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EFFECTIVENESS OF FORMALIN FOOTBATHS IN THE CONTROL OF DIGITAL DERMATITIS IN DAIRY COWS

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ABSTRACT

The aim of this study was to determine the effectiveness of formalin footbaths in the prevention of digital dermatitis. The study on more than 450 dairy cows lasted two years with the use of formalin footbaths in the first twelve months. The study showed that there was a decrease in the number of acute digital dermatitis (M2) in the formalin-free period compared to the formalin period (6.49 % and 12.1 %, respectively), with a significant difference between periods ($P < 0.05$). The number of chronic cases (M3/4) in the formalin-free group tended to be higher compared to the formalin one (22.3 % and 19.9 %, respectively), but the frequencies did not differ significantly between each other. In addition, there was no significant difference in the incidence of digital dermatitis overall. The results show the beneficial effect of footbath skipping on the occurrence of an acute, painful form of digital dermatitis.

Key words: dairy cows; digital dermatitis; formalin footbath

INTRODUCTION

Digital dermatitis (DD) is a major challenge in the modern dairy industry, causing painful, localized ulcerative lesions on the palmar and plantar surface of the hoof, near the coronary band, in the interdigital cleft, beneath the dew claws, and on the pastern skin. These lesions are more frequently found on the rear legs (82 %), with the majority (83 %) located along the proximal border of the interdigital space. Lesions are typically located on the plantar surface of the hindlegs, immediately proximal to the hoof [9]. Lesions are characteristic with a circular to oval shape and clear demarcation to adjacent, healthy skin with typical hypertrophied hairs. Chronic lesions have a typical granular surface. Causative agents for this disease are strongly suspected to be spirochete bacteria of genus *Treponema* spp. Several new scoring systems have been developed to describe the different stages of DD lesion morphology, primarily for research purposes. The "M" scoring system tracks macroscopic changes from a healthy bovine foot to an advanced DD lesion, with M2 (Fig. 1) representing an acute, painful stage, and M4 (Fig. 2) indicating a chronic,

Fig. 1. Acute digital dermatitis (M2)

Fig. 2. Chronic digital dermatitis (M4)

non-painful form [9]. DD outbreaks can lead to widespread lameness in herds, impacting both cattle welfare and productivity [13]. Furthermore, the disease causes significant financial losses in the cattle industry, resulting from reduced milk production, lower fertility rates, and increased premature culling [18]. The most common way of introducing the disease is the import of infected animals from infected herds. It is also possible to be transmitted by other indirect ways, by equipment and dirty shoes [15]. Digital dermatitis is commonly treated by individual treatment together with collective herd treatment with footbaths [14]. Despite this Koch's postulates have not been fulfilled with no efficient vaccine developed yet either [16].

Prevention of DD includes prevention of transmission between herds; demanding proper documentation on importing new animals into the herd, exposure to footbaths upon leaving the original farm before transport, isolation upon arrival and use of footbaths during the first two weeks in the new farm, have regular inspections of the animals in a chute, buy animals from DD-free herds, limit visitors into the facility and the use of imported equipment from abroad countries [4]. The use of footbaths in the dairy industry for the control of infectious hoof disease is widespread around the world. Most confinement housed dairy herd owners use a regular footbath protocol, and frequent use was a feature of the well-managed freestall housed dairy herds maintaining high levels of milk production with low levels of lameness in a recent survey [6]. However, the benefits of footbaths are not universally accepted, because some authors have associated footbath use with increased risk for lameness problems [1].

The objective of this study was to determine the effectiveness of formalin footbaths in the prevention of digital dermatitis.

MATERIALS AND METHODS

The study was performed on a dairy farm with a regular claw trimming/treatment (twice yearly/every week); farm feeding management was based on total mixed ration (TMR), and the dairy cows were housed in free stalls with straw bedding. Average year milk yield was 8,500 litres. The follow-up was spread over a period of two years. In the first year, a footbath with 5 % formalin solution was applied three times a week, through which the cows passed after milking. The footbath was 3 m long, 1 m wide, and 0.25 m deep. The disinfection solution was changed after 150 to 160 milking cows. In the second year of the study,

footbath was omitted. Data on the incidence of digital dermatitis (acute and chronic forms/M2 and M4) were recorded at each functional hoof treatment and treatment of lame dairy cows.

Differences in the incidence of digital dermatitis between the two years were assessed for their statistical significance using the chi-square test (X^2).

Ethical statement

All procedures concerning the animals were performed in compliance with the national guidelines for animal care.

