable solution there were improvements in the lesions of the animals affected, suggesting that tulathromycin is effective for the treatment of ovine foot rot. This is part of an ongoing research that aims to study 120 sheep in total during the period of 6 months, as there is interest in learning if treated animals are less susceptible to re-infections in future. In support of any clinical changes, measures such as cortisol and cytokines are also being assessed, and thermal imaging will also be used in upcoming visits to farms.

Acknowledgments

The authors wish to thank the EU VII Framework programme (FP7-KBBE-2010-4) for financing the Animal Welfare Indicators, and the farmers who were kind enough to let us use their animals and facilities.

References

Egerton JR, Roberts DS 1971 Vaccination against ovine foot-rot. Journal of comparative pathology, 81(2), 179-185.

Ley SJ, Livingston A, Waterman AE 1989 The effect of chronic clinical pain on thermal and mechanical thresholds in sheep. Pain, 39(3), 353-357.

Nowakowski MA, Inskeep PB, Risk JE, Skogerboe TL, Benchaoui HA, Meinert TR, Sunderland SJ 2004 Pharmacokinetics and lung tissue concentrations of tulathromycin, a new triamilide antibiotic, In cattle.Veterinary therapeutics: research in applied veterinary medicine, 5(1), 60.

P33(b). Effect of Citrex® on bovine digital dermatitis induced lameness and lesions

AR Mohamadnia[1], M Rezaei[2], Z Hajari[3], A Nejati[2]

[1]Department of Clinical Science, Faculty of Veterinary Medicine, Ferdowsi University of Mashhad, Iran mohamadnia@um.ac.ir , [2]Faculty of Veterinary Medicine, Ferdowsi University of Mashhad, Iran, [3]Javane Khorasan Co. Mashhad, Iran
mohamadnia@um.ac.ir

Introduction
Digital dermatitis is now the most common infectious cause of lameness in the dairy cow and, along with white line disease and sole ulcers, is one of the top three causes of lameness, with over 70% of herds affected (Laven 2001; Mohamadnia 2007). Three approaches to digital dermatitis treatment have been used: systemic antibiotics, individual topical treatment, and footbath. Footbath as a mass topical therapy is commonly used on many dairy farms (Laven 2006). Formaldehyde is commonly used because of its low price and availability, however, some other agents like copper sulfate, organic acids, zinc, quaternary ammonium compounds, glutaraldehyde, and organic acids have also been used (Silva 2005; Thomsen 2008). A need to identify environmentally friendly materials with good effects on digital dermatitis lesions resulted in this study of evaluation of the effect of Citrex® (activated ascorbic acid, lactic acid, citric acid and glycerin; Citrex Inc, Miami, FL, United States).

Materials and Methods
Eighty one cows in a single commercial dairy farm, commonly receiving a 3% formaldehyde footbath four days a week were selected. Locomotion scores of the cows were based on a five point scale locomotion scoring system (LSS). Pain was evaluated by cold water jet (WJT) test by a single observer and reflex of the animal based to its severity classified on a three point scale from 0 (without any reflex) to 2 (prominent reflex). Both scorings were done before and after treatment. Lesions were photographed at the start of treatment and then again one and two weeks after treatment in a hoof trimming chute. Diameter of the lesions was measured (based on a scale included in photographs) using Image J® v.1.43 software (U.S. National Institutes of Health, Bethesda, MD, U.S.A.) and findings reported in millimeter. Instead of the usual formalin therapy, Citrex® 0.1% solution footbath was used every three consecutive days for two weeks. Four days rest was between two treatments.

Results
No significant changes in LSS were recorded before and after treatment ($P>0.05$). Pain WJT scores decreased significantly after treatment (0.72 to 0.42, $P<0.05$). A total of 16 lesions were recorded among 81 cows (19.75%) and closely watched during the two weeks after start of treatment. The average lesion diameter reduced significantly from 22.74 ± 8.69 mm before to 16.14 ± 6.52 mm two weeks after treatment. One week after treatment, a dark scab appeared on many of the lesions, as usually occurs following antibiotic treatment.

Discussion
These results highlight the efficacy of Citrex® on digital dermatitis lesions. More controlled studies are needed in order to compare its effect with the effects of other available products.

References
Laven, R. 2001. Control of digital dermatitis in cattle. In Practice 23, 336-341.
Laven, R. A. & Logue, D. N. 2006. Treatment strategies for digital dermatitis for the UK. The Veterinary Journal 171, 79-88.
Mohamadnia, A. R., Kheiri, S., Aliabadi, H., Mohamaddust, M. & Kabiri, J. 2007. Study on Distribution of Dairy Cattle Hoof Lesions and its Relation to Locomotion Scoring. Iranian Journal Of Veterinary Surgery 2, 22-30.
Silva, L. A., Silva, C. A., Borges, J. R., Fioravanti, M. C., Borges, G. T. & Atayde, I. B. 2005. A clinical trial to assess the use of sodium hypochlorite and oxytetracycline on the healing of digital dermatitis lesions in cattle. Can Vet J 46, 345-348.
Thomsen, P. T., Klaas, I. C. & Bach, K. 2008. Short communication: scoring of digital dermatitis during milking as an alternative to scoring in a hoof trimming chute. J Dairy Sci 91, 4679-4682.

P34(a). Footbath versus Footbath: A challenge for health management of bovine digital dermatitis

F Zibaee[1], M Nouri [1], F Katouli[1], I Nowrouzian[2], SA Ahmadpanah[1], SMK SeyedJavad [2]
[1] Iranian Arad Pajouh Veterinary University Center, Tehran, Iran; [2] Department of Clinical Sciences, Faculty of Veterinary Medicine, the University of Tehran, Tehran, Iran.
mnouri2@yahoo.com

Introduction
Bovine digital dermatitis (BDD) is a cause of lameness in large numbers of dairy cows and has a negative economic impact in many countries, including Iran. Footbaths are the traditional means to treat, control, and/or prevent foot problems in dairy cattle (Nowrouzian and Zareii, 1995; Kloosterman, 1997; Laven and Proven, 2000). For a procedure that is so widely accepted and applied, there is surprisingly little research to support its use. This short communication investigates the foot bathing procedure of 316 dairies in 6 states by five practitioners in general veterinary practice.

Materials and methods
This retrospective longitudinal cross-sectional study was carried out in 316 dairies in six provinces in Iran during a 7 years period from early in 2004. The prevalence of DD in each herd was estimated by screening the cows at the parlour using a water hose method and verifying the case by inspecting restrained cows in a chute. Complete records were obtained from dairies; Foot bathing procedure practices among the herds, such as type, footbath design, concentrations of footbath compounds, footbath regimen and manure management were considered in our study.

Results
The prevalence rate of non-infectious and infectious disease of the bovine foot was calculated between 39.7 % and 59.8 %, respectively. BDD infection was identified in 38.2 % of cows (6419 out of 16803 cases). Investigation of some footbathing procedure practices present at this study indicated 75.0 % out of 316 dairies did not follow standard procedure and type, concentrations of footbath compounds, footbath regimen and manure management were not effective. Forty three per cent of the footbaths were too small in relation to the number of cows, that is, they were too short. The animals' feet were not systematically cleaned before passing through the footbath.

Discussion
In Iran, a considerable number of farms with digital dermatitis will, at least occasionally, use a group footbath treatment. The most important benefit of using footbaths is that all the cows are treated for digital dermatitis at the same time (Laven and Proven, 2000). For optimal effect of footbathing, the proper location and size, the correct concentration of chemicals, the correct temperature, refresh a footbath and cleaning the foot by prebath before entering a footbath should be considered (Kloosterman, 1997; Laven and Proven, 2000). In a retrospective study from 267 dairies, 42% of the dairy farms had evidence of repeated outbreaks of lameness in particular digital lesions after the abusage of footbath. Interestingly, in 26% of the dairies, where footbath was not used on a regular basis, the solution regimen was not properly used, there were evidence of individual aggravated chronic lesions of the horny tissue of the claws (Nowrouzian and SeyedJavad, 2002). Efficacious footbaths actually help maintain management conditions. However, a footbath is not a substitute for attentive hygiene but assists in control of the environmental bacterial burden (Kloosterman, 1997).

References
Kloosterman P 1997 Claw care, In: Lameness in Cattle. Greenough, P.R., Weaver, A.D., (Eds.). 3nd Edition, WB Saunders Co. Philadelphia, USA. pp. 133-5.
Laven R, Proven M 2000 Use of an antibiotic footbath in the treatment of bovine digital dermatitis. Veterinary Record 147, 503- 506.
Nowrouzian I, Zareii S 1998 Comparison of two application forms of Lincomyrin HCL for group treatment of digital dermatitis in dairy cows. Proceedings of the 10th Inernational Symposium Lameness in Ruminants, Lucerne, Switzerland, pp. 287-9.
Nowrouzian I, SeyedJavad SMK 2002 Preventive effects of footbaths on lameness: Use, misuse and abuse. Proceedings of the 12th International Symposium on Lameness in Ruminants, Florida, USA, pp.: 386.

Session 10

Claws

52. Claw shape of Scottish Highland Cows after pasture and housing periods

K Nuss[1], E Kolp[1], E. Weidmann[1], U. Braun[1]
[1] Department of Farm Animals, Vetsuisse-Faculty, University of Zurich, Switzerland
knuss@vetclinics.uzh.ch

Introduction
Little is known about the claw size and claw health in cattle that are pastured throughout the year. Therefore, repeated claw measurements in Scottish Highland Cows were carried out and claw lesions recorded.

Materials and Methods
The claws of the right thoracic and pelvic limbs of 22 Scottish Highland cows were measured four times two months apart. The cows were kept on various alpine pastures before the first measurement, on a two-hectare low-land pasture before the second measurement, in a welfare-compliant straw-bedded free stall before the third measurement and again on alpine pasture before the fourth measurement. General claw health was assessed, and the dorsal wall length, dorsal wall angle, heel length, height and width, sole length and width, and claw length were measured. Differences in variables with a normal distribution (Shapiro-Wilk test) were analysed using a paired t-test and differences of variables with a non-normal distribution were analysed using the Wilcoxon signed ranks test. $P < 0.05$ was considered significant.

Results
Except for heel and sole width, all variables had large variations among cows. Long dorsal walls and heels and greater symmetry between lateral and medial claw were common after pasturing (Figure 1a). Most claw measures increased after low-land pasturing but the dorsal wall angle decreased.

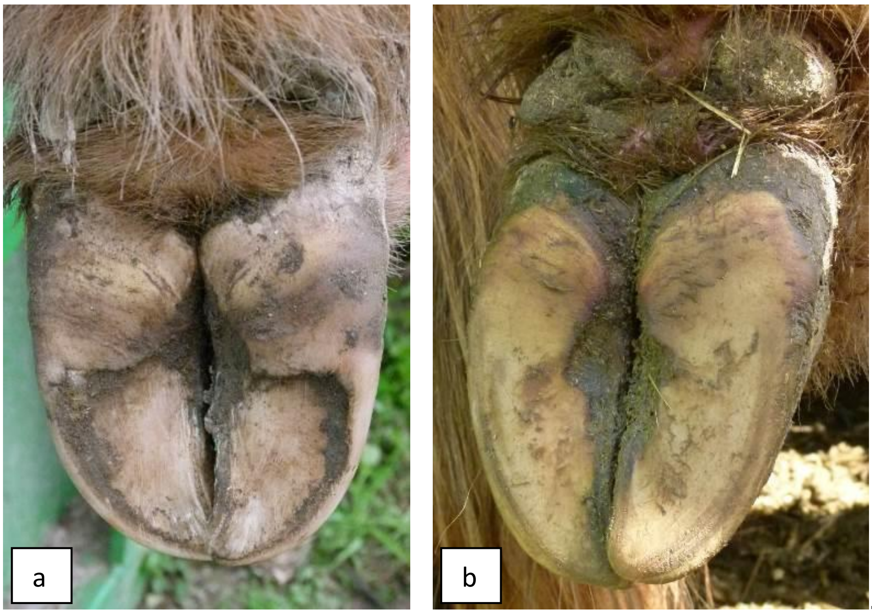


Figure 1. Claws of a right hind limb of a 3 year old Scottish Highland Cow **a)** after a six month period on an alpine pasture: The heel is strong without signs of horn erosion, the axial groove is well established, the sole thick and the wall protrudes over the sole. **b)** After 2 months in a free stall: the sole, heel and wall have worn down, the area of the white line is softened and the lateral claw larger than the medial claw.

Free-stall housing was associated with shorter dorsal walls and larger dorsal wall angles but wider soles in the lateral hind claws and narrower soles in the medial hind claws. In addition, wearing of the hoof wall edges, white line deterioration and heel horn erosion were common (Figure1b). Claw size increased again during the second alpine pasture period.

Discussion
Housing conditions significantly affected claw dimensions. After free-stall housing, there was an increase in asymmetry of the hind claws, similar to that reported in dairy cows housed under similar conditions. The

Scottish Highland cows examined in the present study had relatively large claws, which were composed of dry, hard horn during pasture periods, and had prominent weight-bearing heels and hoof-wall borders and soles with a natural axial slope. Claw lesions were absent with the exception of one animal affected by a vertical fissure, and therefore the “long claws” seen after pasturing in these cows were not considered in need for claw trimming.

53. Development of a method to determine internal tissue deformation due to external load in cattle hind claws

W Ouweltjes[1,2], JL van Leeuwen[1], SWS Gussekloo[1], CW Spoor[1]
[1]Wageningen University, Experimental Zoology Group, P.O. Box 338, 6700 AH Wageningen, The Netherlands, [2]Wageningen UR Livestock Research, P.O. Box 65, 8200 AB Lelystad, The Netherlands
wijbrand.ouweltjes@wur.nl

Introduction

Sole hemorrhages are frequently diagnosed in cattle claws at trimming. It is hypothesized that high mechanical load due to long standing on hard floors contributes to the development of sole lesions in cattle claws.

Materials and Methods

To predict under what circumstances and where lesions due to overloading could occur, the internal distribution of externally applied loads should be known. This distribution cannot be measured directly, however, but can be predicted with a finite element model. The model uses geometry and biomechanical properties of distinct tissues in the claws as input parameters. Such a model is developed for cattle hind claws by Hinterhofer et al. (2009), but the biofidelity if this model is not reliably tested.
A method is being developed to apply a realistic range of loads to dissected hind limbs of dairy cows during standing, and to determine deformations inside the claws resulting from these loads. A loading device equipped with a 3D force plate and calibration box for Rontgen stereo photogrammetry was constructed. obtain force distribution over the limbs that resembles the in vivo situation hind limbs are prepared for load experiments. Muscular tissue proximal from the knee joint is dissected such that the gastrocnemius muscles remained intact. The patellae are fixed on the femur, such that the tendons in the lower leg remain intact and functional. In order to measure deformation by means of stereo X-ray photogrammetry, tantalum and tungsten markers are placed in the phalanges and horn shoe.

Results

A series of load experiments is carried out with prepared legs with variation in both duration and level of loading. Results of this work enable to refine and validate the finite element model constructed by Hinterhofer et al. (2009) and provide a better understanding of effects of external mechanical load on claw tissues. Preliminary results indicate that the procedure is suited to obtain biologically realistic deformations.

References

Hinterhofer C, Haider CH, Apprich V, Ferguson JC, Collins SN and Stanek C 2009 Development of a twenty-one-component finite element distal hind limb model: Stress and strain in bovine digit structures as a result of loading on different floorings. Journal of Dairy Science 92:972–979.

54. Morphometric analysis of blood vessel architecture in histological sections of the bovine claw - method and preliminary findings

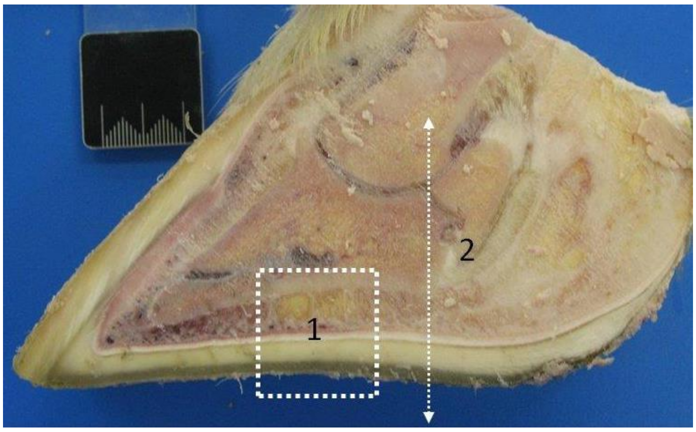
LJ Laven[1], RA Laven[1], M Perrott[1], N Lopez-Villalobos[1], TJ Parkinson[1]
IVABS, Massey University, Palmerston North, New Zealand
l.j.laven@massey.ac.nz

Introduction

Visual examination of haemorrhagic claw lesions cannot determine the aetiology of those haemorrhages. They may result from direct damage to claw vasculature (coriosis), from external trauma, or from "internal" trauma due to distal phalanx movement. Histology may be useful in determining aetiology; for example, coriosis due to vasoconstriction may result in more vascular remodelling than trauma. The aim of this study was to develop a method for identifying vascular remodelling using morphometry and to identify whether differences in vascular morphometry exist between medial front and lateral hind claws and site within claw.

Materials and Methods

Distal limbs from 28 non-lame cull dairy cows were frozen (-20^{o}C) for > 24 hours before sampling. Tissue samples (~3mm thick) were taken from medial front and lateral hind claws at two sites (Figure 1) and placed in 10% buffered formalin, before 3-4µm histological sections were made (Figure 2).



:

Figure 1 Sample sites (after Räber et al 2004). Site 1 was directly below the concavity of the distal phalanx and included digital cushion while Site 2 was a transverse cut through the flexor tuberosity of the distal phalanx

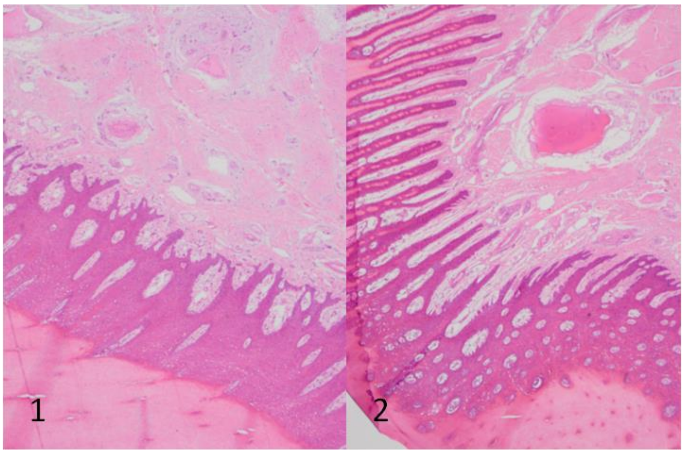


Figure 2 (H&E) sections (x 2.5) of the two sites.

Each slide was processed in a randomised order using a castellated search pattern, and the first ten arterial vessels which satisfied the inclusion criteria photographed (x 40 magnification). Selected vessels had a near-circular cross-section and at least one smooth muscle layer. A calibration bar was added to each photograph, which were then exported as TIFF for image analysis (Image J).

The area of the lumen (L) was measured by outlining the lumen and the area of the vessel plus lumen (V) by outlining the tunica media (Figure 3). The ratio of the two areas (L/V) was then calculated, square root transformed and used in an ANOVA to assess the effect of foot and site on the ratio.

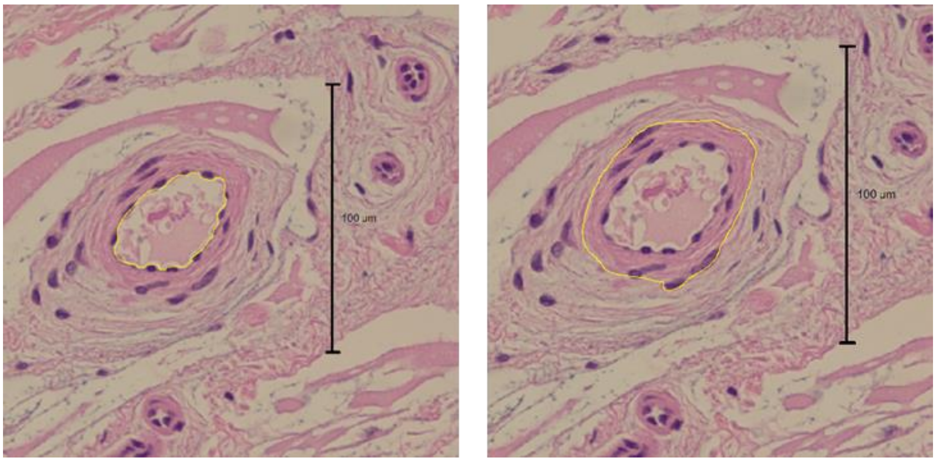


Figure 3 Outline of lumen area (left) and area within the tunica media (right). Bar= 100µm

Results

Sections of sufficient quality were obtained from 54 claws (27 cows). Sections from site 1 were made from all 54 claws, but sections from site 2 were useable from only 22 individuals (44 claws). There was no significant effect of foot on L/V (*P* = 0.07) nor a significant interaction between site and foot (*P* = 0.46); however site was significant (*P* = 0.006). L/V was smaller at site 2 than at site 1(back transformed mean 0.22 vs. 0.24 respectively), i.e. for vessels with the same size lumen there was more associated tissue at site 2.

