TREATMENT OPTIONS FOR FOOT DISEASES IN DAIRY CATTLE

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REVIEW

Abstract

The multiple kind of foot diseases in cattle represents a pathology with deep implications for animals welfare and profitability of dairy cattle farms. The high frequency of these conditions and their significant economic impact are highlighted by references to global and local studies. The multidisciplinary approach for the effective control of lameness is done through diagnostic methods, current treatment protocols (topical, systemic), and also prevention and control strategies. This complex approach is necessary to improve the condition of the animals, to make a more efficient production and increase the profitability.

Keywords: cattle, lameness, foot, dairy, control
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INTRODUCTION

Foot health (foot and hoof health) is an essential element of productivity and welfare in modern cattle farms, especially in dairy farms. The foot conditions often grouped under the generic term of lameness, represent a major problem at a global level.

The economic impact of these diseases is considerable, being frequently ranked as the third cause of financial loss in dairy farms, after reproduction and mastitis problems (Akin & Akin, 2018; Hernandez et al., 2001).

The losses result from reduced milk production (Györkös et al., 1999; Pavlenko et al., 2011; Relun et al., 2013), treatment costs, premature animal reformation and the negative impact over the ovarian function and the calving-to-conception interval (Garbarino et al., 2004; Hernandez et al., 2001).

The awareness of the negative impact on health (Ramanoon et al., 2018) and on performance (Garvey, 2022), led to an increased research for etiology, prevention and management of foot disorders (Potterton et al., 2012).

Furthermore, lameness severely compromises the well-being of animals, causing pain, discomfort and behaviour changes (Bruijnis et al., 2012).

Technological advances, such as using locomotion scoring (Werema et al., 2022) and precision technologies (Silva et al., 2021), provide new tools for early detection and rapid intervention. (Tabel 1.)

Effective recognition and management of these diseases require a deep understanding of their complex etiology, which involves interactions between the pathogen, animal and environment.

Description of the main foot diseases

Foot pathologies in cattle are diverse and can be classified in two major categories: infectious and non-infectious (mechanical).

Infectious diseases

Digital dermatitis (DD) also known as “Mortellaro’s disease”, is a superficial, ulcerative or proliferative pododermatitis, highly contagious. It is caused by a polymicrobial bacterial infection, and a main role is assigned to anaerobic spirochete bacteria from Treponema (Canales et al., 2022; Nascimento et al., 2015). Lesions typically appear in the skin area over the interdigital space, especially on the hind limbs. The active lesion (stage M2 according to the M-stage scoring) is a reddish, circular or oval wound, extremely painful. Risk factors include poor hygiene of the animal shelter, increased floor humidity and the introduction of infected animals into the herd (Ahlén et al., 2022; Palmer & O’Connell, 2015).

Interdigital phlegmon (interdigital necrobacillosis), popular known as “foot rot”, is an acute bacterial infection of the interdigital space, characterized by symmetrical swelling of the foot, unpleasant, repulsive smell and severe lameness (Bednarski, 2015). It is predominantly caused by Fusobacterium necrophorum. The infection requires a pre-existing lesion of the

interdigital skin (a friction, a sting) in order to penetrate.

Table 1

Methods for scoring locomotion for cattle

Scoring method	Method type	Short description and key features	Main Bibliographic source/Support
Sprecher scoring system, 5 points	Visual, Manual, Subjective	It evaluates the posture of the back (from 1=straight back to 5=severely arched back)and the way the animal puts weight on its legs. It is one of the most used references scales.	Sprecher et al.,1997 Roche et al., 2024
LS scoring system , 4 points (Welfare Quality/Dairy NZ)	Visual, Manual, Subjective	Evaluates is based on the co-assessment of walking speed, walking rhythm, weight-bearing, back alignment, head position, stride length, and foot placement	Werema et al., 2022
Force Plate analysis	Objective, technological , research	It measures the vertical force applied by each foot on a specialized board built into the floor. Identifies the asymmetries of weight and force.	Ramanoon et al., 2018
Precision technologies (Sensors/Video)	Objective, Automated	It uses accelerometers, pressure sensors or computer vision systems to continuously monitor the walking patterns, speed and back positions, recording automatic data.	Silva et al., 2021; Antanaitis et al., 2021
In-Parlour Scoring	Visual, Manual, Quick	A quick screening method that observes a single parameter (eg. Back position) while milking.	Werema et al., 2022
Direct clinical examination of the hoof	Clinic, Diagnostics	Physical detailed examination by a specialist in order to diagnose the specific lesion (eg: plantar ulcer, digital dermatities).	Kleinhenz et al., 2014

