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Effect of a tea tree oil and organic acid footbath solution on digital dermatitis in dairy cows

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ABSTRACT

Copper sulfate is the industry gold standard footbath ingredient for controlling dairy cow digital dermatitis. However, when used footbath solutions are deposited on soil, high levels of copper in the soil may result, which can have toxic and negative effects on plant growth. An alternative to copper sulfate is Provita Hoofsure Endurance (Provita Eurotech Ltd., Omagh, UK), which is a biodegradable solution containing organic acids, tea tree oil, and wetting agents. 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 3 commercial dairy herds. This study was conducted from January 5, 2012, to March 19, 2012, in 3 commercial Kentucky dairies with 120, 170, and 200 milking Holstein cows. None of the herds was using a footbath for digital dermatitis control before the study. Footbath solutions were delivered using a split footbath. During the study, a 3% Hoofsure Endurance solution for the left hooves and a 5% copper sulfate solution for the right hooves was used. Digital dermatitis was scored every 3 wk using the M0 to M4 system, where M0 = a claw free of signs of digital dermatitis; M1 = a lesion <2 cm that is not painful; M2 = the ulcerative stage, with lesion diameter of >2 cm, and painful to the touch; M3 = the healing stage and covered by a scab; and M4 = the chronic stage and characterized by dyskeratosis or proliferation of the surface that is generally not painful. McNemar's test statistic suggested that a statistically significant difference existed in the proportions of M1 and M2 lesions between the beginning and end of the study for both treatments. This indicates that each solution was effective in decreasing the proportion of M1 or M2 lesions from baseline to the last time point. A chi-square test calculated using PROC FREQUENCY of SAS (SAS Institute Inc., Cary, NC) indicated that no statistically significant relationship existed between the treatments among changes in digital dermatitis frequency from the baseline to the end of the study. Performance of the 2 footbath solutions was comparable throughout the study. No significant differences were observed between the copper sulfate and Provita Hoofsure Endurance.
Key words: dairy hoof care, digital dermatitis, copper sulfate, tea tree oil, split footbath

INTRODUCTION

Digital dermatitis, more commonly known as a hairy heel wart, is one of the leading causes of dairy cattle lameness (Laven, 2001). Cheli and Mortellaro (1974) first described this infectious disease in Italy. It is a painful dairy cattle disease that affects animal welfare, production, and farm profitability. Digital dermatitis is a circumscribed superficial ulceration of the skin along the coronary band, often on the plantar interdigital ridge of the rear foot (Greenough et al., 2008). It has been described as "a reservoir of infection," and comprises bacteria in the epidermal skin of the heel of cattle (Blowey, 2005, 2007). The infection is caused by multiple species of anaerobic spirochete bacteria. It is erosive and affects both the skin and bulb, but it can also be identified between the claws (Döpfer et al. 1997). Digital dermatitis is present in 70 to 95% of dairy herds, with herd prevalence rates averaging between 20 to 30% in Europe and the United States (Holzhauer et al., 2008a; Capion et al., 2008; Cramer et al., 2008; Barker et al., 2009). Digital dermatitis is a problem not only for welfare reasons, but also for economic reasons (Laven, 2001). Early diagnosis and prevention are helpful because a subclinical case costs an average of $18 per cow, whereas a clinical case costs an average of $95 per cow (Bruijnis et al., 2010). Risk factors for contracting digital dermatitis include low parity (i.e., younger animals), low DIM, confinement, high production, wet corrals, and presence of interdigital dermatitis or interdigital hyperplasia (Rodríguez-Lainz et al., 1996, 1999; Somers et al. 2005).