Discussion

There were marked differences in the ease of creating sections between the two sites, but when sections were made, L/V was relatively easy to measure at both sites.
The between site difference may be related to anatomy – site 2 is underneath the digital flexor tuberosity and may be more susceptible to ‘internal’ trauma. This suggests that trauma can produce detectable vascular remodelling. Further research in animals thought to have coriosis is required to establish what the changes in vascular morphometry are in those cases.

Acknowledgments

Part funded by the McGeorge Research Fund.

References

Räber M, Lischer CJ, Geyer H, Ossent P 2004 The bovine digital cushion - a descriptive anatomical study. *The Veterinary Journal* 167: 258-264.

55. Determination of subcutaneous tissue on bovine hind claws with and without sole ulcers

KA Munk[1], NC Capion[1]
[1] DVM, Odense, Denmark, Department of Medical and Health Sciences, University of Copenhagen
ngw367@alumni.ku.dk

Introduction
The pathogenesis of sole ulcers is not fully understood. The newest theory is that sole ulcers are caused by mechanical strain to the dermis by the distal phalanx followed by a disruption in sole horn production and ulceration. Understanding the pathogenesis of sole ulcers is important regarding prevention or early diagnosis and treatment of lameness. A method to non-invasively examine and assess the thickness of the digital cushion or the soft tissue beneath the claw in the same cow over time will be an advantage.

Materials and Methods
The hind legs from 17 Danish Holstein dairy cows with and without sole ulcers were obtained from a slaughterhouse. The sole was trimmed, and each claw was scanned with B-mode ultrasound at the toe and heel as described by Kofler et al (1999). The soft tissue thickness (STT) was measured as the distance between the distal phalanx and the transition line between the sole and the subcutaneous tissue (**Figure 1**). The claws were transected sagittally using a band saw, and the same distances were measured as in the ultrasound pictures.

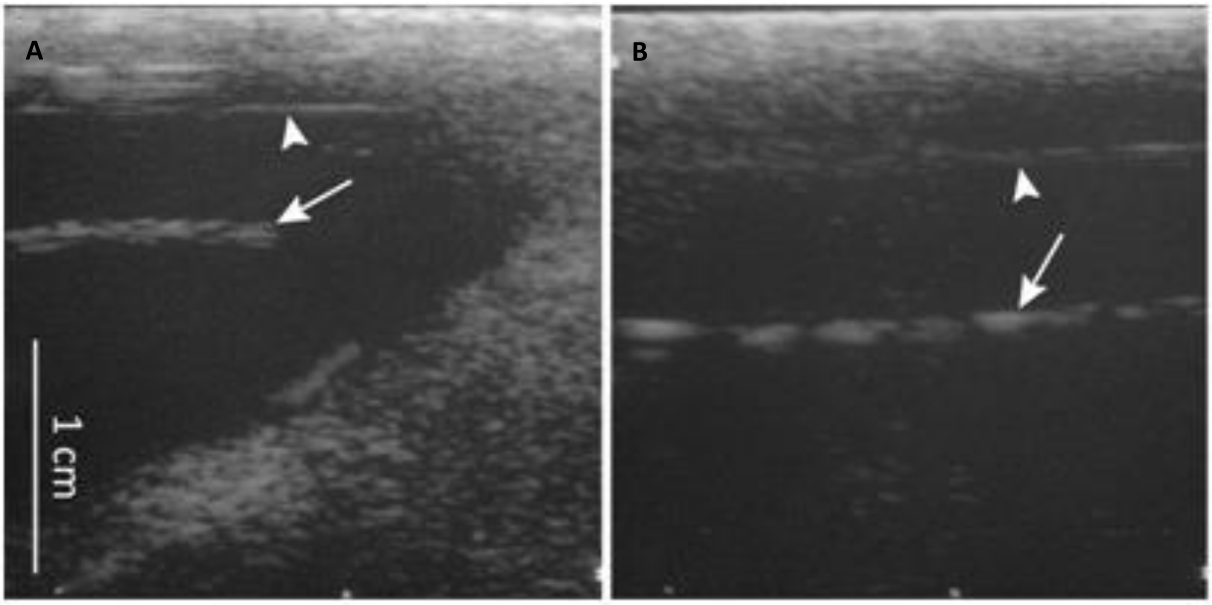


Figure 6. Ultrasound images of the tissue beneath the distal phalanx. The transition between the sole and the soft tissue can be seen as a thin echogenic line (arrowhead), and the distal phalanx can be seen as a deeper lying thicker line (arrow). (A) An image of the toe and (B) of the heel.

Results
Three cows had sole ulcers, but when the legs where transected, it was found that further nine cows, who either had no lesions or only sole hemorrhages on the sole surface, had lesions such as rotation or distal displacement of the distal phalanx. Ultrasound images of the subcutaneous structures were obtained at 130 out of 136 scanning sites. To determine the agreement between the two methods a Bland-Altman Plot was made. The differences were on average equal, but with relatively large limits of agreements. The mean STT as well as the STT in the toe and lateral claws was significantly thinner in cows with either sole ulcer or displacement of the phalanx compared to cows with no lesions. In claws with a rotation of the distal phalanx there was a tendency that the STT in the heel was thicker than in claws with no lesion (P=0.07).

Discussion

The decreased STTs in cows with sole ulcer or displacement of the distal phalanx show that the STT may be an important structure in the pathogenesis of sole ulcers, but no cause-relationship can be concluded from this study. The tendency that the STT in the heel of claws with rotation of the distal phalanx was thicker than in claws with no lesion shows the importance of measuring the STT at both the heel and toe to assess the risk of sole ulcers. This preliminary study shows that ultrasound may be further investigated as a method of assessing the soft tissue thickness in live dairy cows.

References

Kofler J, Kubber P & Henninger W 1999 Ultrasonographic imaging and thickness measurement of the sole horn and the underlying soft tissue layer in bovine claws. Veterinary Journal 157: 322-331

56. The trigonometry of the bovine claw: Identifying how the environment affects claw conformation

R.A. Laven[1], L.J.Laven[1]
[1] IVABS, Massey University, Palmerston North
r.laven@massey.ac.nz

Introduction

One key influence on claw conformation is environment – cubicle-housed cattle need trimming to optimise conformation and reduce lameness. On softer floors, e.g. straw or pasture, cattle have shallower toe angles, perhaps due to reduced toe horn wear (Somers et al 2005) or reduced heel horn development (Livesey and Laven 2002). If the first suggestion is correct then trimming should restore normal shape and function, but if the second is correct, trimming will not be effective and lack of horn development may increase risk of lameness on hard surfaces.
Claw height and heel height (see Figure 1) are strongly related parameters but are difficult to measure. Toe angle and toe length are easier to measure and claw height simple to calculate from these two parameters – claw height = sine (toe angle) * toe length (Āryabhaṭa 499).

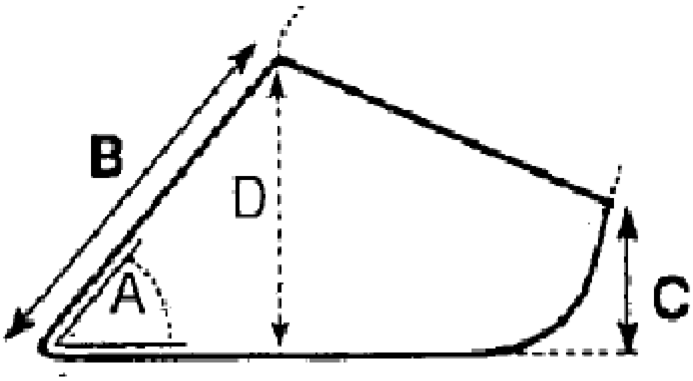


Figure 1. Claw traits related to toe angle. A, toe angle; B, toe length; C, heel height; D, claw height. Modified from Vermunt and Greenough (1995).

Data from three studies which reported shallower toe angles in animals kept on softer surfaces (Vermunt and Greenough 1996 (a); Livesey and Laven 2002 (b); Somers et al 2005 (c)) were used to identify what the pattern underlying this change was.

Materials and Methods

Lateral hind claw height was calculated using toe length and angle. Calving data were used from (a), 6 weeks prior (b) and mean lactation (c).

Results

Table 1. Calculation of claw height from toe length and toe angle, based on data from three studies.

	Vermunt and Greenough (1996)†		**Livesey and Laven (2002)†**		**Somers et al (2005)***	
Floor	**Slatted Concrete**	**Dry Lot**	**Solid Concrete**	**Straw**	**Solid Concrete**	**Straw**
Toe length (cm)	7.3	7.7	6.7	7.1	7.8	8
Toe angle (^{0})	52.4	50.4	41	27	47.8	42.5
Claw height (cm)	5.8	5.9	4.4	3.2	5.8	5.4

†, near calving heifers; *, mixed age cows in lactation

Discussion

For study (a) calculated claw height was not affected by group. This suggests that compared to concrete a dry lot has less toe wear, but no difference in claw height. In contrast, analysis of the data from (b) showed a marked effect on claw height, with 88% of the difference in toe angle resulting from the difference in claw height. Thus in this study shallow toe angles on heifers kept on straw with no concrete access was principally due to reduced heel height. In study (c) the effect of straw was less (probably because these cattle had access to concrete), but the difference in toe angle between the groups was principally due to claw height (75%) rather than increased claw length (25%).

Acknowledgements

Chris Livesey for undertaking the research and developing the hypothesis.

References

Āryabhaṭa 499 Ganitapada. In: Āryabhaṭīya verses 14-46

Livesey C and Laven R 2002 The effect of environment pre-calving on the hoof conformation of first lactation heifers. In: Proceedings of the 12th International Symposium on Lameness in Ruminants, Orlando, Florida, USA p 290

Somers JGCJ, Schouten WGP, Frankena K, Noordhuizen-Stassen EN and Metz JHM 2005 Development of claw traits and claw lesions in dairy cows kept on different floor systems. Journal of Dairy Science 88: 110-120

Vermunt JJ and Greenough PR 1995 Structural characteristics of the bovine claw: Horn growth and wear, horn hardness and claw conformation. British Veterinary Journal 151: 157-180

Vermunt JJ and Greenough PR 1996 Claw conformation of dairy heifers in two management systems. British Veterinary Journal 152: 321-331

57. Morphopathological findings of white line disease with digital and inner organ infections in culling dairy cows

I Nowrouzian[1], M Nouri[1], SH Marjanmehr[2], T Madadzadeh[3]
[1] Department of clinical Sciences; [2] Department of Pathology, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran; [3] Private Veterinary Practitioner, Ardebil, Iran.
mnouri2@yahoo.com

Introduction
White line disease (WLD) is a commonly observed lesion and has frequently been reported as a major cause of lameness. Several reports from Iran indicated the condition as responsible for between 1.53 % and 27.14 % of lameness. Although laminitis is generally regarded as the primary cause for the pathological changes within the white line region of the sole, other contributing factors should be considered.

Materials and Methods
This cross-sectional and descriptive study was carried out at an abattoir in the vicinity of Tehran. During the three- month period of investigation, 53 culled lame cows of 1135 culled Holstein cows having digit disorders were randomly selected for clinical, radiographical and pathomorphological purpose.

Results
Sixteen cases out of the total of 53 cases (30.1 %) were affected by WL lesions; 7 cases (13.2 %) and 9 cases (16.9 %) were affected with white line disease in zone 2 (WLD 2) and white line disease in zone 3 (WLD 3), respectively. The prevalence rate of WL lesion in the hind limb (75.0 %) was higher than fore limb. Eight cases had been trimmed incorrectly. Radiographic signs such as soft tissue swelling, new bone formation, osteitis and gas density were distributed in different sizes. The naked bone showed considerable bone changes such as excessive new bone formation, osteolysis, ankylosis and sequestration.

Discussion
In most cases chronic osteophytes of extensor tendon was seen at insertion on the extensor process, but only six out of 16 cases (37.5 %) showed calcification of the deep flexor tendon on P3 bone. Abnormal weight bearing and claw conformation effect on the excessive traction on the tendon.
Pedal osteolysis was found on the abaxial wall of P3 bone of the affected claw with WLD2. This sign is due to the persistence of the external lesion. The osteolysis and pedal osteitis in the region of the laminae at the dorsal edge of P3 bone are considered signs of laminitis (Bargai, 1989). In grosspathologic study of naked bone, pedal osteolysis was found on the abaxial margin of the P3 bone. However, other radiographic studies have reported pedal osteolysis on the solar margin bone (Gantke *et al.*, 1998; Hashemi *et al.*, 2005).
Infection of the distal interphalangeal joint (DIJ) usually results from localised purulent processes that spread to the deeper structures of the claw, such as white line disease (WLD) (Heppelmann *et al.*, 2009). In our study, 33.3 % out of the total of WLD3 cases showed septic osteoarthritis in distal inter-phalangeal joint.
The results of the present study indicate that laminitis may have affected virtually all these cases at some previous time.

References
Bargai U 1989 Radiological diagnosis of the foot. In: Bargai U., Pharr J., Morgan J.P., 1 eds, Bovine Radiology. 1st ed. Ames, IA, Iowa state University Press.
Gantke S**,** K **Nuss and R** Kostlin**, 1998** Radiologic findings in bovine laminitis, Tierärztliche Praxis 26:239-46.
Hashemi M, Veshkini A and I Nowrouzian I 2005 Radiographic feature of white line disease in dairy cattle, Proceedings of the 4th Convention of Iranian Veterinary Clinicians, Urmia, Iran, pp. 175-6.
Heppelmann M, Kofler J, Meyer H, Rehage J and Starke A, 2009 Advances in surgical treatment of septic arthritis of the distal interphalangeal joint in cattle: A review, Veterinary Journal 182: 162–175.

58. Feeding behaviour, milk yield, activity, and insulin sensitivity in dairy cows with acute claw lameness

S. Janßen[1], M. Heppelmann[1], M. Piechotta[1], R. Palme[2], U. Meyer[2], S. Dänicke[2], J. Rehage[1]
[1] Clinic for Cattle, University of Veterinary Medicine, Hannover, Germany, [2] Department of Natural Sciences - Biochemistry, University of Veterinary Medicine, Vienna, Austria, [3] Friedrich-Loeffler-Institute, Federal Research Institute for Animal Health, Institute of Animal Nutrition, Braunschweig; Germany
simone.janssen@tiho-hannover.de

Introduction
Lameness is seen as an expression of pain in dairy cows with claw lesions. Affected cows have a higher risk of ketosis than sound cows. This may be caused by pain stress induced decreased feed intake and hence more fat mobilization from adipose tissues to cover energy demands for milk production or a disposition or induction of reduced insulin sensitivity. Thus, aim of the study was to investigate feeding behaviour, activity and insulin sensitivity in lame dairy cows and healthy herd mates.

Material and Methods
Twenty one pluriparous lame dairy cows (sole ulcers or white line disease of one hind limb; lameness score ≥ 2 on a scale from 0-5) were detected by bi-weekly lameness scoring. Lame cows were matched with healthy herd mates (controls) according to parity and days in milk. All cows received functional claw trimming and lame cows additionally claw treatment of the affected claw. Feeding behaviour (dry matter intake (DMI), number of trough visits, feeding rate), body weight, milk yield were automatically recorded on a daily basis from day -7 to day 7 related to the day of lameness detection (d0). Milk constituents were sampled weekly. Activity was recorded by pedometers. Blood samples were collected from d0 to d7 and analysed for glucose, NEFA, insulin (from which RQUICKI was calculated as a surrogate insulin sensitivity index) and cortisol. Faeces was analysed for cortisol derivatives. Results were statistically evaluated by analysis of variance for repeated measurements (SAS statistical package).

Results
Compared to controls on average lame cows showed longer lying periods (11 vs. 13 hours/d, resp., $p<0.01$), spent less time feeding (188 vs. 155 min/d, resp., $p<0.01$), had less trough visits (48 vs. 31 /d; $p<0.05$), and higher feeding rates (116 vs. 143, resp., $p<0.05$). Daily DMI, milk yield and calculated energy balance did not differ between controls and lame cows. Mean plasma concentrations of glucose and insulin as well as faecal concentrations of cortisol derivatives did not differ significantly between groups. In lame compared to control cows mean plasma cortisol (12.7 vs. 5.9 ng/ml; resp. $p<0.05$), NEFA (340 vs 175 µmol/l, resp., $p<0.05$) was higher and RQUICKI was significantly lower (0.44 vs. 0.58, resp., $p<0.05$).

Discussion
Early detected mild to moderate lameness reduces activity and thereby feeding behaviour in dairy cows. DMI appears to remain in such cases unaffected due to higher feeding rates when troughs are visited. Increased NEFA plasma levels may be due to reduced activity and muscular NEFA utilization or may reflect increased fat mobilization due to decreased insulin sensitivity. Reduced insulin sensitivity in lame cows with claw lesions may be caused by pain stress or reflects possibly a general disposition of insulin resistance in such cows.

59. Using Swedish claw trimmers' reports to evaluate influence of different grazing management on claw health

C Bergsten[1], J Carlsson[2] & M Jansson Mörk[2]
[1]SLU, Biosystem and Technology, Alnarp, Sweden, [2]Växa Sverige, Animal Welfare, Stockholm, Sweden
Christer.Bergsten@slu.se

Introduction
For more than a decade Swedish claw trimmers have recorded and reported claw diseases at maintenance claw trimming. The data is stored in the national milk recording scheme and available to farmers and extension service via internet. Sweden is the only country in Europe with legislated grazing during summer and many Swedish herds would like to have a more flexible grazing regulation and with comparable provisions to other countries in Europe. In Denmark grazing was found beneficial with less lameness and lower mortality (Burrow et al 2011). This study was made to evaluate the influence of different grazing management in cubicle systems on claw health.

Material and Methods
200 cubicle housed herds from northern to southern Sweden including the three zones of two, three or four months mandatory grazing were selected. Inclusion criteria were that the cows in the herds were trimmed and claw diseases recorded close before being grazed in spring and shortly after being housed autumn. All herd data was retrieved from the Swedish milk recording scheme and herd related parameters, housing and grazing management, were retrieved from the herdsperson by a telephone interview. The statistical analysis was based on 16,364 trimmings in 174 herds and was made by multilevel logistic regression ($p<0.05$).

Results
The real grazing time as reported was in average longer than the predicted. After the housing season in spring, cows in herds with longer grazing period (4 months) had a lower prevalence of total claw health remarks as well as less digital dermatitis (DD) and sole ulcers than those with shorter. Organic herds had lower prevalence of total remarks, dermatitis and DD, and herds with Swedish Holstein (SH) had more total remarks and sole ulcers than conventional and Swedish Red (SR), respectively. At autumn trimming after the grazing season only heel horn erosion had a lower prevalence than before the grazing season. Higher density of cows at pasture increased the risk of sole ulcers and dermatitis. Longer trimming interval increased the risk for sole ulcer and SH had more total remarks and sole ulcers than SR. However, the highest risk for a claw disease to occur after the grazing season was if the cow had the same claw disease before grazing. Thus the risk was 9.5, 6.5, 5, and 3.8 times higher for heel horn erosion, dermatitis, sole ulcer, and total remarks, respectively.

Discussion
Better claw health in organic herds both before and after pasture is positive but could not only be explained by longer grazing than conventional. Breed differences with less good claw health in SH is in agreement with earlier studies (Manske, 2002). However, from a claw health perspective, and under Swedish mandatory grazing conditions, pasture doesn´t seem to be able to compensate for suboptimal conditions during the housing season causing claw disease.

Acknowledgements
The study was granted by the Swedish Board of Agriculture

References
Burow E, Thomsen PT, Sorensen JT, and Rousing T 2011 The effect of grazing on cow mortality in Danish dairy herds. *Preventive Veterinary Medicine* **100:** 237-241.
Manske T 2002 Hoof lesions and lameness in Swedish dairy cattle; prevalence, risk factors, effects of claw trimming and consequences for productivity *Animal Environment and Health*, pp 168. Swedish Univ Agr Sci (SLU): Skara

P34(b). Monitoring claw conformation in two cohorts of first lactation New Zealand heifers

LJ Laven, RA Laven, N Lopez-Villalobos, TJ Parkinson, JK Margerison
l.j.laven@massey.ac.nz

Introduction

Poor claw conformation is a significant lameness risk factor. In New Zealand, heifers are generally reared on pasture, and there is no regular contact with harder surfaces, such as concrete and tracks, until calving at ~24 months. Contact with concrete can significantly affect hoof conformation; Livesey and Laven (2002) showed that toe angles, dorsal borders and heel bulb development of straw-reared heifers changed rapidly after calving to match the conformation of cubicle-reared heifers, but this did not prevent the development of significant hoof horn haemorrhages after calving.

A similar analysis of conformation change after calving has not been undertaken in New Zealand. As part of a two-year study looking at hoof conformation of first lactation New Zealand dairy heifers, toe angle and dorsal border were measured in two cohorts of heifers on the same farm.