RESULTS

During the first year of our study using formalin footbath, acute digital dermatitis occurred in 12 % of the dairy cows. Examination of the claws further showed that during this period, skin changes in the coronal area, typical of chronic digital dermatitis, affected almost one-fifth of the animals. In the period without the use of a footbath, the incidence of the acute form of digital dermatitis was only about half the number ($P < 0.05$) that was recorded during the year with the use of a bath (6.49 %). At the same time, the number of dairy cows with chronic digital dermatitis appeared to be unaffected by the use of disinfectant footbath to prevent the disease. In addition, there was no significant difference in the incidence of digital dermatitis overall. (Table 1).

Table 1. Rate of acute and chronic digital dermatitis in dairy cows with or without formalin footbath.

Index	5 % formalin	No formalin
Total cows	487	462
Digital dermatitis overall	156 (32 %)	133 (28.8)
Acute digital dermatitis (M2)	59 (12.4 %)	30 (6.49) *
Chronic digital dermatitis (M3, 4)	97 (19.9 %)	103 (22.3 %)

* $P < 0.05$ (X^2)

DISCUSSION

There is a general view that the use of footbath is important in the control of infectious claw diseases in cows, but their use in practice is associated with many issues. Footbathing is currently the most widely used herd-level control strategy for DD, but there is significant variation in the types of products, concentrations, and frequencies applied. A recent Canadian study found that 87 % of 141 free stall farms used footbaths, with each farm utilizing between 1 to 4 different products [17]. The most commonly used products were copper sulfate ($CuSO_4$) and formalin. However, $CuSO_4$ poses environmental risks due to soil accumulation [10, 11, 12], and formalin is a known carcinogen [8], highlighting the need for safer alternatives. The effectiveness of footbath protocols is inconsistent, with most evidence being anecdotal or based on clinical experience. Comparing these protocols is challenging, as the literature includes a wide range of products, concentrations, frequencies of use, and comparators, making direct assessments difficult. Most authors agree that the technical aspects of implementing footbath are considerably complex, and compliance with them determines the outcome [7]. To immerse the hind limbs twice, the bath vessel needs to be at least three meters long and allow a 15 cm level of the disinfectant solution, which corresponds to the parameters of the disinfectant footbath used in our study. As the cows pass through the footbath, the solution is consumed and at the same time, its concentration (urine output) decreases. In our study, the solution was replaced after 150–160 dairy cows had passed through, which was in line with the general recommendation [3]. According to this author, the minimum bactericidal concentration to kill treponemes was 0.33 % at 20 % hoof contamination with treponemes. It is common to work with a formalin concentration of 3–5 % to achieve sufficient penetration into the epithelium, hair follicles and any granulation or hyperkeratotic tissue. It is possible to increase the effect of the disinfectant solution by pre-washing the claws after milking, but this is not always easy. Formalin is considered to be a dangerous substance and therefore contact with it should be shortened and the concentration of the solution should be kept as low as possible. D o a n e and S a r e n b o [8] investigated the exposure of farm workers and animals to formalin/formaldehyde during the use of formalin footbaths, focusing on the final concentration of formalin in the solution. They discovered that the expected concentration of 5 % was actually only 3 % in the footbath. Additionally, they observed that the concentration frequently drops below 3 %, and in some cases, even below 2 %, due to the rapid contamination of the disinfectant solution with organic matter such as urine and feces. They highlighted that when the concentration falls below 2 %, the antiseptic effectiveness is greatly reduced, leading to wasted time,

money, and losses for the dairy farmer, as the cows are subjected to a stressful procedure with minimal benefit.

It is generally believed that frequent disinfectant baths can have a preventive effect on digital dermatitis. Their frequency is not clearly established and frequent use is associated with increased health risks for staff and high financial costs. Several breeders report that they have seen a good preventive effect of disinfectant baths on the incidence of new cases of digital dermatitis when used twice daily once or up to three times a week [3]. In our follow-up, the concentration of formalin used and the frequency of its application did not lead to a reduction in the number of dairy cows with acute digital dermatitis. Going through a formalin footbath is always associated with pain in acute digital dermatitis, to which dairy cows may react by refusing to enter the disinfectant solution.

Despite a large number of trials aimed at testing different types of disinfectant baths, convincing evidence of their acceptable efficacy for the prevention and control of digital dermatitis in the herd has so far failed to be obtained [2]. There are indications that various disinfectants may be effective in ameliorating the acute form of digital dermatitis, but data on their protective effect on healthy skin are lacking [3]. It appears that current science cannot clearly answer the question of whether early treatment of acute cases is comparable to the effect of disinfectant baths [13]. Similarly, footbaths have a significant role to play in the control of infectious hoof disease in confinement housed dairy facilities, but they are not a replacement for good hygienic practices and lame cow surveillance and treatment [5].

CONCLUSIONS

Based on the results of this study, it can be concluded that our results show the beneficial effect of footbath skipping on the occurrence of an acute, painful form of digital dermatitis.

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