Interdigital dermatitis (DID) or "superficial digital dermatitis" is a superficial bacterial infection, polymicrobial, although is often associated with the presence of Dichelobacter nodosus, with chronic evolution of the skin from the interdigital space in cattle, without severe swelling of the entire foot above the hoof, it can progress and predispose the animal for more serious lesions, such as digital dermatitis or horn lesions (Bicalho & Oikonomou, 2013).

Non-infectious/mechanical diseases

These are predominantly hoof injuries resulting from mechanical trauma, management errors, shelter construction or nutritional deficiencies.

Foot ulcer is a lesion of the sole of the hoof, occurring as a result of excessive pressure on the corium (the living tissue that produces the hoof horn) causing inflammation and disruption of healthy horn production. Factors include hard concrete surfaces, excessive time spent standing (eg. waiting for milking), incorrect hoof trimming and subclinical ruminal acidosis.(Van Amstel et al., 2003; Bednarski, 2015).

White line disease (WLD). The white line is the junction area between the sole of the foot and the outer wall. It is a structurally weak area. WLD appears when the pebbles, impurities or excessive pressure enters in this junction, creating a crack or abscess. (Blowey, 2015). The formed abscess can erupt at the crown level. Risk factors are similar to those for plantar ulcers. (Barker et al., 2009).

Hoof hematomas/bleeds (also known as foot bleeds or contusions) represent common subclinical lesions characterized by the leakage of blood from the blood vessels of the corium (the living tissue beneath the horn) inside the horn layer of the hoof. They are caused by mechanical trauma, excessive pressure on the sole (prolonged standing on concrete, hard surfaces), or by weakening of the horn structure. They can be key indicators of subclinical lesions and direct precursors of serious lesions such as foot ulcers. (Machado, V.S., et. Col., 2010).

Foot disease incidence

The incidence of foot disease varies significantly between farms and geographical regions, being influenced by the production system (intensive vs extensive), climate, breed and management practices.

Digital dermatitis is considered the most spread infectious hoof disease worldwide in industrialized dairy farms. The prevalence in

affected herds can reach alarming levels. For including Romania, report average prevalences of clinical lameness ranging between 10% and 50% or even more, although the prevalence of DD itself can be much higher, reaching 70-90% in some large farms. (Palmer & O'Connell, 2015).

Non-infectious diseases, such as foot ulcers and white line disease are also common example, case studies from various countries, and often directly related to structural factors of the shelter and hoof trimming. The evaluation of the frequency is crucial to implement appropriate preventive measures and to estimate the real economic impact. (Lopes Júnior et al., 2012).

Table 2

Average prevalence of foot diseases in cattle based on international literature
(Thomsen et al., 2023; Roche et al., 2024; Blowey, 2015; Refaai et al., 2013).

Foot problem	Average frequency (%)	Main category
Digital dermatitis (DD)	15% - 70%	Infectious
White line disease	5% - 25%	Non-infectious
Foot ulcer	5% - 20%	Non-infectious
Interdigital dermatitis	5% - 15%	Infectious
Interdigital phlegmon	1% - 10%	Infectious
Hematomas/Bleeds	5% - 15% (as a distinct lesion)	Non-infectious

Treatment methods and therapeutic protocols

Effective treatment of foot diseases requires an accurate and early diagnosis (by using scoring methods) to identify affected animals before lameness becomes severe (Flower & Weary, 2009) and a quick intervention, often combining pain management, local or systemic therapy and hoof grooming.

Physical and surgical therapies

These are the basis of management of horn and structural lesions.

Functional and corrective grooming is a fundamental procedure. Standardized techniques, described by various authors (Shearer & van Amstel, 2001; Manske et al., 2002), aim to rebalance the weight on the four hooves, reduce pressure on the painful areas and remove the necrotic or weakened horn. After the removal of necrotic and soft tissue or weakened horn, an oxygen microenvironment is formed, preventing the replication of anaerobic microbes and abscess formation. If the procedure is performed without damaging the healthy tissue of the dermis, the pain after the procedure is minor and the animal recoveres faster.