Materials and Methods

Heifers were restrained in a foot crush and hind feet lifted for measurement of dorsal border (tape measure) and toe angle (electronic angle finder) in all four claws (Figure 1).

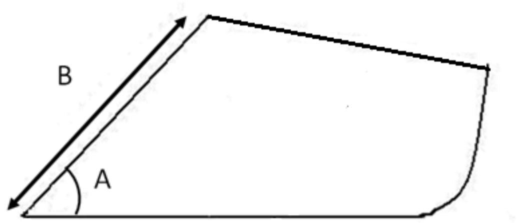


Figure 1 Measurements made on claw

A. Toe angle: Angle of dorsal border to weight-bearing surface

B. Length of dorsal border from skin: horn junction at coronary band to apex of toe

Year 1 (Y1): 25 mixed breed (Friesian and crossbreds) were assessed at ~10, 60, 110, 160 and 220 days after calving (dac).

Year 2 (Y2): 29 heifers (Friesian) were assessed at ~10, 60, 120 and 220 dac.

In both years, there were significant changes in toe angle and dorsal border after calving, but the pattern of the change was appreciably different between years (Figure 2, 3).

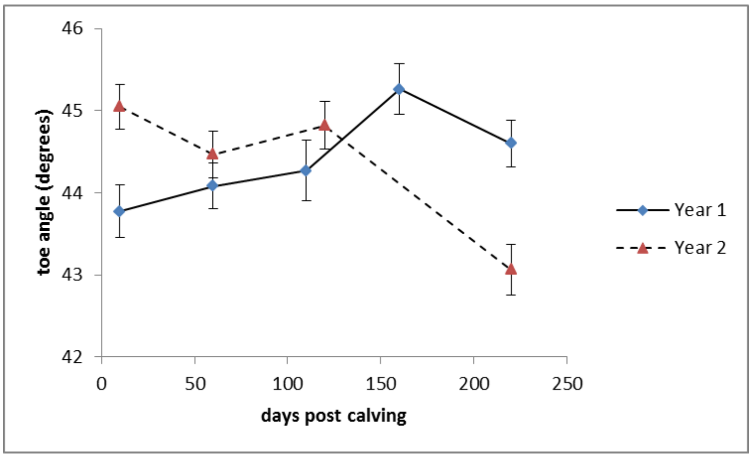


Figure 2 Comparison between years for mean toe angle of four hind claws

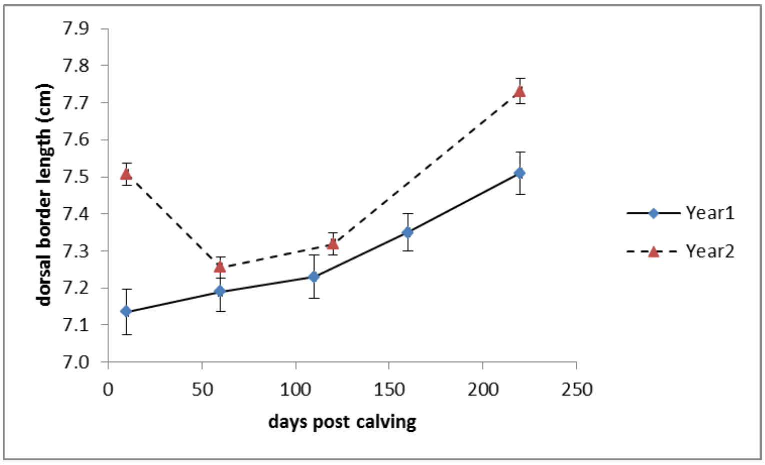


Figure 3 Comparison between years for mean dorsal border of four hind claws

In Y1, toe angle started lower than in Y2, but increased with time, whereas in Y2, the tendency was for it to decrease with time. For dorsal border, the difference between years at 10 dac was even more apparent, but once dorsal border had decreased in Y2, the pattern of change was similar between years.

Discussion

Despite the two cohorts being reared in the same environment, there were differences in toe angle and dorsal border at 10 dac. Some of this may be a breed effect but a preliminary analysis suggested that breed had a smaller effect on hoof conformation than year. This difference at 10 dac was then followed by a different pattern of change after calving. For dorsal border, the change seemed to be towards the same point, whereas the endpoints for toe angle were different between years. Nevertheless in both cases the changes in hoof conformation were markedly less than the changes reported by Livesey and Laven (2002) in the straw-reared heifers, probably because the pasture environment that our heifers were on was less extreme than the straw system used by Livesey and Laven (2002).
Further research is required to establish the factors underlying conformation change in first lactation New Zealand heifers and how to optimise conformation during rearing to minimise the impact of the exposure to harder surfaces after calving.

Acknowledgements

Kim Fraser, Andrew Rowatt; Bell-Booth Ltd. for financial support

References

Livesey C & Laven R 2002 The effect of environment pre-calving on the hoof conformation of first lactation heifers. In: Proceedings of the 12th International Symposium on Lameness in Ruminants, Orlando, Florida, USA p 290

P35(a). Clinical and mechanical properties of bovine claw horn after inducing subacute ruminal acidosis (SARA)

K Russell[1], AM Danscher[1], JC Knudsen[1]
[1]University of Copenhagen, Denmark
karussell@live.dk

Introduction

A connection between subacute ruminal acidosis (SARA) and laminitis-like changes in bovine claw horn has been suggested (Beauchemin & Penner 2009). Clinical signs consistent with laminitis can be associated with changes in the mechanical properties of bovine claw horn (Winkler & Margerison 2012). This study aimed to describe the effect of experimentally induced SARA on puncture resistance and elastic module of the sole horn and the effect on sole and white line haemorrhages in dairy cattle.

Materials and Methods

SARA was induced in four primiparous Danish Holstein cows (31-34 month, 6-11 month post partum) by feeding increasing amounts of grain pellets over a period of seven days (maximal 40% of daily dry matter intake). Ruminal pH was continually measured by an intraruminal bolus (Rumen Analyzer, eCow, Exeter, United Kingdom). The following data were collected from all claws of all cows (n = 176): Claw horn samples from zone 5 on the international foot map, registrations of solar and white line haemorrhages and photographs from the distal view of the claws. Data were collected prior to inducing SARA and in the weeks (week 4, 6, 8, 10) after inducing SARA. The claw horn samples were stored in plastic bags at -20ºC until testing on an Instron 5564 mechanical testing frame. Puncture resistance was determined as the maximal load before sample failure. The elastic module was calculated as the elastic module in the deflection of plates from the results of the puncture resistance testing. The clinical registrations and the photographs of the distal view of the claws were used to calculate the number and severity of sole- and white line haemorrhages, as described by Leach et al (1998). An analysis of covariance was performed to investigate the alteration of the measured parameters in time.

Results

No significant changes of the mechanical and clinical properties of the claw horn in the weeks after inducing SARA could be demonstrated. The elastic module and puncture resistance decreased slightly, but not significantly (P=0,0715 and P=0,05262).

Discussion

The lack of significance might implicate that no changes of the mechanical and clinical properties of the claw horn occur in the weeks after inducing SARA. However, the numerical changes of elastic module and puncture resistance may indicate a connection between SARA and the mechanical properties that might appear more clearly in a lager scaled study.

Acknowledgements

We are grateful to Saville Statistical Consulting Limited for the statistical help. We would also like to thank Tanja Nielsen and Anne Just Knudsen for their technical support.

References

Beauchemin K, Penner G 2009 New developments in understanding ruminal acidosis in dairy cows. In: Eastridge ML (ed) Proceedings of the 18th annual tri-state dairy nutrition conference, Fort Wayne 21-22 April, Indiana, USA pp 1-12. Ohio State University, Ohio, Indiana, USA

Leach KA, Logue DN, Randall JM, Kempson SA 1998 Claw lesions in dairy cattle: Methods for assessment of sole and white line lesions. Veterinary Journal 155: 91-102

Winkler B, Margerison JK 2012 Mechanical properties of the bovine claw horn during lactation. Journal of Dairy Science 95: 1714-28

P35(b). *In vitro* cultivation of equine keratinocytes as potential model for bovine laminitis

N Reisinger[1], S Schaumberger[1], S Hessenberger[1], G Schatzmayr[1]
[1]BIOMIN Research Center, Tulln, Austria
nicole.reisinger@biomin.net

Introduction

Keratinocytes are an important cell type for horn growth of ungulates. During laminitis, keratinocyte proliferation and differentiation is altered by several trigger factors (e.g. toxins or biogenic amines). Primary cells help us to understand changes in cell metabolism and destruction of the tissue during laminitis. In cattle and horses, laminitis is considered to have a comparable pathogenesis (Nilsson 1982). While only a few studies focused on cultivation of keratinocytes from the bovine claw (Nebel 2004, Hoffmann 2006), isolation and cultivation of keratinocytes from equine hooves (Visser and Pollitt 2010, Wunn *et al.* 1999) is well established. We therefore, isolated and cultivated equine keratinocytes to establish an *in vitro* model for studying bovine laminitis.

Material and Methods

Hooves (n=4) were obtained from the slaughter house, and explants were prepared in a similar way as described by Pollitt (1996). After dissection, cells were isolated with dispase II and trypsin.
Cells were cultivated either in D-MEM with and without 5% FBS or in CnT-07 medium (CellnTec) supplemented with 5% FBS. T25-flasks were used either without coating or coated with a collagen matrix kit (Gibco). Cells were incubated at 37 °C and 5% CO_2. Media were changed after cell attachment and afterwards every 48 hours.

Results

Isolation of keratinocytes was successful. However, separation of epidermal and dermal tissue was difficult, and an additional incubation for 1 hour at 37 °C was necessary. Cells incubated with different media and coating resulted in different growth of cells. In cells incubated with D-MEM without FBS and without coating, no attachment or growth was possible. Cells incubated with D-MEM with 5% FBS and without coating showed poor attachment and a slow growth rate. Cells incubated with CnT-07 medium in coated flaks were able to attach and grow. It was possible to sub-cultivate cells once (Figure 1). If keratinocytes were not sub-cultivated, cells started to grow three-dimensionally (Figure 2).

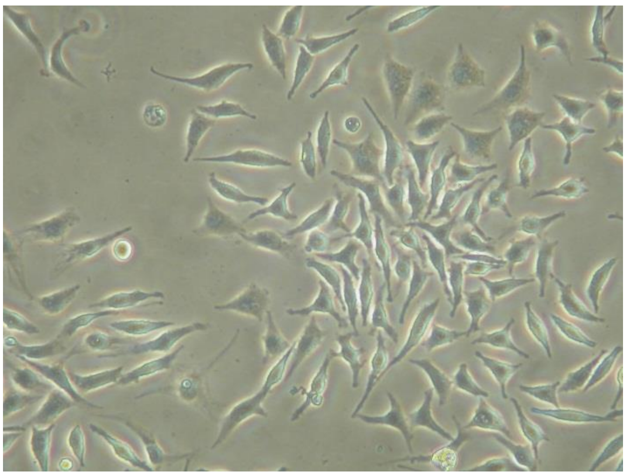


Figure 8 Sub-confluent monolayer of equine keratinocytes after first sub-cultivation.

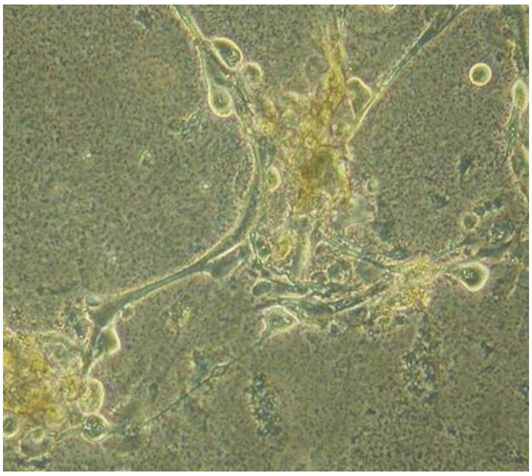


Figure 7 Co-culture of keratinocytes and fibroblasts without sub-cultivation showing three-dimensional growth.

Discussion

Isolation and cultivation of keratinocytes was successfully established, although some modifications are necessary. Concentration of dispase II should be increased to make separation of epidermal and dermal tissue easier. For attachment of keratinocytes, collagen coating is necessary. Medium composition needs to be improved for better cell growth.

Isolation and cultivation of keratinocytes is the first step to establish a complex *in vitro* model of bovine laminitis. This model can be used to study trigger factors like endotoxins (Bergsten 2003) and their influence on various parameters e.g. matrix metalloproteinase (Hendry *et al*. 2003) during laminitis *in vitro.*

References

Bergsten C 2003 Causes, Risk Factors, and Prevention of Laminitis and Related Claw Lesions *Acta Veterinaria Scandinavica* **44**(1):157-166

Hendry KA Knight CH Galbraith H and Wilde CJ 2003 Basement membrane integrity and keratinization in healthy and ulcerated bovine hoof tissue Journal Dairy Research 70:19-27

Hoffmann D 2006 Perfusionskammersysteme zur Entwicklung organotypischer Kokulturen boviner Fibrozyten und Keratinozyten aus der Klaue Dissertation Fachbereich Veterinärmedizin der Freien Universität Berlin

Nebel U 2005 In vitro Modelle proliferierender und differenzierender epidermaler Keratinozyten der Rinderklaue Dissertation Fachbereich Veterinärmedizin der Freien Universität Berlin

Nilsson SA 1982 Laminitis in cattle in comparison with equine laminitis Fourth International Symposium On disorders of the ruminant digit Paris

Pollitt, CC 1996 Basement membrane pathology: a feature of acute equine laminitis Equine Veterinary Journal 28(1):38-46.

Visser MB and **Pollitt** CC 2010 Characterization of extracellular matrix macromolecules in primary cultures of equine keratinocytes *BMC Veterinary Research* **6**:16

Wunn D Wardrop KJ Meyers K Kramer J and Ragle C 1999 Culture and characterization of equine terminal arch endothelial cells and hoof keratinocytes American Journal of Veterinary Research 60(1):128-32

P36(a). Optical properties evaluation of bovine hooves for phototherapeutic dosimetry optimization in laminitis treatment

FP Sellera[1], RG Gargano[1], CP Sabino[2], AM Deana[3], MS Ribeiro[2], RD Ollhoff[4], FC Pogliani[1]
[1] University of São Paulo, Brazil; [2] Center for Lasers and Applications, IPEN-CNEN/SP, Brazil; [3] Nove de Julho University – Biophotonics Program, Brazil; [4] Pontíficia Universidade Católica do Paraná, Brazil
fabiocp@usp.br

Introduction
Visible and near-infrared radiations have been widely employed in medical sciences over the last few decades. Even though most of the recently developed techniques are yet restricted to basic science in laboratories, biophotonics already became a powerful alternative tool in health sciences from diagnosis to therapeutics and phototherapy arise in this context as a potential approach.
Among the researched phototherapies, the low level laser therapy (LLLT) has been helping tissue repair through their biomodulation effects (Woodruff et al, 2004), and its application in inflammatory processes has been investigated mainly by causing reduction in the number of inflammatory cells (Whelan et al, 2001).
Laminitis is an aseptic, inflammatory and degenerative disease (Greenough, 2007), therefore, LLLT may be an useful tool for the treatment of laminitis and should be investigated as therapeutical method. However, depending on light parameters results could be unsatisfactory and/or null. The optical barriers characteristics located prior to the target tissue must be well known to apply an ideal dosimetry.
The aim of this study was to evaluate whether the radiation emitted by laser penetrates the bovine claw horn enabling future research on the treatment of laminitis with LLLT.

Materials and Methods
Five Holsteins cows were randomly chosen at slaughterhouse and pigmented and unpigmented claws were collected. Four samples from different anatomical regions extracted according to corium characteristics (i.e. periople and coronary band, lamenar and sole zones). Each sample was cut in 15mm wide squares and had the external surface sanded to remove environmental residues.
Spectroscopic measurements were carried out by a spectrophotometer coupled to a single integrating sphere. The spectra for transmittance and reflectance wavelengths were measured ranging from 350 nm to 1400 nm. The optical absorption, scattering and total attenuation coefficients were determined using an one-dimensional, two-flux Kubelka-Munk model.

Results
The attenuation coefficients were calculated originating the graph in Figure 1. We considered that an attenuation coefficient below 5 cm^{-1} indicates a high transmission of waves. This occurred between 600 to 1350 nm and is also known as an optical window, indicating the wavelengths that can be employed for phototherapeutic procedures.

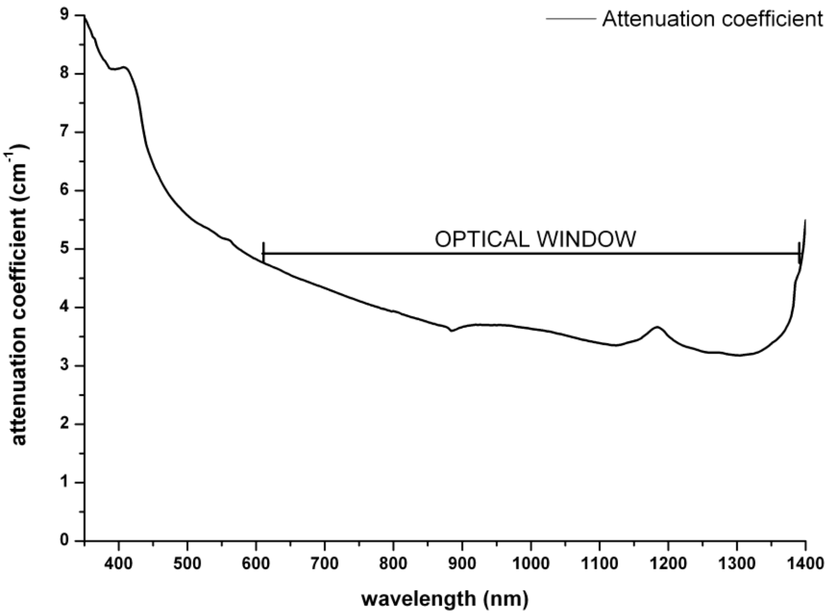


Figure 1 Optical window of bovine hooves.

Discussion
In the present study we evaluated the optical properties of pigmented and unpigmented Holstein cattle hooves to establish recommended irradiation parameters for phototherapies in cattle laminitis.
The radiation emitted by low level lasers with spectral interval ranging from 600 to 1350nm was denominated as optical window in all regions of cattle pigmented and unpigmented hooves. Once bovine hooves presented variable thickness, the most privileged light transmission anatomical site was the perioplic region. The results show that the radiation emitted by lasers pervade the hooves, making light in wavelengths between 600 to 1350 nm suitable to be tested in the treatment of laminitis or other claw injuries located in the tissue surrounded by the horn capsule, encouraging future studies.

References
Greenough PR 2007 Bovine laminitis and lameness: a hands-on approach. Elsevier, 311p.
Whelan HT, Smits RLJr, Buchman EV, Whelan NT, Turner SG, Margolis DA, Cevenini V, Stinson H, Ignatius R, Martin T, Cwiklinski J, Philippi AF, Graf WR, Hodgson B, Gould L, Kane M, Chen G, Caviness J 2001 Effect of NASA light-emitting diode irradiation on wound healing. Journal Clinical Laser Medicine and Surgery, 19(6):305-314.
Woodruff LD, Bounkeo JM, Brannon WM, Dawes KS, Barham CD, Waddell DL, Enwemeka CS 2004 The efficacy of laser therapy in wound repair: a meta-analysis of the literature. Photomed Laser Surgery, 22(3):241-247.

P36(b). Effect of hoof care products on hoof hardness

MB Gentilini[1], M Lopez-Benavides[2], TC Hemling[2], LR Molina[3], VM de Paula[3]
[1] DeLaval Ltda,Estácio de Sá,560, Jd. Sta. Genebra, Campinas SP, Brazil; [2]DeLaval Inc., 11100 N Congress Ave, Kansas City MO, 64153, USA; [3] University of Minas Gerais, UFMG, Av. Antônio Carlos,6627, Belo Horizonte MG, Brazil.
marianna.gentilini@delaval.com

Introduction
Claw lesions and lameness are of major concern in dairy farming. Claw hardness may influence the likelihood that a cow will suffer from claw lesions due to its influence on rate of horn wear and erosion. Anecdotally, some hoof bath products are indicated as positively or negatively impacting hoof hardness, but little supporting data exists. The objective of the study was to assess hoof hardness comparing 2 different hoof care products under field conditions.

Material and Methods
A 45 day trial was conducted in an open free stall commercial dairy farm in Minas Gerais, Brazil. For the study, 105 animals were enrolled in a split hoofbath design. Left hooves walked through 5 % (vol/vol) Formalin and right hooves through 4Hooves™ (DeLaval) at a 1% (vol/vol) dilution, once a day, three times a week. Three evaluations were performed in a standing hoof trimming chute: at the beginning of the experiment 30 days, and 45 days after. Hoof hardness was assessed using a durometer (Shore D DP-400, Instrutherm). Triplicate measurements of each hoof area were taken by pressing the instrument against 3 designated areas of the claw as shown in Figure 1. Average temperature during the experiment was 24,2°C and sum of precipitation was 152.7mm in November and 140.4mm in December. Data were analyzed using ANOVA for repeated measures using individual hooves as the experimental unit (MedCalc Software v.12.4.0).

