Effects of the addition of electrolyzed water to a footbath solution on digital dermatitis incidence

Abstract

Digital dermatitis (DD) can cause lameness and pain in dairy cows. The objective of this 11-week study, conducted at the University of Kentucky Coldstream Dairy Research Farm, was to test the effects of electrolyzed water, in a copper sulfate solution on DD. A split, plastic footbath was used to deliver two footbath solutions. The control solution, assigned to the left hooves of the cow, contained 79.5L of water with 1.75kg of copper sulfate, and 325ml of acidifier. The treatment solution, assigned to the right hooves of the cows, contained the same solution as the control side with the addition of 7.5L of electrolyzed water. The footbath solutions were made Monday thru Friday before morning milkings. Cows walked through the footbath while exiting the milking parlor once a day. The solutions were dumped after the completion of morning milkings. Holstein cows (n=77) DD were scored biweekly in the milking parlor to determine active or inactive DD. Rear hooves were hosed off to remove debris before being evaluated. A headlamp was worn to provide clarity of hooves while scoring. The FREQ Procedure of SAS (SAS Institute, Cary, NC) was used for a chi-square analysis and a McNemar’s test was used to compare the number of hooves with active DD to the number of hooves with non-active DD. No significant differences in DD between the control and treatment groups existed (P>0.05); however, over the course of the study, both footbath solutions improved DD overall (P<0.01). These results suggest that the addition of electrolyzed water in a footbath solution had no negative effect on DD. Keywords: digital dermatitis, footbath, hoof health, copper sulfate

Introduction

Digital dermatitis (DD) is a pressing issue in the dairy industry. Digital dermatitis is an infection caused by a spirochete infection on the back of the hoof, between the claws. The bacteria known as Treponema spp. are believed to be the causative agent of DD. The infection is likely to cause inflammation, which is the foundation for skin damage, pain, discomfort, and lameness.

If not prevented or treated, DD can cause serious economic losses. A footbath offers a low maintenance, low labor solution to the prevention and treatment of many hoof diseases, including DD. On average, the cost per DD case is $132.96. Therefore, the objective of this study was to explore electrolyzed water as a possible footbath additive along with copper sulfate on the prevention of DD.

Materials and methods

This study was approved by the University of Kentucky Institutional Animal Care and Use Committee (IACUC protocol number: 2016-2361) and was conducted at the University of Kentucky Coldstream Dairy Research Farm from April 26, 2016 (baseline) to July 5, 2016 (end). Holstein cows (n=77) were separated into two groups that were balanced by DIM and parity and were housed in a compost bedded pack barn. The dimensions of the whole barn were 46.3m by 40.2m. Kiln dried sawdust was used in the pack which was stirred twice daily. A TMR was delivered in the morning and afternoon to meet the lactating cow nutritional needs. Sprinklers and fans were placed over the feed bunk which used a feed line headlock system. The compost bedded pack barn was located 60.02meters from the milking parlor.

Digital dermatitis was scored before the footbath was applied to establish a baseline for the study. Hooves were trimmed by a professional hoof trimmer every 6months before starting the study. The footbath solution was disposed of after morning milkings because of the ineffectiveness of electrolyzed

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No significant difference in DD existed between hooves with the control or treatment solutions (P≥0.05; Table 1). These results suggest that electrolyzed water had no negative effect on the effectiveness of a copper sulfate footbath solutions on DD. Zero cows developed new DD over the course of the study (Table 1). Sixty-seven hooves and sixty-four hooves began and ended the study with no DD present for control and treatment solutions, respectively (Table 1). These results provide evidence that routine footbath treatments are an effective way of preventing new DD.

The number of non-active lesions decreased throughout the entirety of the study (Table 2). These hooves went from scores of M3 or M4 to scores of M0, or having no lesion present. Active lesions increased from 2 to 10 and 3 to 11 for the control side and treatment side, respectively (Table 3). Scores of M0, which indicated no DD, decreased and scores of M1, which indicated the beginnings of DD, increased (Table 4). However, no significant different between the treatments was found (P≥0.05). The cause of this increase in active lesions may have been related to the excess manure in the barn. The alley is scraped only once per day. Scraping more than once per day reduces the incidence of clinical lameness cases.1

Table 1 Presence of active and inactive digital dermatitis at baseline and end1,2,4

| Item | Control | Treatment |
|------|---------|-----------|
| No lesion at Baseline and no lesion at End | 67 | 64 |
| No lesion at Baseline and lesion at End | 0 | 0 |
| Lesion at Baseline and no lesion at End | 8 | 12 |
| Lesion at Baseline and lesion at End | 2 | 1 |

1 The baseline of the study was April 26, 2016 and the end was July 5, 2016
2 A McNemars Test for control was used to produce these results
3 The scoring system used consisted of five different scores. The scores ranged from M0 to M4 where M0 indicated no DD present, M1 indicated the beginnings of DD, M2 indicated active DD, M3 indicated the scabbing or healing DD, and M4 indicated keratinized and protruding DD.
4 A split footbath was used for the treatment and prevention of DD. The solutions were a control side, assigned to the left legs of the cow, which consisted of 79.5L of water with 1.75kg of copper sulfate, and 325 mL of acidifier. The treatment side, assigned to the right legs of the cows, contained the same solution as the control side (79.5L of water with 1.75kg of copper sulfate, and 325 mL of acidifier) with the addition of 10% (7.5Litters) of electrolyzed water.