Hoof block is a vital method for the treatment of foot lesions such as ulcers or white line abscesses (Van Amstel et al., 2003). A wooden or rubber block is applied, glued on the healthy hoof (medial to the hind feet) to life and completely deviate the weight from the affected hoof, allowing the exposed corium to heal. This method is considered to be essential by many practitioners (Kleinhenz et al., 2014).

Excision of necrotic tissue.

In cases of severe fusobacteriosis or extensive abscesses meticulous removal of necrotic tissue, foreign bodies and pus is necessary to allow the access for topical and stimulate healing (Bednarski, 2015).

There are some cases when it may be necessary to apply a dressing, which is usually a thick layer of cotton wool soaked in zinc/copper sulfate, or an antibiotic (usually tetracycline or oxytetracycline in powder or spray form), possibly formalin, which is then fixed with a bandage. This type of treatment is used for toe injuries, digital dermatitis or atypical digital dermatitis. The dressing protects the wound against infection and it is recommended that the animal stands on a dry surface. The dressing applied should not be too tight because it can prevent blood circulation in the hoof, and also the healing of the wound, because the supply of nutrients is obstructed. Van Amstel, si col., 2003 often observed that, in animals with dressings, damaged hooves heal more slowly than in those without dressing.

Pharmacological therapies

The use of medications is complementary to physical interventions and is essential for controlling infection and pain.

Nonsteroidal anti-inflammatory medications are crucial for the management of the pain and inflammation associated with lameness. These medications (meloxicam, flunixin meglumin) not only reduce animal suffering (Ramanoon et al., 2018), but also improve recovery rates and subsequent performance (Wilson et al., 2022). Their administration is recommended both at the time of diagnosis and also in some protocols, preventively at calving (Wilson et al., 2022).

Topical treatments

For digital dermatitis, local treatments are the first line of defense. Solutions based on oxytetracycline, copper sulfate or zinc are applied directly on the cleaned lesion (Shearer et al., 2015; Berry et al., 2012). Effectiveness depends on correct and repeated application. Studies have evaluated various formulations, including those without antibiotics, to reduce antimicrobial resistance (Afonso et al., 2021).

Systemic antibiotics are used in severe or chronic cases, or when the infection has penetrated deep into the profound structures (e.g., severe interdigital phlegmon, osteomyelitis). It is preferable that the used antibiotics have a "0" day withdrawal period for milk, especially in the case of dairy cattle. (e.g., ceftiofur, etc.).

Control and prevention at herd level

Prevention aims to reduce exposure to risk factors and increase animal resistance (Roche et al., 2024).

Reducing the exposure to moisture and faeces by a rigorously cleaning of the stable floors and ensuring a dry bedding thus minimizing risk factors (Barker et al., 2009; Palmer & O'Connell, 2015).

Footbaths are used both preventively and as a mass treatment. Footbaths use solutions such as zinc or copper sulphate or diluted formaldehyde to reduce bacterial load and treat the incipient lesions (Bicalho & Oikonomou, 2013). Consistent use of these footbaths represents an effective and recommended control of foot diseases in cattle, especially digital dermatitis (Potterton et al., 2012)

CONCLUSIONS

Foot disorders in cattle represent a complex of animal health, welfare and economic management problem due to the frequency with which it still persists on many cattle farms (Thomsen et al., 2023), especially in dairy farms. The multifactorial nature of the diseases (infectious, environmental and nutritional factors) require a complex approach from the veterinarians and farmers.

The scientific literature provides clear evidence that early intervention, accurate diagnosis (Afonso et al., 2021) and appropriate treatment protocols are the key to success. Preventive measures such as maintaining superior shelter hygiene, optimizing nutrition to strengthen the hoof horn (Laven & Logue, 2006) and regular and correct hoof trimming are essential to reducing the incidence of foot pathology.

Although significant progress has been made in understanding and treating these diseases, the challenge remains to consistently implement the best practices at the farm level (Leach et al., 2010). Integrated approaches and continuous monitoring are needed to minimize the negative impact of lameness on cattle herds.

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