Figure 1. Hardness measuring points. Point 1: the tip of the toe at sole midway between white line and claw edge. Point 2: midpoint at the apex of the sole. Point 3: abaxial wall

Results and Discussion
Results indicated no treatment differences in the hardness of claws occurred. However, hoof hardness changed in the same direction, regardless of treatment during the trial period (P<0.001) (Table 1). In both treatments, a significant decrease in hoof hardness could be seen from day 0 to day 30 (P<0.001) that also coincided with rainy episodes and higher humidity. Because of the open free stall design, it is hypothesized that hooves were exposed to increased environmental humidity. This may have increased absorption of water by the hoof that consequently reducing the structural integrity and reduced hardness of the hooves.

Table 1. Mean values (D units*) of hoof hardness (± StDv) of hooves soaked in 4Hooves™ or Formalin during the trial period

Treatment	Day 0	Day 30	Day 45
4Hooves™ (1%)	44.2 ± 0.3[a]	41.6 ± 0.4[b]	44.1 ± 0.4[a]
Formalin (5%)	44.0 ± 0.3[a]	41.5 ± 0.47[b]	45.2 ± 0.4[a]

[a-b]Means within a row or column with different superscripts differ (*P*<0.001). * D scale: range 0 - 100, higher values indicates harder material.

Conclusion

In this study, no difference on hoof hardness when using either 4Hooves™ or Formalin was observed. Results support previous findings that if hooves are kept under moist conditions they will become softer independently of product being used for hoof care management. The study raises questions in general to claims on the impact of hoof bath products on hoof hardness.

References

Borderas TF, Pawluczuk B, Passile AM, and Rushen J. 2004 Claw hardness in dairy cows: relationship to water content and claw lesions. J.Dairy Sci. 87:2085-2093.

Teixeira AGV, Machado VS, Caixeta LS, Pereira RV, and Bicalho, RC. 2010 Efficay of formalin, copper sulfate, and a commercial footbath product in the control of digital dermatitis. J.DairySci. 93:3628-3634.

P37(a). Pedal Bone dimensions in relation to hoof trimming protocols

R Blowey, B Inman[1]
[1]RVC, Hawkshead Lane, Hertfordshire.
rogerblowey@mailbox.co.uk

Introduction
Many texts have quoted dimensions for bovine hooves (Toussaint Raven 1985), leading to discussion as to the correct size to trim. The current study was an attempt to identify ‘normal values’ for pedal bone dimensions, and to enable a comparison of claws with lesions.

Materials and Methods
Barren cow legs selected at random from an abattoir, or from amputated digits, were boiled for eight hours, cooled, the pedal bones removed, and soaked in 10% formalin for two weeks before examination. Initial measurements were made using a manual gauge; these were later repeated using a Laser digital vernier caliper.

Results
Due to the method of processing at the abattoir it was not possible to be sure whether feet selected were front feet or hind feet. The description of ‘presumed medial’ and ‘presumed lateral’ is based on comparison of the two claws from each leg, on the assumption that the samples were from hind legs only, with ‘presumed lateral’ being the largest of the pair and ‘presumed medial’ being the smallest. In using this nomenclature it is accepted that some of the legs may have been front feet, where the medial claw is larger, and in some hind claws the larger claw may have been the medial. The disparity between the number of medial and lateral claws examined is due to the exclusion of all claws showing lesions. The category ‘claws with lesions’ included feet with visible lesions from the abattoir, plus claws derived from amputations.

		Number of measurements	**Lowest value (mm)**	**Mean (mm)**	**Highest value (mm)**
Length of dorsal wall	Presumed lateral	25	52.6	60.5	76.4
	Presumed medial	40	49.9	59.3	75.7
	From claws with lesions	49	40.0	62.5	84.7
Length of base of bone	Presumed lateral	25	66.8	81.1	99.6
	Presumed medial	40	63.3	80.4	101.4
	From claws with lesions	49	58.0	82.3	115.1

Discussion
From various texts (Tousaint Raven 1985; van Amstel and Shearer 2006; Blowey 2008) it would appear that most authors consider that the normal length of the dorsal wall of the hoof should be between 70 and 85mm, a variation of just 15mm (21%), and yet in our measurements we found that the dorsal wall of the pedal bone varied from 49.9mm to 76.4mm, i.e. a difference of 30mm, or 61% larger. Our measurements also demonstrate the disparity of bone size between the two claws of each foot. Our study has not related the dimensions of the hoof itself to the size of the pedal bone, but it is likely that a close relationship exits, as described by Bystron (pers,comm, 2013). Our results suggest that it may not be correct i) to trim claws to a fixed length; ii) to trim the two claws to the same size; and iii) particular care is needed when trimming feet with lesions. This work requires considerably more study.

References
Blowey R 2008 Cattle Lameness and Hoofcare, by Old Pond Books, p 35
Blowey R, Inman B 2012 Veterinary Record 2012, **171**, p 592-593
Greenough PR 2007 Bovine Laminitis and Lameness, by Saunders Elsevier, p175
Pijl R 2003 in Klauenprobleme Schneller Losen, by Landwirtschaftsverlag GmbH, p 9
Toussaint Raven, E 1985, Cattle Footcare and Claw Trimming, by Farming Press Ipswich, page 83.
Van Amstel SR, Shearer J 2006. Manual for Treatment and Control of Lameness in Cattle. Wiley-Blackwell. p 53.

P37(b). Do changes in pedal bones reduce the healing of hoof lesions?

R Blowey*, B Inman[1]
[1]RVC, Hawkshead Lane, Hertfordshire
rogerblowey@mailbox.co.uk

Introduction
One hypothesis for the failure of toe necrosis and other 'non-healing' lesions to resolve was that, in addition to the disruption of the corium by Treponemes, there was a proliferative osteitis of P3, and spicules of bone protruding from its solar surface further damaged the corium (Blowey 2011).

Materials and Methods
Claws from amputated digits (8) or selected from the abattoir (92) were boiled for eight hours, cooled, the pedal bones removed, and soaked in 10% formalin for two weeks before examination. The bones were examined visually to assess abnormalities and comparative measurements were made.

Results
The visual changes seen in the pedal bones, and the hoof lesions commonly associated with these changes, are shown in Table 1.

Table 1 Pedal bone changes and associated hoof lesions

Description of change in pedal bone	Associated hoof lesions
Spicules on solar surface	NH lesions
Enlarged extensor tuberosity	TN
Reduced bone length	TN
Thickened flexor tuberosity	SU
Reduced bone density	TN
Pedal bone fracture	TN
Increased thickness of pedal bone	WLD
Fusion of navicular and pedal bone	WLD
Fusion of P2 + P3	Chronic infections

Comparative measurements showed that, compared with normal claws, cows with sole ulcers had an increased pedal bone thickness at the flexor tuberosity of 2.4 mm ($p < 0.001$), and in cows with white line lesions the length of the base of the pedal bone increased by 10.6mm ($p = 0.001$)

Table 2 Median (Min-Max) pedal bone measurements from 92 claws

Variable	All Bones	No Lesions (65 claws)	All Lesions (WLD + SU)	WLD (8 claws)	SU (12 claws)
Base Length	80.56 (63.00-115.13)	79.00 (63.00-101.40)	84.65 (74.33-115.13)	89.65 (77.23-115.13)	83.84 (74.33-106.30)
Dorsal Wall Length	61.07 (49.90-84.65)	53.31 (49.90-76.43)	65.51 (56.00-84.65)	65.99 (56.00-84.65)	61.73 (56.03-78.37)
Flexor Tuberosity Height	20.42 (17.83-29.03)	20.03 (17.83-22.45)	22.76 (19.25-29.03)	23.82 (19.26-29.03)	22.38 (19.25-26.83)

Discussion
Reports of changes in the pedal bone are not new. Rusterholz (1920), quoted by Greenough (2007) suggested that sole ulcers might result from changes in the pedal bone. Radiographic studies by Zantinga (1973), quoted by Greenhough et al (1981) described osteolytic and not proliferative changes, and confirmed findings that not all sole ulcers are associated with pedal bone changes. Toussaint Raven(1985) and Weaver (1981) described an increased roughness of the lateral pedal bone as a normal feature of many older cows. Sharp spicules of bone protruding from the solar surface onto a corium already infected with BDD are likely to reduce its capacity to produce new hoof. Bone enlargement inside the restricted space of a claw must produce pain and reduced healing, thus explaining the findings of Groenvelt et al (2011) that

delayed treatment reduces recovery rates. Logic would suggest that prompt treatment using a shoe on the sound claw, and especially a shoe that is weight bearing on the wall, might reduce the probability of these bony changes from developing.

References

Blowey RW 2011 Non Healing lesions in Dairy Cows, *Veterinary Record* 2011 169: 534

Greenhough PR 2007 in Bovine Laminitis and Lameness , by Saunders Elsevier, p 86

Greenhough PR, MacCallum FJ and Weaver AD 1981 in Lameness in cattle, by Wright Scientifica, page 180

Groenvelt M, Bell NJ, Tisdall DA, and Main DCJ 2011 Quantifying the benefits of early detection and treatment, Proceedings: 16th Symposium on Lameness in Ruminants, NZ, March 2011

Toussaint Raven, E (1985), Cattle Footcare and Claw Trimming, by Farming Press Ipswich, p 29

Weaver A. D (1981) In Lameness in Cattle. Wright Scientifica. p 78.

P38(a). Investigation into the gross morphology of non-healing lesions on outdoor grazing farms in Southern Chile supporting amputation as a treatment

JP Acevedo[a], RN Chesterton[b]
[a] Toromiro S.A. [b] Inglewood Veterinary Services
chesterton@inspire.net.nz

Introduction

In 2008 toe necrosis (Blowey) and non-healing white line (Holzhauer, Cook and Burgi) were described. The resultant bony changes were described by Blowey in 2010.

In 2012 a large number (2000 in a herd of 19,000 cows) of chronic non-healing lesions were found in some pasture fed herds in Southern Chile. These non-healing lesions fitted the description of Blowey (2010). The treatment chosen for the 400 worst cases was amputation of the affected claw. This amputation provided an opportunity at the same time to confirm the extent of the internal damage due to this condition.

Aim

To view the extent of gross morphological changes on inner structures of the foot resulting from non-healing lesions, in order to support claw amputation as a means of treatment for non-healing lesions in pasture fed cattle.

Materials and Methods

A sample of claws with non-healing lesions were amputated and boiled. The bones were removed. Another sample of amputated claws were sawn in half.

Results

In all the chronic cases examined there was extensive change to the bone. There was bone autolysis under the site of the lesion and also extensive bone exostosis on areas of surrounding bone. There was no involvement of the joint capsule.

Figure 1. Non-healing White line

Figure 2. Bone exostoses

Figure 3. Bisected claw.

In only a few of the claws did it appear that there had been changes to the skin of the coronet above the non-healing lesion. In most cases there was no evidence of an entry point apart from the possibility of ascending from an injury point below or tracking upwards via the lamellae.

Viewing the bisected claws, spicules of the exotosis were seen “invading” the corium under the sole.

Discussion

The extent of the damage to bone under non-healing lesions was dramatic. There was permanent, irreversible damage, and an obvious welfare issue. How quickly the bone structures become involved was outside the present investigation, however, several young cows with chronic lesions had been in the herd less than 9 months.

Even in cases treated for more than a year the joint surfaces appeared normal. This suggested that the source of pain was more likely the bone exostoses, leaving no choice for the grazing cow apart from amputation or slaughter.

Because amputation of the claw seems to be the only treatment option left due to the damage, the main emphasis for non-healing lesions must be prevention, by minimizing damage, early treatment of claw injuries and control of BDD infection pressure.

References

Blowey RW 2008 Cattle Lameness and Hoofcare: An Illustrated Guide. Old Pond Publishing. pp 71-89

Blowey RW 2011 Non-healing hoof lesions in dairy cows (letter) Veterinary Record doi: 10.1136/vr.d7267

Cook N and Burgi K 2008 ‘Hairy attack’: a new lesion affecting the corium of the white line – a case report. Proceedings of the 15th International Symposium and the 7th Conference on Lameness in Ruminants. Kuopio, June 9 to 13, 2008. p 214

Holzhauer M 2008 Non-healing white line disorders, a new clinical presentation. Proceedings of the 15th International Symposium and the 7th Conference on Lameness in Ruminants. Kuopio, June 9 to 13, 2008, p 206

P38(b). Sole thickness in heifers in Southland

R.A. Laven[1], L.J.Laven[1], M. Bryan [2]
[1] IVABS, Massey University, Palmerston North; [2] VetSouth, Winton, Southland
r.laven@massey.ac.nz

Introduction

Excess hoof horn wear is considered to be an important cause of lameness in New Zealand cattle, particularly heifers. However there has been little objective measurement of its importance, particularly its impact on sole thickness

Ultrasound measurement of the distance from the sole surface to the distal phalanx (DDP) is a useful method of assessing sole thickness (Laven et al 2012). In a single farm study, mean DDP decreased between calving and mid-lactation, but thin soles at calving tended to thicken after calving. Further studies on more farms are needed to provide better baseline data. This study evaluated the changes of DDP over lactation in heifers from four farms.

Materials and Methods

In each of four spring-calving pasture-based dairy herds in Southland, New Zealand, 20 early-calving heifers were selected. Measurements were made at 10, 60, 110, and 160 days post calving (dpc) (Laven et al 2012). Briefly, the probe was applied to the sole perpendicular to a line from the abaxial groove to the axial border. Estimates for DDP were taken at the tip of the distal phalanx. Claws were identified as thin, marginal, and adequate as described by Laven et al (2012).

Results

In all four herds mean DDP decreased between day 10 and day 110, but the pattern of change varied ($p<0.001$) (Figure 1).

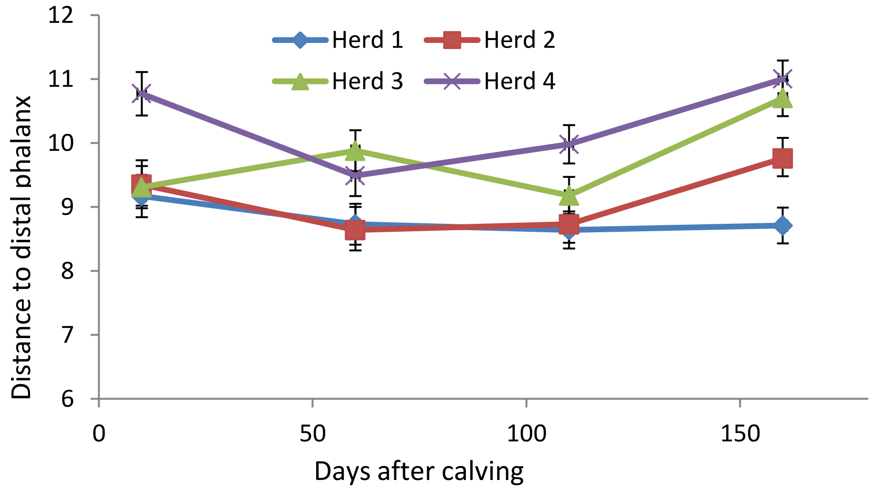


Figure 1. Effect of time after calving on mean DDP of lateral claw of right hind foot

Eleven heifers in two herds had thin claws (DDP < 7 mm at any timepoint). Thirty-six had marginal claws (DDP < 8.25 mm at any time). No heifers had a thin sole at more than two timepoints and only one heifer had at a marginal sole at every timepoint

Increased DDP on day 10 was associated with an increased loss of DDP after calving ($r^2 = 0.477$, $p<0.001$); this association was affected by herd ($p<0.005$) (Figure 2).

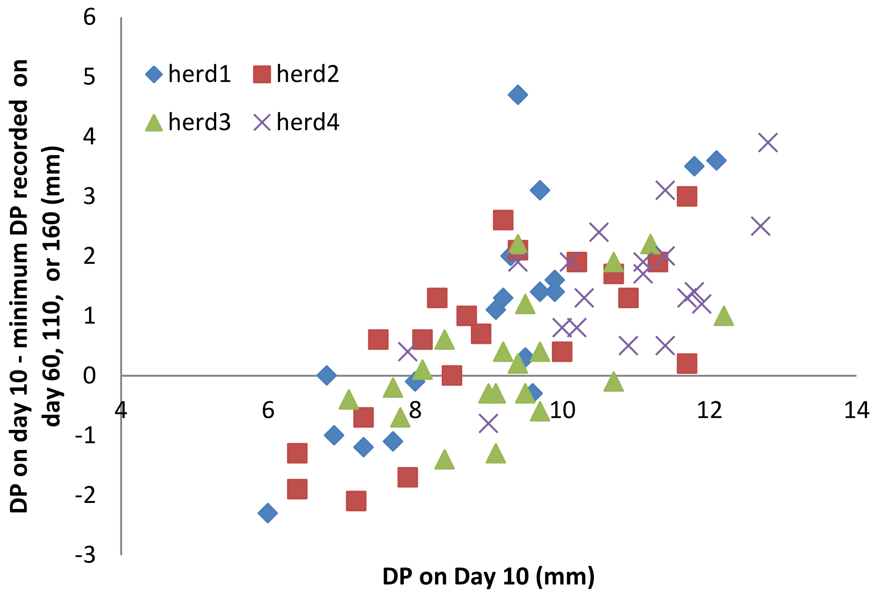


Figure 2. Association between day 10 DDP and minimum subsequent DDP.

Discussion

Ultrasound measurement of DDP was easily applied in the field. Compared to Laven et al (2012), mean DDP on day 10 was greater in these four herds (herd means 9.3 to 11.3 mm cf. 8.8 mm), but the pattern of change was similar.

There were significant differences in DDP within and between herds, even for DDP on day 10, despite all heifers on all farms having been reared on pasture. More research is needed to establish the cause of these differences.

Herd mean DDP on day 10 was a good predictor for the risk of thin soles. Nevertheless, such an effect is not inevitable; herd 3 had fewer thin soles than would have been predicted. Further research on how management after calving affects DDP is needed.

Excess wear was not an issue on any farm. Two farms had no thin soles, and on the other farms no more than three (herd 1) or two (herd 2) heifers had thin soles at any single timepoint. Furthermore heifers with thin soles at calving lost less DDP than heifers with thicker soles –sole growth was able to overcome increased early lactation wear.

Acknowledgements

Staff on all four farms and the tech team at VetSouth. Supported in part by NZ Dairy Cattle Vets.

References

Laven LJ, Laven RA, Parkinson TJ, Lopez-Villalobos N and Margerison JK 2012 An evaluation of the changes in distance from the external sole surface to the distal phalanx in heifers in their first lactation. The Veterinary Journal 193:639-43.

Session 11

Lameness Intervention Programmes

and

Risk Factors for Lameness

60. Building a national lameness management programme

D Colson[a]
[a] The Vet Group, 132a Ziegler Parade, Allansford, Victoria, Australia 3277
dcolson@thevetgroup.com.au

Introduction

Under the National Dairy Industry Animal Welfare Strategy the Australian Dairy Industry has a goal to minimise lameness by encouraging farmers to adopt practices for prevention, early detection and effective treatment on farm. A 2012 report of an investigation into the development of a lameness assessment and management program for Australian dairy farmers recommended the following:

- The industry should develop a national program to assist individual farms to manage lameness on farm
- The industry should consider the development of a national system for recording and analysing the incidence, prevalence and types of lameness on farm.
- A Steering Committee should be formed to oversee a Working Group (fig 1) to drive the development, implementation and promotion of a national lameness programme

This paper describes the decisions behind and the process of designing a National Program aimed at creating change management in the Australian Dairy Industry.