Table 2 Raw frequency for non-active digital dermatitis at baseline and end1,2,4

| Scoring | Control [no. (% of Hooves with digital dermatitis)] | Treatment [no. (% of Hooves with digital dermatitis)] |
|---------|--------------------------------------------------|--------------------------------------------------|
| Baseline | 75 (26.6)                                        | 74 (26.24)                                       |
| End     | 67 (23.76)                                       | 66 (23.40)                                       |

1 The baseline of the study was April 26, 2016 and the end was July 5, 2016
2 The FREQ Procedure was used to produce these results
3 The scoring system used consisted of five different scores. The scores ranged from M0 to M4 where M0 indicated no DD present, M1 indicated the beginnings of DD, M2 indicated active DD, M3 indicated the scabbing or healing DD, and M4 indicated keratinized and protruding DD.
4 A score of M0, M3, or M4 are considered inactive lesions. A score of M1 or M2 are considered active lesions.

Electrolyzed water has no negative effects on the environment. Electrolyzed water was produced from a single stream of water after 6 hours upon being exposed to organic material. The footbath was rinsed with water before each use to eliminate debris. A split, plastic footbath (Intra Bath; Diamond Hoof Care LTD. Diamond City, Alberta, Canada) with each side being 32.5 cm wide and 233 cm long was used to deliver two footbath solutions. The footbath was placed in the exit alley of the milking parlor. The control solution, assigned to the left hooves of the cow, contained 79.5L of water with 1.75kg of copper sulfate, and 325 mL of acidifier. The treatment solution, assigned to the right hooves of the cows, contained the same solution as the control side with the addition of 7.5L of electrolyzed water. The electrolyzed water was produced from a single stream electrolyzed water generator.

A five-point scoring system was used to classify the stages of DD for the rear hooves of each cow. These scores were assigned in the milking parlor. Scores ranged from M0 to M4 where M0 indicated no DD present, M1 indicated the beginnings of DD, M2 indicated active DD, M3 indicated scabbing or healing DD, and M4 indicated keratinized and protruding DD.10 To provide a clear view of each hoof for scoring, cow hooves were sprayed with water. A flashlight was used to visually evaluate the hooves.

The FREQ Procedure of SAS (SAS Institute, Inc., Cary, NC) was used to produce a chi-square analysis and a McNemer’s test to analyze the deviations of DD from the beginning to end of the study. The FREQ procedure was also used to analyze the amount of DD at each scoring independently. The analysis compared the number of hooves with active DD (scores of M1 and M2) to the number of hooves with non-active DD (scores of M0, M3 and M4). The FREQ procedure analysis consisted only of cows that were present throughout the entire study. Cows that went dry, had missing data, or that were culled were excluded from all analyses.

Results and discussion

No significant difference in DD existed between hooves with thecontrol or treatment solutions (P≥0.05; Table 1). These results suggest that electrolyzed water had no negative effect on the effectiveness of a copper sulfate footbath solutions on DD. Zero cows developed new DD over the course of the study (Table 1). Sixty-seven hooves and sixty-four hooves began and ended the study with no DD present for control and treatment solutions, respectively (Table 1). These results provide evidence that routine footbath treatments are an effective way of preventing new DD.

Over time, both the control and treatment sides significantly improved the DD present and the overall number of active lesions decreased (P≥0.01; Table 1). Eight hooves from the control solution and twelve hooves from the treatment solution presented a lesion at the baseline of the study and presented no lesion at the end. This may be due to the cows moving to a composted bedded pack barn. The herd moved into this barn before the beginning of this study. The cows were previously housed in a free stall barn.

The alley is scraped only once per day. Scraping more than once per day reduces the incidence of clinical lameness cases. After use, electrolyzed water reverts back to its original state of regular water.11 Using electrolyzed water in footbath solutions is an environmentally safe way to ensure antimicrobial activity.
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Table 3: Raw frequency for active digital dermatitis at baseline and end\textsuperscript{1,2,3,4}

| Scoring | Control [no. (% of hooves with digital dermatitis)] | Treatment [no. (% of hooves with digital dermatitis)] |
|---------|-------------------------------------------------|--------------------------------------------------|
| Baseline | 2(7.69)                                          | 3(11.54)                                          |
| End      | 10(38.46)                                        | 11(42.31)                                         |

\textsuperscript{1}The baseline of the study was April 26, 2016 and the end was July 5, 2016

The FREQ Procedure was used to produce these results

A split footbath was used for the treatment and prevention of DD. The solutions were a control side, assigned to the left legs of the cow, which consisted of 79.5L of water with 1.75kg of copper sulfate, and 325 mL of acidifier. The treatment side, assigned to the right legs of the cows, contained the same solution as the control side (79.5 L of water with 1.75kg of copper sulfate, and 325mL of acidifier) with the addition of 10% (7.5 liters) of electrolyzed water.

Table 4: Raw frequency of severity of total (hooves) digital dermatitis from baseline to end\textsuperscript{1,2,3,4}

| Scoring | M0 | M1 | M2 | M3 | M4 |
|---------|----|----|----|----|----|
| Baseline | 22 | 5  | 0  | 123| 4  |
| End      | 10 | 19 | 2  | 123| 0  |

\textsuperscript{1}The baseline of the study was April 26, 2016 and the end was July 5, 2016

The FREQ Procedure was used to produce these results

A split footbath was used for the treatment and prevention of DD. The solutions ranged from M0 to M4 where scores M1 and M2 represented active DD.\textsuperscript{10}

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Conclusion

The objective of this study was to test for negative effects of electrolyzed water in a footbath solution. No significant difference in DD incidence existed between the control and treatment solutions. Therefore, electrolyzed water had no negative effects on the prevalence of DD. These results suggest that electrolyzed water footbaths perform well in footbath solutions.

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Conflict of interest

The research of this study remained unbiased throughout the entity of the study. The faculty, staff, and researchers reported all data honestly as it was collected.

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