To promote improved hoof health, milk production, and animal welfare, dairy producers use a variety of preventative and treatment measures. Footbaths may be an effective method for prevention, although some

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research demonstrates that effectiveness is not universal (Laven and Logue, 2006; Thomsen et al., 2008b). Additionally, poorly managed footbaths may actually increase the spread of digital dermatitis. Dairy farmers use many different types of solutions in footbaths; however, many of the compounds have adverse effects on the cows, handlers, or the environment. The industry standard to treat digital dermatitis is a copper sulfate footbath (Cook et al., 2012; Logue et al., 2012; Speijers et al., 2012). However, copper sulfate may reach the soil and eventually cause toxic effects to the environment and have a negative effect on the cow (Bolan et al., 2003; Blowey, 2005). High levels of copper in the soil may have toxic and negative effects on plant growth. Formalin is also often used in footbaths; however, concerns exist with its use because it is a carcinogen. Provita Hoofsure Endurance (Provita Eurotech Ltd., Omagh, UK) is a biodegradable footbath solution containing organic acids, tea tree oil (primary antimicrobial), and wetting agents without the negative environmental concerns of copper sulfate. The primary active antimicrobial ingredient in this product has been shown to have antimicrobial effects and antiinflammatory effects (Halcón and Milkus, 2004; Taga et al., 2012). 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 3 commercial dairy herds.

MATERIALS AND METHODS

This study was conducted from January 5, 2012, to March 19, 2012, in 3 commercial Kentucky dairies with 120, 170, and 200 milking Holstein cows. None of the herds was using a footbath or any other prevention or treatment for digital dermatitis control before the study. Footbath solutions were delivered using a split footbath (Intra Bath; IntraCare BV, Veghel, the Netherlands), with each side measuring 32.5 cm wide by 233 cm long, allowing for 80 L of solution per side. Each side was separated by a 25-cm wide and 29-cm high ringed divider. The spaces in between the rings prevented splash over from contaminating the solution on the opposite side. Split footbaths are commonly used when comparing hoof care products (Gradle et al., 2006; Holzhauer et al., 2012; Logue et al., 2012). The advantage of using a split footbath is that cow and environmental factors are accounted for within the study design. Cows were provided the footbath solutions once daily during the same 5 milkings each week with no footbath used on the other 2 d. No prebaths were used and no treatment measures were used for any cow during the study. Hooves were not washed before cows left the parlor. A 5% copper sulfate solution was used on one side and 3% Provita Hoofsure Endurance on the other side.

Rear hooves were scored for digital dermatitis once before treatment was initiated and then every 3 wk (scoring 1, 2, and 3) for the remainder of the study. The cows were always scored during milking at the same milking after washing feet, on the same day of the week and by the same person. The scorer wore a headlamp to ensure sufficient lighting while scoring. Thomsen et al. (2008a) demonstrated that scoring during milking was a reliable alternative to scoring during hoof trimming. The person performing the scoring was blind to which side was being treated with which product to prevent bias. The scoring system consisted of 5 stages (M0 to M4; Döpfer et al., 1997). On this scale, M0 signifies a claw free of signs of digital dermatitis; M1 is a lesion <2 cm and is not painful; and M2 is a lesion in the ulcerative stage, with a diameter of >2 cm and painful to the touch. Although pain was not recorded in this study, when determining a lesion that was between the M1 and M2 stage, the lesion was gently touched to see if pain was evident. Stage M3 is the healing stage and is covered by a scab and M4 is the chronic stage and is characterized by dyskeratosis or proliferation of the surface that is generally not painful. For analysis, the frequency of hooves with an active lesion (M1 or M2) was compared with the frequency of those without an active lesion (M0, M3, or M4). The FREQ Procedure of SAS (SAS Institute Inc., Cary, NC) was used to determine digital dermatitis prevalence with each observation period considered independently. The FREQ procedure of SAS was used to perform McNemar's test and a chi-square analysis of changes in digital dermatitis from the beginning to the end of the study. For each solution, the number of cows having an M1 or M2 lesion was collected at baseline and the last time point. These counts were then entered into a 2×2 contingency table. For this analysis, only cows ($n = 286$) observed at each scoring throughout the study were included, allowing for statistical comparisons of frequencies across time in the same animals. Reasons for removal included drying off, culling, or missed observations.

RESULTS AND DISCUSSION

Overall, digital dermatitis frequencies are presented in Table 1. The frequency of infected hooves was reduced from 57 to 39% for left and right rear hooves, respectively. The digital dermatitis on the hind legs reduction rate was almost identical for both solutions during the study. Even though this data does not differentiate between products, it supports that footbaths are an effective method of reducing digital dermatitis (Holzhauer et al., 2008b; Teixeira et al., 2010; Speijers