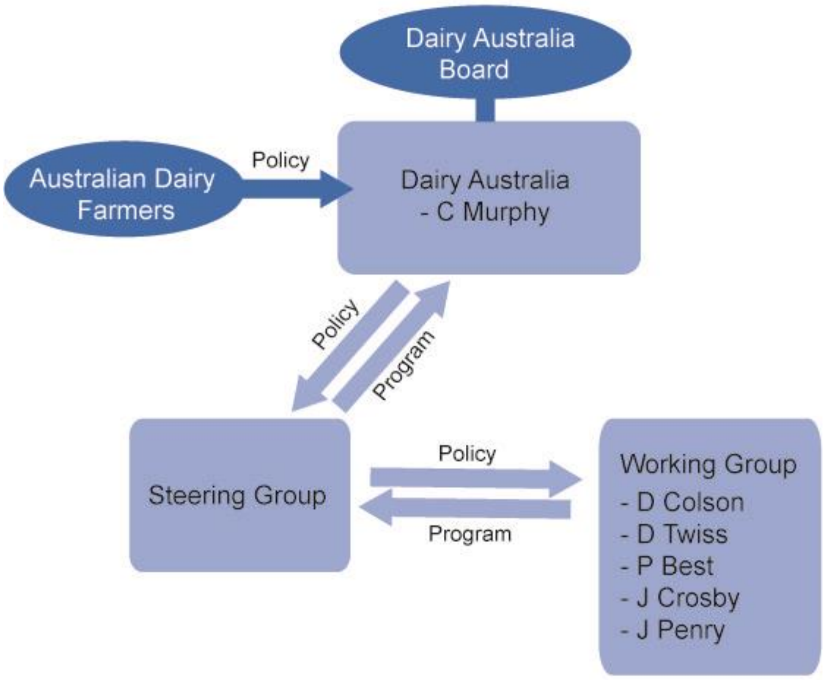


Figure 1 National Lameness Project organisational plan

Materials and Methods

The National Lameness Project Steering Group acts under the Terms of Reference developed by Dairy Australia. The steering group has autonomy in its project design and projects recommended by the steering group are funded by the parent body (Dairy Australia).
Using the process described in the "Development Led Innovation" Paper (Brightling et al 2010), the Steering group created a project design for Australia's National Lameness Program.
The framework for the development of this program follows the principles established in this paper and follows many of the features used for the development of the highly successful "Count Down Down Under" mastitis control program (Brightling et al 2009)
In Summary:

- Develop a business case =DEVELOP
- Understand the business of the key players =UNDERSTAND THE DOMAIN
- Decide on the nature of change =ESTABLISH GOALS
- Identify features of the enabling environment =INDUSTRY/SYSTEM CAPACITY
- Examine & Design the route to change =PROCESSES
- Pilot & refine =TEST

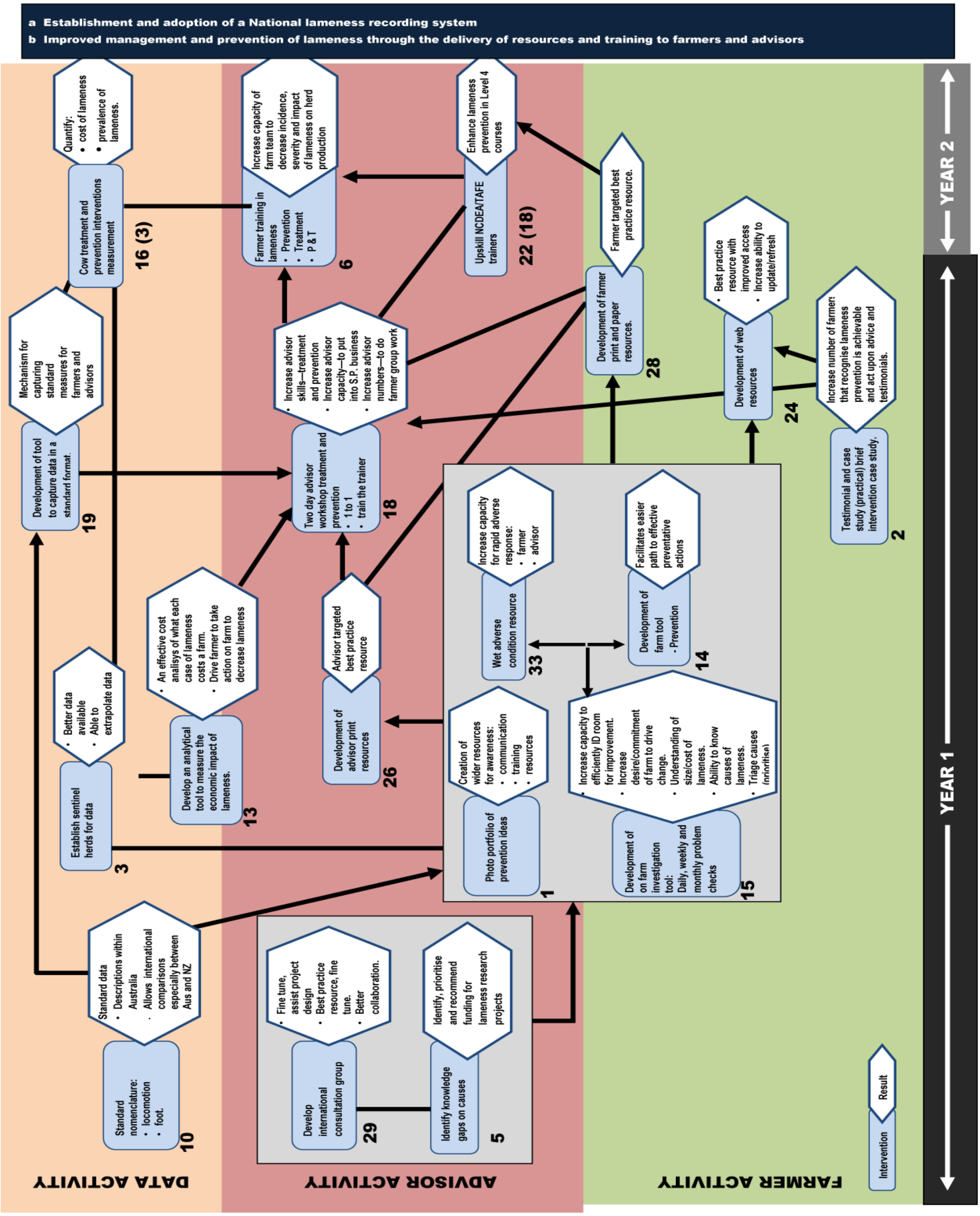


Figure 2. National Lameness Project Roadmap

Results

At the time of writing the steering group has created a roadmap for the project, the “project on a page” (Fig 2) concept as described as critical to the development phase of a change management project in the “D-Led Innovation” paper.

This Document is based upon a series of 18 interrelated project elements which are combined to create a project which instructs the project development team on the priorities over the initial 2 years of the project, which is due to commence receiving funding on July 1, 2013.

Discussion

Lameness is an important animal welfare issue for the dairy industry that also has significant productivity and profitability impacts. The early detection and treatment of lame cows is crucial to ensure animal well-being and minimise farm business' costs however accurate detection of lameness by farmers is thought to be poor. While there are many resources available for farmers to support them in addressing lameness on farm its multi-factorial nature presents practical challenges for farmers in the adoption of appropriate prevention and treatment protocols.

Note

Healthy Hoof – Farmer Extension Package Hardcopy available upon request from Dairy Australia
Healthy Hoof – Advisor Support Package Electronic version available upon request from Dairy Australia

References

Brightling PB, Dyson RD, Hope AF and Penry J 2009 A national programme for mastitis control in Australia: Countdown Downunder" Irish Veterinary Journal, 62(Suppl 4):S52-58).

Brightling PB, Hope AF, Nettle R and Coats S 2010 Development-led Innovation. A new model for operationalizing RD&E, Dairy Australia Internal Document

61. Inclusion of lameness and other welfare outcomes into UK dairy farm assurance schemes

M.C. Crawley[b], J. Avizenius[c], D. Kennedy[d], D.C.J. Main[a]
[a]University of Bristol Veterinary School, Langford BS40 5DU, UK; [b] Soil Association, South Plaza, Marlborough Street, Bristol BS1 3NX, UK; [c] Royal Society for the Prevention of Cruelty to Animals, Wilberforce Way, Southwater, Horsham, West Sussex, RH13 9RS UK; [d]Red Tractor Assurance Dairy Scheme, Hestan House, The Crichton, Dumfries, DG1 4TA
d.c.j.main@bristol.ac.uk

Introduction

Farm assurance schemes are essential to provide consumers with assurance of compliance with animal welfare, food safety and environmental standards, throughout the food chain. Scheme membership is associated with better compliance with welfare legislation requirements (KilBride et al. 2012). However, despite very high proportions of UK dairy farms having farm assurance membership, levels of important welfare outcomes, such as lameness, remain a challenge. This has been recognised by industry within the GB Dairy Cow Welfare Strategy (NFU, 2010) which promotes the implementation of the DairyCo Healthy Feet Programme (Main et al. 2012a) and includes the specific action: “Future [farm assurance] standards to incorporate welfare outcome measures”. This strategy coincided with the start of the AssureWel project, a collaborative project led by the University of Bristol, Royal Society for the Prevention of Cruelty to Animals and Soil Association, which promotes the application of welfare outcomes into schemes (Main et al. 2012b). AssureWel has worked closely with the Red Tractor Assurance dairy scheme which certifies 85% of UK dairy farms.

Implementation into schemes

After industry consultation and two pilot studies, assessors from three UK dairy farm assurance schemes (Red Tractor Assurance, Freedom Food and Soil Association Certification) will be routinely assessing outcome measures during every farm visit (table 1). Measures were chosen based on their welfare importance and ability to improve the assessment of existing standards. Ensuring assessment methods are harmonised across industry and, where possible, equivalent to existing UK industry standards such as the DairyCo mobility score, has been a priority.

Schemes assessors are trained through a combination of on-line and on-farm training. Twenty cows are observed on each farm, some cows in conjunction with the farmer. This provides results which give very high confidence of scheme level estimates of the prevalence of measures. The much higher number of cows that would need to be sampled on each farm to provide similar farm level confidence was not considered feasible. Consequently farm results are used to initiate further investigation and promote action on individual farms but not to directly influence certification decisions.

Discussion

The GB dairy cow welfare strategy aims to encourage farmers to improve the welfare of commercially farmed dairy cattle. Incorporating outcome assessments within schemes has been designed to promote necessary husbandry changes. For example, where high levels of lameness are observed on farm, the assessor can ensure that appropriate corrective action has been taken at both herd and individual cow levels. The assessment is being promoted as a useful routine management tool and the joint assessment of cows by farmer and assessor aims to highlight this. As the schemes are accredited against the EN45011 standard, assessors must not give specific instruction on possible solutions (Main et al., 2012b) but are trained in how to engage farmers in a motivating discussion and signpost appropriate sources of advice e.g. DairyCo Healthy Feet Programme.

References

KilBride AL, Mason SA, Honeyman PC, Pritchard DG, Hepple S, Green LE 2012 Associations between membership of farm assurance and organic certification schemes and compliance with animal welfare legislation. The Veterinary Record 170: 152.

Main DCJ, Leach KA, Barker ZE, Sedgwick AK, Maggs CM, Bell NJ, Whay HR 2012a Evaluating an intervention to reduce lameness in dairy cattle. Journal of Dairy Science, 95: 2946-2954.

Main DCJ, Mullan S, Atkinson C, Bond A, Cooper M, Fraser A, Browne WJ 2012b Welfare outcome assessments in laying hen farm assurance schemes. **Animal Welfare** 21: 389-396.

Table 1. Summary of the measures and sampling strategy to be used on Freedom Food, Soil Association and Red Tractor certification schemes. Full description of measures and scoring sheets available at www.assurewel.org.uk.

Individual measures	
1a. Mobility – individual scoring **2. Body condition** **3. Cleanliness** **4. Hair loss, Lesions** **5. Swellings**	• Assessed on **20 cows** from the dairy herd, sampled randomly from **all groups of milking cows** by assessor. Lying cows need not be included if it might risk their welfare. • **3** or more cows out of the 20 to be assessed jointly with the stockperson (record assessor's score only).
Herd measures	
6. Broken tails * **7. Response to stockperson**	• Assessed across **all milking cows.**
All animals on farm	
8. Cows needing further care *	• Assessed across **all animals on farm.** • For example identify any mobility score three cows not receiving adequate care / treatment.
Records measures	
1b. Mobility – assessment * + **9. Mastitis** **10. Calf / Heifer survivability** **11. Cull and Casualty Cows**	• From records.

* Soil Association & Freedom Food only + Red Tractor Assurance will introduce in 2015

62. Outbreak-specific monovalent/bivalent vaccination for treatment, control and eradication of virulent footrot in sheep flocks in Australia

O Dhungyel[a], R Whittington[a]
[a]Faculty of Veterinary Science,The University of Sydney, Australia
om.dhungyel@sydney.edu.au

Introduction

Virulent footrot results from the interaction of the essential causative bacterium *Dichelobacter nodosus* with the living hoof epithelium in susceptible sheep following warm, moist, environmental conditions (Beveridge 1941, Egerton et al 1969). Apart from direct economic losses due to reduced production and control costs, there is a very significant animal welfare concern in outbreaks of virulent footrot and control of the disease is often justified (Green and George 2008, Egerton et al 2002). D. nodosus is a strict parasite of hoof epithelium and its removal from a flock is the principle on which footrot eradication is based. Vaccinal immunity is related to the level of antibodies against *D. nodosus* pili or fimbriae which determine the ten serogroups (A,B,C,D,E,F,G,H,I and M) (Claxton 1989) . Immunity is serogroup-specific and multiple serogroups are common in affected sheep flocks in Australia (Dhungyel, 2013). Ideally vaccines would contain antigens representing all ten serogroups. However, this leads to poor efficacy due to "antigenic competition" and so mono- or bi-valent vaccine is preferable (Raadsma 1994) . The aim of this study was to evaluate the use of outbreak specific vaccination in commercial sheep flocks in Australia to control and eradicate virulent footrot.

Materials and Methods

A longitudinal intervention study was conducted in 12 commercial sheep flocks of southeast Australia with flock sizes of approximately 1200 – 4200 sheep to evaluate the use of sequential monovalent or bivalent vaccines to control/eliminate/eradicate virulent footrot.

Table 1 Summary of initial prevalence of footrot and the serogroups of *D. nodosus* detected on each farm. Isolates of the serogroups shown were classified as virulent or benign (shown in parentheses) based on tests for protease activity

Farm/ Flock	Location	Pre Trial Prevalence %	Post Trial Prevalence %	P value[2]	No. of virulent serogroups identified prior to vaccination[3]	Serogroups identified (benign)
A1	Kangaroo Island, SA	50	Nil	<0.001	1	A, (C), (D)
A2	Kangaroo Island, SA	40	Nil	<0.001	4	A, B, C, D, (E)
A3	Lucindale, SA	35	2.7	<0.001	6	A, B, C, D, H, I
A4	Adelaide Hills, SA	31	0.4	<0.001	2	E, H
B1	King Island, TAS	88	1.9	<0.001	7	A, B, E, G, H, I, M, (C)
B2	King Island, TAS	85	3.9	<0.001	5	A, B, G, H, M (D)
B3	King Island, TAS	31	11.2	<0.001	6	A, B, C, D, E, G
C1	Kangaroo Island, SA	79	Nil	<0.001	5	A, B, C, D, E
C2	Kangaroo Island, SA	88	3.7	<0.001	4	A, C, G, H
D1	Seymour, VIC	39	44*	0.732*	5	D, E, F, G, H
D2	Fingal, TAS	47	4	<0.001	6	A, B, D, E, G, H
D3	Launceston, TAS	45	Nil	<0.001	2	G, I

[1]Prevalence of sheep with at least one foot with a lesion of score $\geq$2. [2]Comparision of pre trial prevalence with post trial prevalence. [3] Serogroups with at least one virulent isolate of *D. nodosus*
*Trial discontinued

Results and Discussion

Where there were only 1 or 2 serogroups (3 farms) the clinical response was rapid and dramatic; prevalence was reduced from 45-50% before vaccination to 0% (2 farms) or 0.4% (1 farm) after one round of vaccination (Table 1). In the remaining 9 flocks there were more than 2 serogroups and successive bivalent vaccines (sequential vaccination) were administered leading to eradication of virulent footrot on 2 farms over 4 years and control of the disease on all but 3 of the others (Table 1). Of the latter farms, 1 discontinued, and 2 initially had poor response to vaccine due to misdiagnosis of serogroup 'M', which was previously unknown in Australia. Control was achieved after administration of a serogroup M vaccine (Table 1). These results provide clear evidence for control, elimination and eradication of virulent footrot by outbreak-specific vaccination in Australia.

References

Beveridge WIB 1941 Foot-rot in Sheep: a Transmissible Disease due to Infection with Fusiformis nodosus (n.sp.). Studies on its Cause, Epidemiology and Control. Bulletin No. 40. Melbourne: Council for Scientific and Industrial Research.

Egerton JR, Roberts DS, Parsonson IM 1969 The aetiology and pathogenesis of ovine footrot. I. A histological study of the bacterial invasion. Journal of Comparative Pathology 79:207-16.

Green LE, George TR 2008 Assessment of current knowledge of footrot in sheep with particular reference to Dichelobacter nodosus and implications for elimination or control strategies for sheep in Great Britain. Veterinary Journal 175(2):173-80.

Egerton JR, Ghimire SC, Dhungyel OP, Shrestha HK, Joshi HD, Joshi BR 2002 Eradication of virulent footrot from sheep and goats in an endemic area of Nepal and an evaluation of specific vaccination. The Veterinary Record 151(10):290-5.

Claxton PD 1989 Antigenic classsification of Dichelobacter nodosus. In: Egerton JR, Young WK, Riffkin GC, editors. Footrot and Foot Abscess of Ruminants. Boca Raton: CRC Press Inc, pp 155-66.

Dhungyel O, Schiller N, Eppleston J, Lehmann D, Nilon P, Ewers A 2013 Outbreak-specific monovalent/bivalent vaccination to control and eradicate virulent ovine footrot. Vaccine 25;31(13):1701-6.

Raadsma HW, O'Meara TJ, Egerton JR, Lehrbach PR, Schwartzkoff CL 1994 Protective antibody titres and antigenic competition in multivalent Dichelobacter nodosus fimbrial vaccines using characterised rDNA antigens. Veterinary Immunology and Immunopathology 1994;40(3):253-74.

63. How does reviewing the evidence change vets' beliefs regarding the treatment of ovine footrot?

HM Higgins[1], LE Green[2], MJ Green[1], J Kaler[1]
[1] University of Nottingham, School of Veterinary Medicine and Science, Sutton Bonington, LE12 5RD, UK
[2] School of Life Sciences, University of Warwick, Coventry, CV4 7AL, UK
helen.higgins@nottingham.ac.uk

Introduction

In the UK, a common treatment for footrot has been to pare the hoof horn (foot trimming) and apply a topical antibacterial. However, evidence from recent studies suggests that the combined use of a systemic and topical antibacterial offers a substantially better cure rate. The aim of this study was to capture vets' clinical beliefs regarding the difference in cure rate from lameness, within 5 days of receiving one of these two treatments, pre- and post-exposure to a review of the current evidence.

Methods

Workshops were conducted with 6 UK vets holding ovine post-graduate qualifications (Group 1), and 5 vets without (Group 2). During one-to-one interviews, a statistical technique called 'probabilistic elicitation' was used to capture the vets' beliefs in a numerical format, as probability distributions. Subsequently, vets' beliefs were re-captured (individually and numerically), after they had been presented with a review of the current evidence. Following a group debate, a consensus opinion was also obtained, again probabilistically. Qualitative information contextualized the findings; transcripts of the discussions were subjected to thematic analysis.

Results

In both groups, there was substantial variation in vets' beliefs before the review. For Group 1, vets' 95% Bayesian credible intervals covered a range from an 88% difference in favour of systemic therapy to 33% in favour of foot trimming; for Group 2 the range was 83% in favour of systemic therapy to 70% in favour of foot trimming. Both groups contained one vet who entirely favoured foot trimming, in that they assigned no probability to systemic therapy offering a better cure rate.

After the evidence review 7 out of the 11 participants quantifiably, and in some cases markedly, altered their beliefs, and all vets subsequently entirely favoured systemic therapy. Moreover, whilst considerable diversity in individual opinion still remained, both groups achieved a consensus view.

Key findings from the qualitative data were: (i) vets believed that farmers are unlikely to actively seek advice on lameness, suggesting a pro-active veterinary approach is required (ii) more attention could be given to improving the way in which veterinary advice is delivered to farmers (iii) the practicalities of catching lame sheep in large flocks is a barrier to prompt treatment.

Discussion

The results suggest that a considerable amount of the variation in vets' beliefs related to differences in their knowledge of the current evidence base; it supports the view that improved transfer of research knowledge into veterinary practice is needed. The results also showed that the evidence that exists is capable of changing opinion. Possible reasons for the remaining heterogeneity in clinical beliefs include: (i) differences in clinical experiences and how compatible the current evidence is with participants' original beliefs (ii) differences in the perceived biological plausibility of the two treatments (iii) the strength of evidence provided (iv) differences in personality types. This study has demonstrated a practical method for quantifying how vets' beliefs change.

Acknowledgments

Our thanks go to those involved with the workshops. HM Higgins is funded by a Wellcome Trust fellowship.

References

Higgins HM, Green LE, Green MJ and Kaler J 2013 How does reviewing the evidence change veterinary surgeons' beliefs regarding the treatment of ovine footrot? A quantitative and qualitative study. *PLoS ONE 8(5): e64175.* http://dx.plos.org/10.1371/journal.pone.006417

64. An investigation into the association between lameness and hair loss on the hock, in a longitudinal study

PY Lim[1,2], JN Huxley[1], MJ Green[1], AR Othman[2], SL Potterton[1], J Kaler[1]
[1] The University of Nottingham, School of Veterinary Medicine and Science, Sutton Bonington Campus, Sutton Bonington, Leicestershire, LE12 5RD, UK, [2] Universiti Sains Malaysia, 11800, Pulau Pinang, Malaysia.
svxpl@nottingham.ac.uk

Introduction
Hock lesions have been reported as positively associated with lameness; both are welfare concerns in dairy cattle (Kielland, et al. 2009). The cause and effect of the relationships between hock lesions and lameness remains unknown, lameness may precede the development of hock lesions, or vice versa. The aim of this study was to investigate the association between lameness with the presence of hair loss on the hock and other related factors.

Materials and Methods
Holstein-Friesian heifers calved between July 2008 and July 2009 were recruited from three herds which housed adult cattle in cubicles with mattresses bedded with sawdust. Herds were located in Nottinghamshire (n=2) and Northamptonshire (n=1) and were visited monthly from September 2008 until March 2010. The body condition score, mobility score and cleanliness score of all recruited animals were measured monthly. The degree of hair loss on both hocks were recorded using a scoring system (score 0-3) described previously (Huxley & Whay 2006). Milk records were provided by farmers. The outcome variable of a logistic regression model was no hair loss (hock score 0) and any hair loss (hock score 1-3). A lameness predictor with five categories was included in the model: lameness for three continuous visits (previous (t-1), current (t) and next visit (t+1)) was assessed. Category 1: not lame at three continuous visits; Category 2: not lame at previous and current visits, being lame at next visit; Category 3: lame at previous and recovered at current visit; Category 4: not lame at previous and being lame at current visit; Category 5: lame at previous and current visits. Other predictors with $p \leq 0.05$ were retained in the final model.

Results
Twenty three, 30 and 17 animals were selected from herds 1, 2 and 3 respectively. A total of 1475 records (739 records for left hocks and 736 records for right hocks) were used in the analysis. The logistic regression model is presented in Table1. Cows which were lame at the previous visit and recovered (OR: 8.65; 95%CI: 2.07-36.26) or continue to be lame (OR: 7.01; 95%CI: 2.15-22.89) at the current visit had higher odds of having hair loss on the hocks compared with the cows not lame at three continuous visits respectively. Farm 3 (OR: 7.46; 95%CI: 1.27-43.77) had higher odds of having hair loss on the hocks compared with Farm 1. Milk yield and cleanliness score were both associated with having hair loss on the hock.

Discussion
Our provisional results suggest that cows which are detected as lame in the previous month (whether they are lame or recover in the current month) had a higher risk of having hair loss on the hock in the current month compared with animals which were not lame in the previous and current month. Our provisional results imply that lameness precedes hair loss on the hock i.e. lame cows develop hair loss rather than hock hair loss makes animals lame in the future.

References
Huxley JN, and Whay HR 2006 Cow based assessments Part 2: Rising restrictions and injuries associated with the lying surface. *UK Vet* **11** 1-5.
Kielland C, Ruud LE, Zanella AJ, and Osteras O 2009 Prevalence and risk factors for skin lesions on legs of dairy cattle housed in freestalls in Norway. *Journal of Dairy Science* **92:** 5487-5496.

Table 1. The list of predictors in the logistic regression model

Variable	Categories	Frequency	Coefficient	Odd ratios	P value	Confidence interval	
						lower	upper
Intercept		1475	0.61				
Left/right	Left	739	Ref.				
	right	736	-0.25	0.78	0.37	0.45	1.34
Milk yield (kg)	3.0-21.7	326	Ref.				
	21.8-27.2	327	1.17	3.22	*<0.001	1.43	7.24
	27.3-32.1	320	1.47	4.35	*<0.001	1.60	11.82
	32.2-48.0	321	1.88	6.56	*<0.001	2.00	21.56
Cleanliness score	0-5	513	Ref.				
	6-7	739	0.62	1.85	0.07	0.95	3.61
	8-11	211	1.12	3.06	*0.04	1.08	8.66
Farm	1	593	Ref.				
	2	508	1.27	3.57	0.10	0.79	16.14
	3	374	2.01	7.46	*0.03	1.27	43.77
Lameness (t-1,t,t+1)	Not lame at three visits	474	Ref.				
	Not lame at previous and current visits, being lame at next visit	64	0.15	1.16	0.79	0.39	3.46
	Lame at previous visit and recovered at current visit	82	2.16	8.65	*<0.001	2.07	36.26
	Not lame at previous visit and being lame at current visit	102	0.50	1.66	0.34	0.59	4.62
	Lame at previous and current visits	211	1.95	7.01	*<0.001	2.15	22.89

*P≤0.05

65. The relationship between body condition score and mobility score in dairy cows on four commercial UK farms

DA Tisdall[1,2], WJ Brown[1], M Groenevelt[1,2], NJ Bell[3], DC Barrett[1], DCJ Main[1]
[1]University of Bristol, School of Veterinary Science, Langford House, Langford, Bristol, UK, BS40 5DU;
[2]Langford Veterinary Services Farm Animal Practice, Langford House, Langford, Bristol, UK, BS40 5DU;
[3]The Royal Veterinary College, Stinsford Farmhouse, Kingston Maurward College, Dorchester, Dorset, UK, DT2 8PY
david.tisdall@bristol.ac.uk

Introduction

Mobility scores (MS) have been widely used as a research tool to both monitor lameness in dairy cattle and guide interventions at both the herd and cow level (Leach, et al. 2012, Main, et al. 2012). However, the regular, frequent collection and evaluation of these with simultaneous body condition scores (BCS) has been uncommon. A reduction in digital cushion thickness, which is related to body condition score, has been associated with an increased prevalence of claw horn lameness (Bicalho, et al. 2009). This study aims to evaluate the relation between BCS and MS over time.

Materials and Methods

As part of a study which quantified the effects of early treatment for hindlimb lameness in dairy cows (Leach, et al. 2012), simultaneous, fortnightly MS and BCS were collected at milking on four commercial dairy farms, between June 2008 and April 2009. The DairyCo MS (Bell & Huxley 2009, DairyCO 2013) and the Penn-State University BCS were used (DairyCO 2011, Edmonson, et al. 1989).
At each score, cows were categorised as lame (MS>=2), very lame (MS=3), thin (BCS<=2) and very thin (BCS<2). A logistic regression model was fitted: farm, days in milk (DIM), parity (1 and >1), lameness event number and outcome variable-specific time at risk were included. Lame, very lame, thin and very thin categories were then modelled as predictors both at the time of each scoring event and for the previous four score events. Odds ratios were used to describe the increase in risk for both lame and thin scores. P values less than 0.05 were considered significant.

Results

6617 body condition scores and 6353 mobility scores, representing 1060 dairy cows were collected, of which, 6283 were simultaneous.
Cows scored as thin had a significantly higher risk of being simultaneously scored lame, compared to non-thin cows (OR 1.383, P<0.010), with an even greater risk in very thin cows (OR 1.576, P<0.010) (Figure 1). Similarly, cows scored as lame or very lame had a significantly higher risk of being simultaneously being scored as thin (OR 1.47, P<0.001 and OR 2.43, P<0.00001, respectively), with the greatest risk for very lame cows (Figure 2).

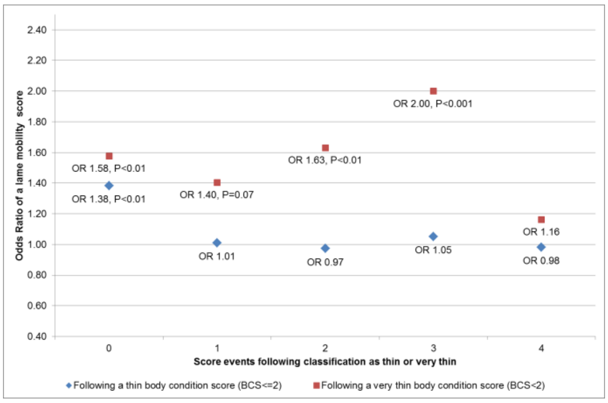


Figure 1. Odds ratios of receiving a lame mobility score at scores after receiving a thin or very thin body condition score. P values where significant are shown.

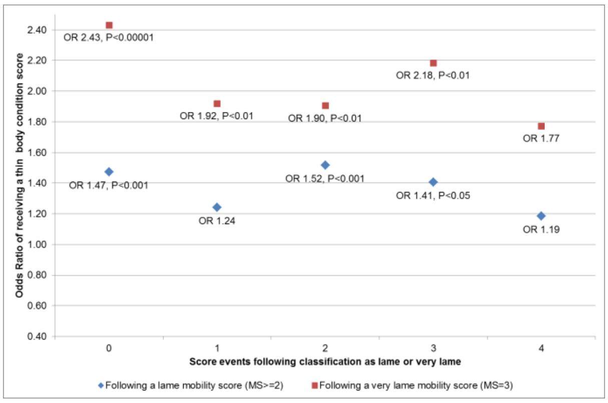


Figure 2. Odds ratios of receiving a thin body condition score at score events after receiving a lame or very lame mobility score. P values where significant are shown.

Very thin cows had an increased risk of being scored lame at each of following three scores: the effect was highly significant at scores two (OR 1.63, P<0.010) and three (OR 2.00, P<0.001), though not at score one (OR 1.41, P=0.078). This effect was not observed for thin cows. The future increased risk of a thin BCS associated with very lame cows was highly significant at score events one (OR 2.43, P<0.00001), two (OR 1.92, P<0.01) and three (OR 1.9, P<0.01).

Discussion

These results emphasise the close and complex relationship that exists between BCS and MS. In general higher MS increased the risk for a lower BCS and vice versa, though the magnitude of the risk of lameness for thinness appears greater than the reverse; particularly in the longer term. In part this may be a lag effect resulting from the slower rate of change of BCS compared to MS.

The increase in risk is greatest for simultaneous scores, while long term risk appears related to the initial severity. At farm level the balance of risk is likely to be influenced by both the aetiology of lameness and the nutrition and feeding systems.

Acknowledgments

The authors would like to acknowledge the generous funding of the Dartington Cattle Breeding trust, alongside the support of participating farmers and the staff of Langford Farm Animal Practice.

References

Bell N, Huxley J 2009 Locomotion, lameness and mobility in dairy cows. *Veterinary Record* 164: 726.

Bicalho RC, Machado VS, Caixeta LS 2009 Lameness in dairy cattle: a debilitating disease or a disease of debilitated cattle? A cross-sectional study of lameness prevalence and thickness of the digital cushion. *Journal of dairy science* 92: 3175-3184.

DairyCO 2011 Body Condition Scoring, p^pp. DairyCO: www.dairyco.org.uk

DairyCO 2013 Mobility Scoring, p^pp. DairyCO: www.dairyco.org.uk

Edmonson AJ, Lean IJ, Weaver LD, Farver T, Webster G 1989 A Body Condition Scoring Chart for Holstein Dairy Cows. *Journal of dairy science* 72: 68-78.

Leach KA, Tisdall DA, Bell NJ, Main DC, Green LE 2012 The effects of early treatment for hindlimb lameness in dairy cows on four commercial UK farms. *Vet J* 193: 626-632.

Main DCJ, Leach KA, Barker ZE, Sedgwick AK, Maggs CM, Bell NJ, Whay HR 2012 Evaluating an intervention to reduce lameness in dairy cattle. *Journal of dairy science* 95**:** 2946-2954.

66. Locomotion of dairy cows newly introduced to new concrete or rubber mat flooring in a Swedish cubicle system with scraped alleys

C Bergsten[1], P Norberg[2], G Pettersson[3]
[1]SLU, Biosystem and Technology, Alnarp, Sweden; [2]Björksta 1, Köping, Sweden; [3]SLU, Animal Nutrition and Management, Uppsala, Sweden
Christer.Bergsten@slu.se

Introduction
Dairy cows introduced to a new barn are very sensitive to challenges related to floors, cubicles, milking and feeding systems as well as to cow traffic and social interactions. Newly casted concrete has both chemical and mechanical properties, which can damage the claws and cause lameness and poor welfare. Treating the concrete in different ways can reduce this impact and using rubber mats on top of concrete is another alternative (Platz et al., 2008). The aim of the present trial was to find out the influence of concrete or rubber floors on dairy cow locomotion, claw and leg health, cleanliness and behavior when introduced to a new dairy barn.

Material and Methods
Fifty cows of each of the Swedish Holstein (SH) and Swedish Red (SR) breeds were introduced to either a group with concrete alleys (H1) or alternatively to alleys equipped with rubber mats (H2). The animals were blocked according to breed, parity and days in milk. Each group had free access to cubicles with mattresses and they were all milked together in a common rotary milking system. The cows in each group were subject to close observations regarding locomotion, claw and leg health, behavior, and cleanliness. The claws were trimmed at the beginning and at the end of the study four months later. Statistical analysis was carried out using Mixed procedure in SAS. Cow was treated as a random effect, and group (H1 and H2), observation date, breed (SH and SR), lactation number (primiparous and multiparous cows) were treated as fixed effects. The interaction between fixed effects was also included in the statistical models.

Results
From the biweekly locomotion scoring it was found that H1 impaired their locomotion considerably in comparison to H2 during the study time. Six and 12 weeks after trimming cows in the H1 group were 10 times more likely to be lame, when only including the 35 cows from each group that remained throughout the study period. Five cows were excluded because they were moved from H1 to H2 due to tender feet and sole lesions. Claw lesions increased in both groups but few severe claw lesions were seen during the study. Heel horn erosion increased more in H2 and there was a tendency for a correlation between sole ulcer and lameness. Hair loss of hocks increased in both groups over time but were twice as extensively in H1 but non-significant. A tendency for more hock ulceration was seen in H1. Cleanliness improved in both groups and no difference between either group was observed. Social grooming behavior occurred more frequently in H2 than in H1. Also self-grooming was more frequent in H2 but not statistically significant.

Discussion
The clear negative effect on locomotion from hard abrasive flooring was not surprising. Secondary effects of poor locomotion and possibly longer lying in H2 were revealed as hocks injuries, and less social and self-grooming behaviour. Preventing dairy cows from excessive exposure to abrasive, hard concrete by using rubber flooring pays off from both a welfare and longevity perspective

Acknowledgements
The study was granted by DeLaval international AB, Tumba Sweden

References
Platz S, Ahrens F, Bendel J, Meyer HH, Erhard MH 2008 What happens with cow behavior when replacing concrete slatted floor by rubber coating: a case study. Journal of Dairy Science 91: 999-1004.

P39(a). Uptake and delivery of a lameness reduction programme in Cheshire and North West England: preliminary findings

OCD Atkinson[1], GEJ Fisher[2]
[1]Dairy Veterinary Consultancy Ltd, Cheshire, UK; [2]Reaseheath College, Cheshire, UK
owen@dairyveterinaryconsultancy.co.uk

Introduction

The DairyCo Healthy Feet Programme (DHFP) was launched in 2011 in order to provide a framework for lameness reduction on individual dairy farms. The programme extends learnings from the Bristol University Healthy Feet Project, funded by the Tubney Charitable Trust to investigate ways to help farmers make changes on their farms to reduce lameness. One of the identified challenges is to help farmers utilise their existing knowledge to develop and apply their own action plan. The DHFP involves trained "mobility mentors" (vets or licensed foot trimmers) to work with the farm over a period of time to steer and facilitate the process. This is suggested to be more effective than merely providing advice or expert opinion on the lameness problem.

During 2012/13, the delivery of the programme in Cheshire and the North West was investigated. This poster presents some of the preliminary findings.

Materials and Methods

24 farms which had voluntarily enrolled for the Healthy Feet Programme ("plan farms") were compared with 21 control farms in the same region that had not enrolled. All milking cows from both groups of farms were mobility scored every three months during a 12 month period. Control farms were not told the results of their scores. A questionnaire for plan farms at the start of the programme captured their reasons for enrolling, their perceived lameness level and costs and their level of understanding of common lesions. All farms were interviewed at the end of the period to capture the changes they had made with respect to lameness during the year, their understanding of common lesions, and their motivations and barriers to various interventions to reduce lameness. Plan farms were also questioned about their perceived value of the DHFP.

Changes in herd mobility scores for plan and control farms were tracked over the 12 month period. The 4-point DairyCo mobility score system was used. Scores 2 and 3 were interpreted as "lame".

Results

The project involved 11,000 cows on 46 farms, and 9 mobility mentors from 5 vet practices.

At the start of the project, mean lame cow prevalence within all herds was 32.7% (range 10-60). There was no statistical difference between plan farms and control farms (Table 1).

Farms which enrolled on the DHFP estimated their lameness prevalence at 25.2% (mean across all herds) but with a wide range of responses (0-50%) which did not necessarily correspond well to the actual prevalence recorded by mobility scores (Figure 1).

Table 1 Mean, Standard Error (SE) and range of lameness prevalence (%) of control and plan farms at first three mobility scores

	Control Farms				Plan Farms			
	Score 2 and 3	**Range**	**Score 3**	**Range**	**Score 2 and 3**	**Range**	**Score 3**	**Range**
First MS	32.0±2.24	10-60	10.1±1.17	1-21	33.3±2.16	18-56	7.4±1.57	0-34
Second MS	31.4±2.78	11-60	8.3±1.04	2-18	28.9±1.85	20-51	5.0±0.78	0-12
Third MS	28.1±2.53	6-53	7.8±1.01	1-17	30.1±1.83	19-58	4.9±0.92	0-15

The most common responses given for enrolling on the DHFP were a wish to improve cattle mobility (37.5%) and vet recommendation (27.5%). The most common responses for motivations for wishing to reduce lameness were to increase productivity (38.7%) and to improve cow welfare (38.7%). Farmers were less clear about the costs associated with lameness in their herds, with 37.5% unable to give any estimate.

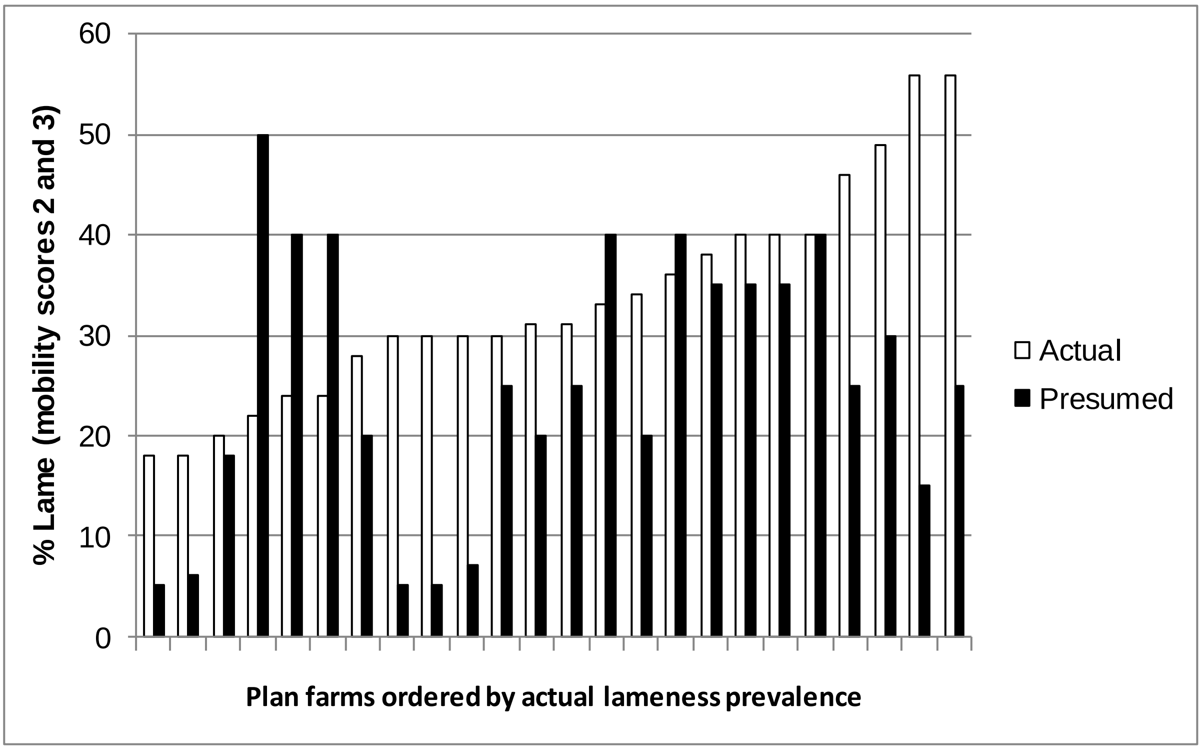


Figure 1 Plan farms at start of period: actual and estimated (presumed) lameness prevalence

Discussion
The mean prevalence of lame cows at the start of the project is in line with a previous recent UK estimate of 36.8% (Barker et al, 2010). Farms which had chosen to enroll on the DHFP had a similar lameness prevalence to those which did not, indicating that lameness prevalence itself is not a motivating factor. Later results from this project will help elucidate if differences occur between plan and control farms on lameness, as well as awareness and motivations to act.

References

Barker Z, Leach K, Whay H, Bell N, Main D 2010. Assessment of lameness prevalence and associated risk factors in dairy herds in England and Wales. Journal of Dairy Science 93: 932-941

Acknowledgements

This project was supported by the Rural Development Programme for England, for which Defra is the Managing Authority, part financed by the European Agricultural Fund for Rural Development: Europe investing in rural areas.

P39(b). Using a balanced scorecard approach to lameness reduction in dairy herds

OCD Atkinson[1], J Hulsen[2], N Bell[3], J Speed[4], K Cross[4]
[1]Dairy Veterinary Consultancy Ltd, Cheshire, UK [2]Vetvice, Bergen op Zoom, NL [3]RVC, Dorset, UK [4]DairyCo, Stoneleigh, UK
owen@dairyveterinaryconsultancy.co.uk

Introduction

Lameness reduction requires a strategic approach, capable of addressing a complex multifactorial problem, so that the correct control measures can be understood and applied in an ongoing manner.
The balanced scorecard (BSC) is a widely used device in commerce and management, originally proposed by Kaplan and Norton (1992). It is employed as part of a holistic process that provides a road map for strategy execution and for making improvements a continual process. The typical BSC used by businesses includes measurement of performance indicators for four key perspectives: financial; customers; internal business processes; learning and growth (Figure 1).

Materials and Methods

The DairyCo Healthy Feet Programme (DHFP), which is a strategic plan for lameness reduction on an individual herd level, includes the use of a BSC-type device to identify the important areas to get right in order to reduce lameness. These are adapted from the "four success factors for healthy hooves" (Hulsen, 2011):

1. Low infection pressure
2. Good hoof shape and horn quality
3. Low forces on feet (short standing times; good cow flow; appropriate floor surfaces)
4. Early detection followed by prompt, effective treatment of lame cows

The three most commonly identified lesions causing lameness are digital dermatitis, white line disease and sole ulcer (Barker, 2007). A three axis graph is used to map the relative incidences of these lesions on the BSC so a simple visual illustration is used for any individual farm to identify the success factors which should be given priority (Figure 2).
During the delivery of the DairyCo Healthy Feet Programme, a full farm appraisal further identifies strengths and weaknesses in each success factor, so that a farm specific action plan can be devised and followed.

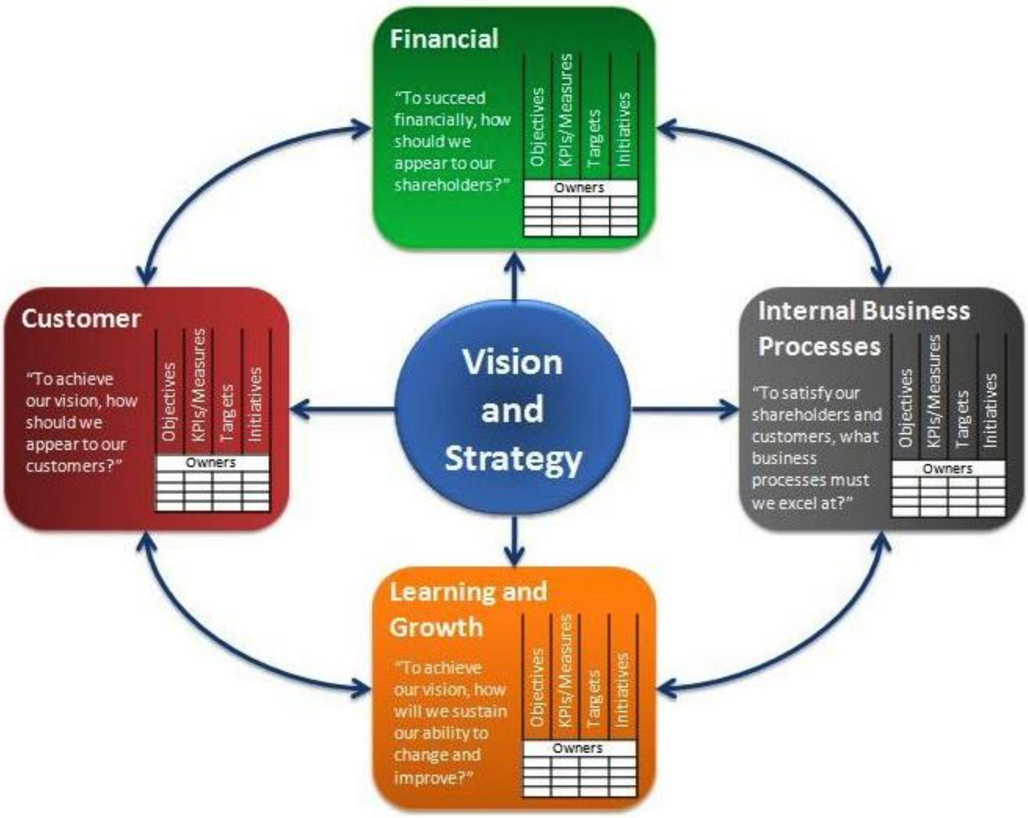


Figure 1
A visual representation of a balanced scorecard used in business

Results
Since 2011, 52,000 cows on 220 UK dairy farms have been enrolled in the DairyCo Healthy Feet Programme, delivered by trained Mobility Mentors (vets or licensed foot trimmers). The BSC approach is popular with farmers and informal feedback indicates that it proves to be a useful device to simplify the complexities of lameness control, and forms a useful framework to develop a farm-specific action plan. On-going field research is collating both the results of implementing the DHFP, and farmer attitudes to lameness reduction using the DHFP.

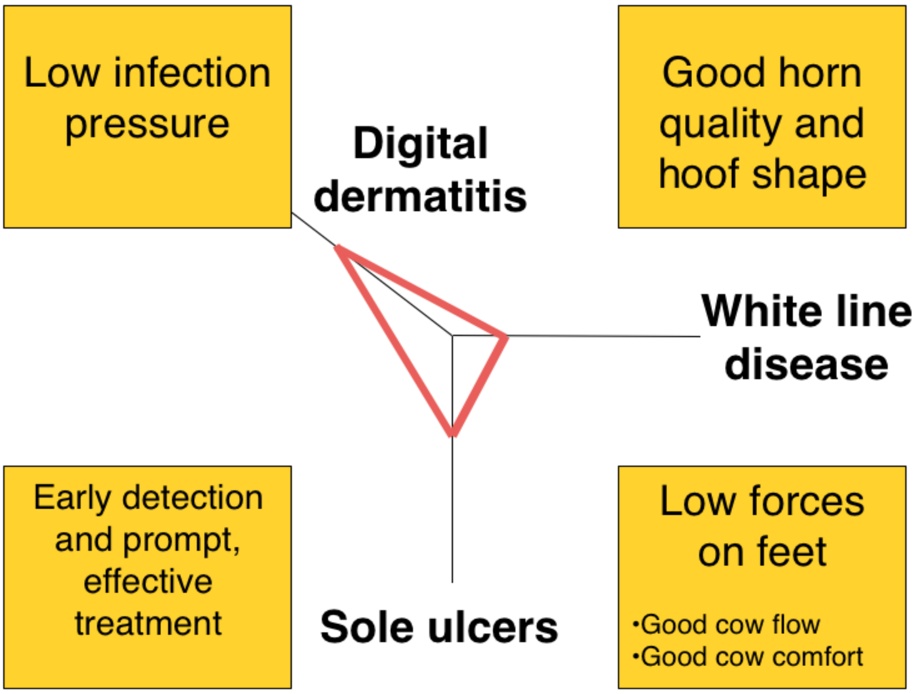


Figure 2 A balanced scorecard to determine which success factors are most important: relative incidence of lesions are plotted along three axes to construct a triangle. In this example, reducing infection pressure, and early detection and treatment should be given particular priority.

Discussion
Using business tools for farm health planning may be beneficial. Businesses and farms share similar challenges with strategy implementation, such as prioritising time and financial resources, employee motivation, identifying and measuring key performance indicators, and using data to the best effect. The BSC is a widely respected approach in business and is likely to be equally valuable for strategic improvement of foot health on dairy farms.

References

Barker ZE 2007. Epidemiology of Lameness in Dairy Cows. PhD Thesis, University of Warwick
Kaplan RS and Norton DP 1992. The balanced scorecard as a strategic management system. The Harvard Business Review p 61-66.
Hulsen J 2011. Hoof Signals: success factors for healthy hooves. Roodbont publishers, Zutphen, NL

P40(a). Designing a field intervention study for lameness in dairy cattle

David Logue[a], Sarah Brocklehurst[b], Jill Offer[b], Andrea le Fevre[b], George Gettinby[d], Mark Hirst[e], Daan Wink[e], Richard Laven, Richard Murray, Nigel French[e]
[b]SAC Veterinary Services; [b] BioSS: [d]University of Strathclyde; [a]University of Glasgow
davidlogue@dsl.pipex.com

Introduction
In designing a field intervention study for dairy cattle lameness, which was reported to the Milk Development Council (MDC) in 2006 (MDC Reference 00/T3/19) our approach was heavily influenced by the Medical Research Council's 2002 publication "Complex Interventions to improve Health".

Materials and Methods
Firstly we collated, analysed and reported all available studies of cattle lameness published over 25 years in reputable scientific journals that described the assessment of risk factors, measures of lameness, effective strategies of data management and putative interventions to reduce lameness in cattle (Hirst et al., 2001a). Similarly data from clinical lameness studies from the University of Liverpool (Hirst et al., 2002b), combined with SAC and ADAS Bridgets data were subjected to further statistical modelling to select interventions to reduce lameness and obtain statistical estimates that could assist in the design of a large-scale field study. Another aspect not yet fully reported was the in-depth statistical analysis of claw horn lesion development, particularly that of haemorrhages on the bearing surface of the claw of first calving heifers, since we believe this might be used to better define the success or otherwise of interventions.

Results
In summary in a simple "Level 1" intervention study, the various interventions are proposed to the test farms, which then incorporate these as they see fit to meet "best practice". Control farms would not be given such advice and would merely be monitored. The lameness outcomes to be examined in this study to determine the success or otherwise of the intervention would be "on-farm" clinical lameness records augmented by quarterly locomotion scoring by the research group. In addition a number of covariates, such as other health and reproductive events, again recorded by the farm would be utilised in the analysis. Our statistical calculations suggest that this study would require at least 80 farms but given potential estimate errors and drop-out rates we recommend around 10% more. The Level 2 study would be more meaningful and involve a similar number of farms, but in this case the various interventions would be applied in a fractional factorial design and both lameness and lesion development outcomes would be studied along with similar covariates to Level 1.

Discussion
In this study the various interventions would be carefully latticed between herds in such a way as to give the maximum power possible and minimum confounding between important effects. In this study only half of the herds, nested within the whole study, would need to have a lesion development component. We consider that both these studies should encompass all the dairying areas in GB and that the Level 2 study would be much more preferable despite an estimated cost of £750K, approximately twice as much as Level 1.

Acknowledgement
We gratefully acknowledge the MDC Project Manager Dr Alison Gibbs

References
Hirst W M, Le Fevre AM, Logue DN, Offer JE, Chaplin SJ, Murray RD, Ward WR, French NP 2002a The Veterinary Journal, 164, 7 – 19
Hirst WM, Murray RD, Ward WR, French NP 2002b Preventive Veterinary Medicine, 54, 191-201
498 words

P40(b). Expected economical gains by changing hoof care management practices

MG Lopez-Benavides[1] and A Lanckriet[2]
[1]DeLaval Inc., 11100 N Congress Ave, Kansas City MO, 64153, USA; [2]DeLaval NV, Industriepark-Drongen 10, Gent, Belgium.
mario.lopez@delaval.com

Introduction

Hoof bathing with disinfectants is the most common practice for reducing the incidence of digital dermatitis (DD) and for maintaining the disease at manageable levels in dairy farms. Increasing hoof bathing frequency may be the right decision to take when a shift in disease levels is desired. However, this change also needs to demonstrate an economical benefit to the farmer in terms of disease cost reduction and costs associated with this change in practice. The objective of this study is to illustrate the potential savings that can be obtained when planning for a change in frequency of use of the hoof bath, based on different levels of DD prevalence and hoof bathing routines.

Materials and Methods

A simulation model was created to quantify the yearly costs associated with the use of 4Hooves™ (1%, DeLaval) or copper sulfate (5%) for a 200 cow dairy. Both products have shown similar efficacy against DD in past studies. Disease and prevention costs were calculated based on different hoof bathing frequencies (2x, 3x or 5x/wk) and weekly DD incidence rates (0,005 to 0,100). The cost of DD was estimated at €105/case ($133 USD), and the cost of a 200L hoofbath of either $CuSO_4$ or 4Hooves™ at €21 per hoofbath. Savings associated with prevention of disease were calculated for a 20%, 40% and 60% reduction in DD cases.

Results and Discussion

The cost of prevention made up 2% to 50% of total costs associated with DD depending on the frequency of use and the DD incidence rate (Table 1).

Table 1. Costs associated with the use of 4Hooves™ (1%) or copper sulfate (5%) for a 200 cow dairy

Digital dermatitis (disease)				4Hooves™ or $CuSO_4$ (prevention)					
				2x/wk		3x/wk		5x/wk	
cases/wk	Incidence rate per week	cases/yr	Annual cost	Prevention Costs/yr	% total costs	Prevention Costs/yr	% total costs	Prevention Costs/yr	% total costs
1	0,005	52	€5.460	€2.184	28,6	€3.276	37,5	€5.460	50,0
2	0,010	104	€10.920	€2.184	16,7	€3.276	23,1	€5.460	33,3
5	0,025	260	€27.300	€2.184	7,4	€3.276	10,7	€5.460	16,7
10	0,050	520	€54.600	€2.184	3,8	€3.276	5,7	€5.460	9,1
20	0,100	1040	€109.200	€2.184	2,0	€3.276	2,8	€5.460	4,5

Farms with high DD will have lower costs associated with prevention and would benefit more from using products that lower the disease level (Figure 1). For instance, a 200 cow farm with a DD incidence of 10 cases per week (2,6 cases DD/cow/year) and hoof bathing 2x/wk will have a total combined cost of €56.784 (disease + prevention), of which prevention costs are 4% (Table 1). By switching to hoof bathing 3x/wk and assuming a 20% reduction in DD, the farmer will save €10.920/yr in disease costs, of which €1.092 would pay for the extra day of hoof bathing necessary to create this positive change. In the end, the farmer would be saving a total of €9.820 because of a change in hoof bathing frequency alone.

Conclusion

Hoof bathing is one of the most important management tools to control DD on farm. Reduction of DD problems may be possible when frequency of use is increased. This study shows that depending on the severity of the problem and the reduction of DD that is expected, an economical benefit may be achievable when a field tested product is used.

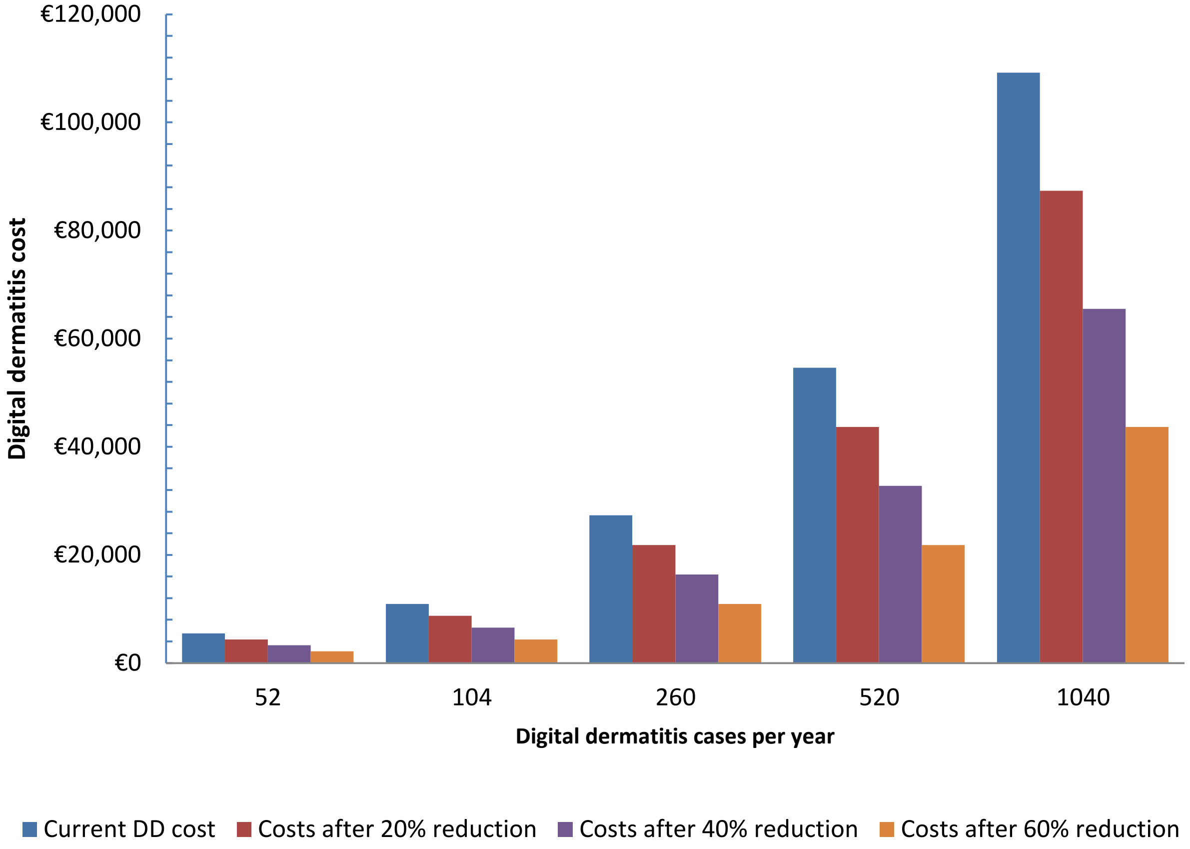


Figure 1. Costs associated with digital dermatitis.

References

Cha E, Hertl JA, Bar D and Gröhn YT. 2010. The cost of different types of lameness in dairy cows calculated by dynamic programming. Preventive Veterinary Medicine 97:1-8.

Lopez Benavides MG, Grow HJ, Buchalova M, Skender A, Britten A and Hemling TC. 2011. Integral hoofcare management for digital dermatitis prevention. In: 16th Symposium and 8th Conference on Lameness in Ruminants, 28 February–3 March, Rotorua, New Zealand pp 156.

P41(a). Factors associated with high prevalence of lameness in 50 Chilean dairy herds

P Levet[1], G Acosta-Jamet[2], N Tadich[2]
[1]Master Degree Student, Faculty of Veterinary Science, Universidad Austral de Chile.
[2]Faculty of Veterinary Science, Universidad Austral de Chile, Valdivia, Chile.
ntadich@uach.cl

Introduction

Lameness is a common disease in dairy cows worldwide. In Chile, Flor and Tadich (2008) reported a mean prevalence of clinical lameness (locomotion score (LS) ≥3, Sprecher et al, 1997) of 16.7% in 91 dairy herds. Lame cows are in pain, produce less milk, are less likely to become pregnant and are more likely to be culled involuntarily. The aim of this work was to determine the structural characteristics of the tracks and the milking parlour waiting yards and to determine their association with the presentation of lameness in cows at pasture in the south of Chile.

Material and Methods

Fifty dairy farms that kept the cows on pasture were used. Twenty five of these farms had a mean prevalence of clinical lameness of ≤11% and 25 had a mean prevalence of lameness ≥16%. The farms were visited once, between September and December of 2011. The locomotion score of all dairy cows was recorded at the exit of the milking parlour. In each visit, a questionnaire was completed by the first author (PL), and general information was gathered: groups of cows, number and management of the lame cows, feeding of sound and lame cows, litres of milk produced, cleaning of the waiting yards, number of paddocks, rotation of the cows on the paddocks. The type of tracks leading to the most distant and closest paddocks, the track material, drainage, presence of loose stones, if tracks were built with more than one material, length and width of the tracks, were also recorded. Waiting and feeding yards were measured and the material of the floor recorded. The space available for the cows in the waiting yard was calculated. Type of driving, number of people doing the driving, and duration of milking, were also recorded. Data were stored in a spreadsheet in MS Excel and were analyzed using descriptive statistics. Finally, a logistic regression analysis using the software R 2.11.1® to determine the risk factors for lameness, was carried out.

Results

Farms with a mean lameness prevalence ≤ 11%, had 200±58 dairy cows; farms with a prevalence of lameness ≥16% had 231±61 cows. Gravel was the most common material used on the tracks of the farms with ≤11% of lameness. In the group of low lameness prevalence, tracks were made with just one material. In the group of high prevalence, tracks were constructed using more than one material. The tracks' length to the most distant paddocks in the group of low prevalence of lameness was of 861±386 m and the width was 5.3±2 m. In the group of high prevalence of lameness, the length of the tracks to the most distant paddocks was 1050±486 m and the width was 6.4±3 m. Seventy two percent of the farms with low prevalence of lameness and 80% of the farms with high prevalence the waiting yard had less than 1.5 m^2 of space per cow. In the logistic regression, the only factor that resulted in statistical significance P< 0,0002 was "tracks constructed with mixed materials", which increased the odds of lameness by a factor of 1.93.

Conclusions

According to the results obtained, roads built with different materials were a risk factor for a higher prevalence of lameness. The fact that the type of driving, the distance walked by the cows, density of cows at the waiting yard, quality of the waiting yards' floors and roads, and waiting period prior to milking, did not represent risk factors probably was due to the fact that an 11% of prevalence was still high prevalence for obtaining differences between farms.

Acknowledgments

This work was funded by project FONDECYT 1090373. We thank the farmers for access to their farms.

References

Flor E, Tadich N, 2008. Claudicaciones en vacas de rebaños lecheros grandes y pequeños del sur de Chile. Arch. Med. Vet. 40, 125-134.
Sprecher DJ, Hostetler DE, Kaneene JB, 1997. A lameness scoring system that uses posture and gait to predict dairy cattle reproductive performance. Theriogenology 47, 1179–1187.

P41(b). Risk factors associated with hock lesions in cubicle housed Dutch dairy cattle

M Holzhauer[1], K Frankena[2], E Kester[2]
[1] GD Deventer, The Netherlands [2] Wageningen University, The Netherlands
esmee.kester@wur.nl

Introduction
Hock lesions are a common problem in many dairy farms. Hock lesions (HL) describe multiple clinical presentations of hock damage whereof hock swellings (peri-tarsitis) are considered most severe. The aim of the study is to estimate the prevalence of HL and to identify and quantify cow-, management-, and housing-related risk factors on farm level that are associated to the presence of HL in Dutch dairy herds, in order to formulate better advice on HL prevention.

Materials and Methods
In 2009-2010 a cross-sectional study of 177 randomly selected farms from a stratified sample of risk- and non-risk farms for welfare with cubicle housing systems was performed, in which cows were examined on the presence of HL. Four cattle health employees of the GD scored randomly selected cows at the feeding fence for either large swellings (larger than a fist) or small swellings (smaller than a fist). Risk factors at cow-, management-, and housing-level were registered. Linear regression analysis was used to identify and quantify factors related to HL associated with the percentage of HL.

Results
The average herd size in the study population was 89 (range 21-247) dairy cows. The predominant breed was Holstein Frisian (164 farms). On each farm approximately 43 cows were assessed. Prevalence of HL, either large or small, was 23.2%. The herd prevalence was 96.1%. In seven herds no cows with any HL were observed and 134 herds had no cows with large swellings. The percentage of HL was positively correlated with the percentage thickened front knees (ρ=0.57), injuries (ρ=0.42), scabies (ρ=0.16), lameness (ρ=0.34), and with herd size (ρ=0.24). Detailed results of the regression analysis quantifying the risk factors associated with hock swellings will be presented at the congress.

Discussion
Although the herd size and breed is generally consistent with the Dutch situation, the sample used in this study is not representative for the Dutch population. Due to the research being part of a bigger welfare project, relatively more risk factor farms for welfare were chosen based on farm parameters like cow- and calf mortality, bulk milk somatic cell count, new udder infections, etc. Therefore the herd prevalence of 96.1% may be a bit high, also compared to the herd prevalences of 42%, 56% and 81% that were reported in three regions of North America for cubicle housing systems (von Keyserlingk et al., 2012). The cow prevalence of 23.2% is however comparable to other cow prevalences of 14.2% (Zurbrigg et al., 2005) and 36% (Brenninkmeyer et al., 2012) that have been reported.
Often HL are observed in combination with knee lesions, this may be due to the fact that many farms do not meet the recent cubicle measures advised by Holzhauer and Vos (2009). For cubicles with a closed front, double row and open front, respectively 98.9%, 97.7% and 91.5% of the farms do not meet the recommended length. Also 99.4% of the farms do not have the recommended box width.
The moderate relation between lameness and HL that was found has also been reported by earlier studies. Yet, this does not indicate HL as the cause of lameness due to pain of hock swellings, nor does it indicate lameness as the cause of HL due to increased lying times and difficulties standing up or lying down in the cubicles which are generally a greater risk for HL (Amstel and Shearer, 2006; Brenninkmeyer et al., 2012). Occupancy of the cubicles was not related to HL, therefore herd size may be a marker for other variables that have not been measured.

References
Amstel vS, Shearer JK 2006 Manual for Treatment and Control of Lameness in Cattle. Iowa: Blackwell Publishing Professional.
Brenninkmeyer C, Dippel S, Brinkmann J, March S, Winckler C, Knierim U 2012. Hock lesion epidemiology in cubicle housed dairy cows across two breeds, farming systems and countries. Preventive Veterinary Medicine 109(3-4): 236-245.
Holzhauer M, Vos JH 2009. Claw health in Dutch dairy herds, an update of some recent disorders. Tijdschrift voor diergeneeskunde 134: 200-205.

Keyserlingk MAG von, Barrientos A, Ito K, Galo E, Weary DM 2012 Benchmarking cow comfort on North American freestall dairies: Lameness, leg injuries, lying time, facility design, and management for high-producing Holstein dairy cows. Journal of Dairy Science 95: 7399-7408.
Zurbrigg K, Kelton D, Anderson N, Millman S 2005 Stall dimensions and the prevalence of lameness, injury, and cleanliness on 317 tie-stall dairy farms in Ontario. Canadian Veterinary Journal 46: 902-909.

P42(a). Laminitis complicated by Treponemes as a major cause of lameness in two dairy goat herds; post mortem results

M Groenevelt[1], C Palgrave[1], K Anzuino[2], R Grogono-Thomas[1]
[1]Univeristy of Bristol, School of Veterinary Science, Langford House, Langford, BS40 5DU
[2]independent advisor
margit.groenevelt@bristol.ac.uk

Introduction

Lameness is a problem in many dairy goat herds in the UK, due to a variety of diseases. Hill et al (1997) found lame dairy goats being affected by horn separation, white line lesions, slippering, abscess of the sole, foreign body, and granulomatous lesions. Foot rot, caused by Dichelobacter nodosus has also been confirmed as a cause of lameness in goats (Depiazza et al. 1999, Bennet et al. 2009). In sheep, a relatively new disease described as Contagious Ovine Digital Dermititis has been seen which causes severe lesions on the foot with suggested involvement of Treponemes (Moore et al. 2005).

Case History

Two dairy goat farms with consistently high levels of lameness were presented to the authors. Animals are housed on straw bedding and fed an ad lib concentrate of 18% protein with forage freely available. Previous treatments focussed on foot rot had not had the expected outcomes.

Clinical Findings

Lameness levels within the herds were 40% and 67% respectively, with no lameness seen in youngstock. Lameness was found to be in the foot. Mild cases showed haemorrhaging while more severe cases showed white line separation. Severe cases consisted of separation of the horn with exposed and infected corium. In very severe cases a large central area of necrotic tissue was seen without visible healthy corium. On only one occasion was involvement of the interdigital space seen.
Swabs taken on several occasions for PCR and culture of *Dichelobacter nodosus* were negative. PCR for treponemes were positive in both adults and young stock.
Rumen pH was measured in 40 live animals and 35% of samples were below 5.5.
Five chronically affected animals where euthanased on farm and presented for post mortem. The macroscopic findings are outlined in Table 1. Picture 1 shows the level of osteolysis found. Samples from the gastrointestinal tract were taken for histology.

Table 1 Overview of results found on macroscopic post mortem

Goat	Feet and claws infected	lame, no infection	rumen pH	Malpositioning of p3	Osteolysis of P3
1	left and right front – medial claw	n/a	5.39	Unidentifiable	yes
2	right hind - both claws	right front	5.26	Yes – right front	Yes – both feet
3	both hind - both claws	n/a	5.29	Unidentifiable	Not investigated
4	left front - medial claw	right front	5.46	Yes – right front	Yes – both feet
5	right hind - both claws	n/a	5.27	Unidentifiable	Yes

Discussion

On both farms D.nodosus was excluded as a causative pathogen. The finding of treponemes suggests that this might be a case of contagious ovine digital dermatitis in goats. The outcome of the rumen pH sampling is suggestive of ruminal acidosis. The finding of osteolysis and malpositioning of p3 in feet that do not show infected lesions suggests involvement of internal factors. It is proposed that as an effect of the low ruminal pH, chronic laminitis could occur which would affect horn growth.

Conclusion

At this stage further investigation is needed to reach a diagnosis. This will be done by microscopic analysis of the histology samples taken as well as by assessing rumen health in living animals by taking rumen content samples and assessing pH and particle size. Metabolic profiling of the goats in various stages of lactation will also give more information on the metabolic state of these animals.

Acknowledgements
The authors would like to thank the farmers for use of their farms and also Delaware Vet Group and LVS Farm Animal Practice for their cooperation.

References
Anzuino K, Bell NJ, Bazeley KJ, Nicol CJ 2010 Assessment of welfare on 24 commercial UK

dairy goat farms based on direct observations *Veterinary Record* (167) 774-780
Bennet G, Loenen van A, Zhou H, Sedcole R, Hickford J 2009 The detection of Dichelobacter nodosus and Fusobacterium necrophorum from footrot lesions in New Zealand goats *Anaerobe* (15) 177
Depiazzi LJ, Richards RB, Henderson J, Rood JI, Palmer M, Penhale WL 1991 Characterisation of virulent and benign strains of Bacteroides nodosus **Veterinary Microbiology (26) 151-160**
Hill NP, Murphy PE, Nelson, AJ, Mouttotou LE, Green LE, Morgan KL 1997 Lameness and foot lesions in adult British dairy goats *Veterinary Record* (141) 412-416
Moore LJ**,** Woodward MJ**,** Grogono-Thomas R. 2005 The occurrence of treponemes in contagious ovine digital dermatitis and the characterisation of associated Dichelobacter nodosus. *Veterinary Microbiology* (111) 199-209

Picture 1 level of osteolysis found on post mortem examination

P42(b). Is Digital Dermatitis a cause of hoof conformation changes in its early clinical stage?

A Gomez[1], N Cook[1], J Rieman[1], K Cooley[1], K Dunbar[1], D Döpfer[1]
[1] School of Veterinary Medicine, University of Wisconsin-Madison, USA
artgomez01@gmail.com

Introduction

It is well described how hoof conformation in dairy cattle changes over time either physiologically or due to each particular production system. Regular hoof-trimming has become an essential component of lameness control, with the objective of re-establishing optimal locomotion conditions in cattle. Specifically for DD, the dramatic transformation the foot experiences in severe clinical cases is easily recognizable. It is not uncommon to observe “square feet” affected with DD, where the heel has overgrown to the point the animal affected modifies gait, wearing the toe and decreasing the dorsal length of the claw sometimes to the same dimension as the heel height. As a consequence, pain and lameness may result from the ulcerated DD lesion, and also from the extra wear/trauma of the toe or the white line area. However, not much is known about possible hoof conformation changes in less severe stages of the disease. The objective of the research presented is to describe the changes in hoof conformation caused by early clinical DD lesions.

Material and Methods

For this purpose, a cohort of 640 pregnant Holstein heifers was evaluated 3 times during a period of 6 months with 3-month intervals. Hoof measurements including dorsal wall length, total length, depth of the interdigital space, heel height, angle of the hoof, hygiene of the interdigital (ID) space (scale 1-4, dichotomized to 1-2 vs. 3-4 to be included in the statistical analysis), axial overgrowth of the lateral toe at 35 mm, heel horn erosion (scale 0-3, dichotomized to 0-2 vs. 3 to be included in the statistical analysis) in addition to clinical evaluation of DD served to construct a deterministic model explaining conformation changes over time in cows affected with DD. Digital Dermatitis lesions were classified upon clinical assessment using the five point method described by Döpfer et al., (1997) (clinical stages: M0, M1, M2, M4, M4.1). Heifers without any lesion identified during the experiment (M0) were used as a reference group to compare with heifers diagnosed with acute clinical lesions (M2).

Results

The clinical DD lesions observed in the study presented a median size (interquartile range) of 24 (21, 31) mm. These small DD lesions significantly changed the conformation of the hoof with exception of the dorsal and total toe length. As shown in table 1, hooves with DD increased their toe angle in 1.1 and 1.7 degrees for the medial and lateral toes respectively. Similarly, hooves affected with DD experienced a statistically significant mean increase in heel height (3.8 and 2.9 mm for medial and lateral toes), 4 mm deeper ID clefts, 18% increase in ID hygiene scores 3-4, and 50% added incidence of heel horn erosion severities 3-4.

Table 1 Summary results obtained from the “difference-in-difference” statistical analysis

Hoof Measurement	**Mean difference (95% CI) between healthy and acute DD (M2) cows over time**			
	Medial Toe	**p-value**	**Lateral Toe**	**p-value**
Total Length (mm)	0.8	NS	0.7	NS
Dorsal Length (mm)	-0.7	NS	-0.5	NS
Toe Angle (degrees)	**1.1** (0.5, 1.8)	**<0.05**	**1.7** (1.0, 2.4)	<**0.05**
Heel Height (mm)	**3.8** (2.8, 4.8)	**<0.01**	**2.9** (2.0, 3.8)	<**0.01**
Depth Interdigital Cleft (mm)	**4.0** (3.4, 4.5)			<**0.01**
Axial Overgrowth Lateral Toe at 35 mm (mm)	**-0.21** (-0.65, 0.17)			NS
Interdigital Hygiene (1-2 vs. 3-4) %	**18** (10, 26)			<**0.01**
Heel Horn Erosion (1-3 vs. 4) %	**50** (45, 56)			<**0.01**

Discussion

Early lesions of DD are associated with changes in hoof conformation that may serve to perpetuate lesion survival and the progression of the disease over time. DD could affect lameness not only through pain, but also by changing hoof conformation, increasing the probability of experiencing other hoof diseases such white line disease or sole ulcers. Both arguments would support the idea of early intervention and prevention as the most important strategy in managing the disease.

Acknowledgements
We would like to thank Zinpro Corporation for their support.

P43(a). A risk assessment to identify and prioritize hoof health risks on dairy farms

JJ Lievaart[1,2], G Cramer[3], S van Rooijen[1], M Drint[1], GW Meerema[1]
[1]Dutch Hoof Health Centre, Bathmen, The Netherlands, [2]Charles Sturt University, Wagga Wagga, NSW, Australia, [3]Cramer Mobile Bovine Veterinary Services, Stratford, Ontario, Canada
jlievaart@csu.edu.au

Introduction

Monitoring and the assessment of lameness data and related risk factors are key components of a successful lameness control program on dairy farms (Barker, et al. 2010, Main, et al. 2012). Nevertheless assessing risk factors without a clear defined protocol can be time consuming and occasionally risk factors are not identified. In order to standardize risk assessments (RA) a lameness RA was developed in Ontario, Canada similar in format to the RAs used by veterinarians for Johne's and SCC's. The aim of this study was to examine if this RA could be utilized as an additional tool as part of a hoof health program to identify and prioritize hoof health risk factors.

Materials and Methods

The existing Canadian RA was modified to add floor space per cow and the number of cows per 10 cubicles. The RA was then tested on 26 Dutch indoor housed dairy herds during the winter period of 2012-2013. All farms were visited by the same observer. Areas assessed by the RA included "the current foot health program", "feeding management risks", "dry cow and heifer housing risks", "lactating cow housing and flooring risks", "trimming and foot bathing risks" and "lameness therapy risks". Each area included several risk factors which were scored separately on a 4 point scale from 1 (low risk) to 10 (high risk). As part of the RA there were predefined descriptions for each score for every single risk factor. Scores of risk factors were added per risk factor area and summed to give a total score for each farm.

Results

The average "dry cow and heifer housing risks" score was 62 (max*. 80, range 39 - 80); "lactating cow housing and flooring risks" 45 (max.120, range 20 - 62); "trimming and foot bathing risks" 52 (max*. 70, range, 32 – 70); "lameness therapy risks" 22 (max*. 30, range 15- 27) and "Total score" 181 (max*. 350, range 124 - 205). Individual risk factors with the highest frequency of the maximum score of 10 were; "feeding frequency", "introduction of heifers", heifers exposed to adult cow manure", "not trimming heifers before entering the herd", and "no foot bathing of dry cows and/or heifers".

Discussion

The variation in RA scores provides evidence of the usefulness of this tool to identify risk factors and groups of animals at risk. The RA will be used in the future to develop a management plan in conjunction with farmers to address the risk factors that are most important to improve hoof health on their farm. The RA also identified that currently, the preventative focus is mostly on the lactating herd (lowest average score) and there is an opportunity to reduce risks for heifers and dry cows.

Acknowledgments

We would like to thank all farmers who participated in this study and Dr. Ann Godkin who provided feedback on original drafts of the risk assessment.

*max. means the maximum score for this area of the risk assessment

References

Barker ZE, Leach KA, Whay HR, Bell NJ, and Main DCJ 2010 Assessment of lameness prevalence and associated risk factors in dairy herds in England and Wales. *Journal of dairy science* **93:** 932-941.
Main DCJ, Leach KA, Barker ZE, Sedgwick AK, Maggs CM, Bell NJ, and Whay HR 2012 Evaluating an intervention to reduce lameness in dairy cattle. *Journal of dairy science* **95:** 2946-2954.

P43(b). Substandard management of claw trimming is a common risk factor for lameness in UK dairy herds

MC Burnell[a], JD Reader[a]
[a]Synergy Farm Health, West Hill Barns, Evershot, Dorset DT2 0LD
mark.burnell@synergyfarmhealth.com

Introduction

Lameness in dairy cows is a significant problem and the relationship between certain lesions and risk factors is not always clear. However, a whole farm risk assessment is a valuable exercise; this should include a study of the cows' interaction with the environment, prevention of infectious claw disease with particular emphasis placed on foot bathing regimes, as well as preventive and curative procedures for lame cows. Based on the findings of the risk assessment it should be possible to give advice and make practical cost effective interventions to reduce lameness on any particular farm (Barker 2007).

Materials and Methods

Eighteen dairy farms were visited, most as part of the South West Healthy Livestock Initiative (SWHLI) lameness strand and a full risk assessment carried out according to the framework of the DairyCo Healthy Feet Program. Part of this was a skills assessment of the person(s) responsible for hoof care on that farm, be it farm staff or external trimmer. This could have been either by direct supervision or assessment of cows recently trimmed. Factors considered a risk factor for the type of lameness seen on that farm, as assessed by predominant lesion types (infectious, sole or white line) were graded on a traffic light system with red being considered to be a highly significant risk factor for lameness on that farm and amber moderately significant. All red and amber risk factors were collated to assess which were the predominant ones across all the farms.

Results

The prevalence of lameness in the herds (mobility score 2 and 3 cows, DairyCo) ranged from 9-51%. Table 1 shows the number of each risk factor assessed which were either red or amber for all farms.

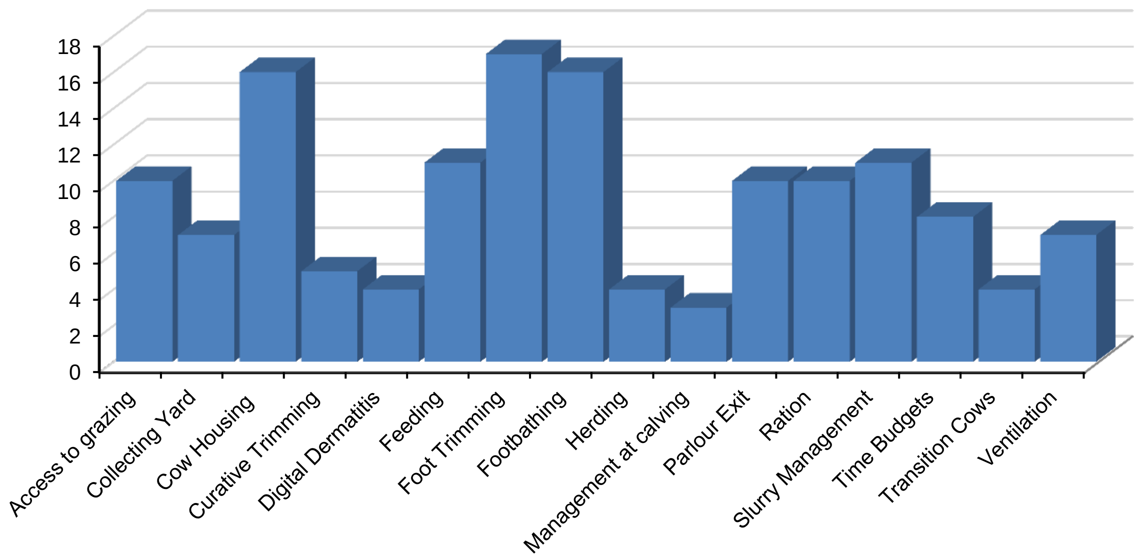


Figure 1. Risk factors associated with lameness on 18 farms

Discussion

Aspects of claw trimming were considered to be the most common significant risk factors across all 18 farms. A consequence of either delayed treatment and/or inappropriate treatment and management of lame cows is a reduction in cure rates and an increase in chronic lameness (Leach et al 2012). These 'legacy' cows which are retained in the herd make an improvement in lameness prevalence a slow process as well as being a serious welfare problem.

The authors conclude that there is still a great need to improve the skills of people involved with cow foot care and to establish a greater ‘team approach’ between all those involved. In some cases it may not be possible to achieve the level of skills required on farm and alternative ‘packages’ of foot care need to be developed.

Acknowledgements
The authors are grateful to Yvonne Critchell for collating and the presentation of the information.

References
Barker ZE 2007 Epidemiology of Lameness in Dairy Cows PhD Thesis Thesis
Leach KA, Tisdall DA, Bell NJ, Main, DC and Green LE 2012 The effects of early treatment for hindlimb lameness in dairy cows on four commercial UK farms. Veterinary Journal 193:626.