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Evaluation of a clay-based acidic bedding conditioner for dairy cattle bedding

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ABSTRACT

This study investigated the effects of a clay-based acidic bedding conditioner on sawdust bedding pH, dry matter (DM), environmental pathogen counts, and environmental bacterial counts on teat ends of lactating dairy cows. Sixteen lactating Holstein cows were paired based on parity, days in milk, milk yield, and milk somatic cell count, and were negative for the presence of an intramammary pathogen. Within each pair, cows were randomly assigned to 1 of 2 treatments with 3-wk periods in a crossover design. Treatment groups consisted of 9 freestalls per group bedded with either untreated sawdust or sawdust with a clay-based acidic bedding conditioner, added at 3- to 4-d intervals over each 21-d period. Bedding and teat ends were aseptically sampled on d 0, 1, 2, 7, 14, and 21 for determination of environmental bacterial counts. At the same time points, bedding was sampled for DM and pH determination. The bacteria identified in the bedding material were total gram-negative bacteria, *Streptococcus* spp., and coliform bacteria. The bacteria identified on the teat ends were *Streptococcus* spp., coliform bacteria, and *Klebsiella* spp. Teat end score, milk somatic cell count, and intramammary pathogen presence were measured weekly. Bedding and teat cleanliness, environmental high and low temperatures, and dew point data were collected daily. The bedding conditioner reduced the pH, but not the DM, of the sawdust bedding compared with untreated sawdust. Overall environmental bacterial counts in bedding were lower for treated sawdust. Total bacterial counts in bedding and on teat ends increased with time over both periods. Compared with untreated sawdust, the treated bedding had lower counts of total gram-negative bacteria and streptococci, but not coliform counts. Teat end bacterial counts were lower for cows bedded on treated sawdust for streptococci, coliforms, and *Klebsiella* spp. compared with cows bedded on untreated sawdust. The clay-based acidic bedding conditioner reduced environmental pathogens in sawdust bedding and teat ends without affecting teat end integrity.

Key words: bedding conditioner, sawdust, teat integrity

INTRODUCTION

Mastitis is the most prevalent disease affecting dairy cows. The estimated cost of mastitis to the dairy industry exceeds $2 billion per year (Schrick et al., 2001). Intramammary (**IMM**) pathogens causing mastitis can be transferred from other infected cows (contagious pathogens) or enter the mammary gland from environmental sources. Implementation of recommended milking procedures have resulted in a reduction in mastitis due to contagious pathogens; therefore, environmental organisms have increased in importance and are the focus of mastitis control programs for today's dairy industry (Hillerton and Berry, 2003). Environmental organisms are difficult to control because of the close proximity to udders and the ability of organic bedding to support bacterial growth (Hogan and Smith, 1997). Therefore, the type and quality of bedding is an important component of an effective mastitis control program. Sawdust is an organic bedding material that is widely used in confinement housing because of its regional availability and compatibility with manure handling systems (Zdanowicz et al., 2004). However, sawdust bedding increases in moisture and manure content with animal use and, in combination with an increase in sawdust pH to neutral levels, can promote growth of environmental organisms (Zehner et al., 1986).

Studies have shown a positive correlation between the number of mastitis pathogens in bedding and on teat ends of lactating dairy cows (Rendos et al., 1975; Hogan et al., 1989, 1990, 1999; Hogan and Smith, 1997; Zdanowicz et al., 2004). In addition, the risk for developing an IMI is highly associated with the number of mastitis pathogens found on the teat ends of dairy cows (Schreiner and Ruegg, 2003). Therefore, reducing the number of pathogenic bacteria in bedding reduces the risk of IMI due to environmental organisms.

Bedding conditioners have been used to maintain either alkaline or acidic conditions in bedding and reduce

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growth of environmental bacteria (Hogan et al., 1999). The optimum pH range for growth of many environmental bacteria is 4.4 to 8.7 (Beales, 2003), although *Klebsiella* spp. can survive in vitro at pH 3 (O'May et al., 2005). Bedding conditioners have reduced mastitis pathogens in bedding for up to 48 h; however, bacterial loads are more effectively reduced when using acidic bedding additives compared with alkaline conditioners (Hogan et al., 1999).

The teat orifice of the dairy cow is the first line of defense against an invading pathogen (Sordillo et al., 1997); as teat integrity declines, the risk of an IMI increases (Neijenhuis et al., 2000; Zadoks et al., 2001). Hogan et al. (1999) reported that alkaline and acidic bedding additives did not affect teat integrity based on visual observation. However, the effects of the bedding conditioner on teat condition were not documented in that study. Studies on the extent and duration of the effect of bedding conditioners on teat end bacterial counts and teat skin integrity have been limited.

Therefore, the objectives of the current study were to determine if the addition of an acidic clay-based bedding conditioner to sawdust decreased the moisture and pH of the sawdust bedding and reduced environmental pathogen counts in bedding and on teat ends of lactating dairy cows over 21 d without affecting teat integrity in mid-lactation Holstein cows.

MATERIALS AND METHODS

The experiment was conducted at the University of Connecticut Kellogg Dairy Center from August 7 to August 28, 2006, for period 1, and from September 11 to October 2, 2006, for period 2. The animals were cared for according to the protocols of the Institutional Animal Care and Use Committee at the University of Connecticut.

Animals and Housing

Sixteen lactating Holstein cows were paired based on parity (mean = 1.63 ± 0.5), DIM (mean = 165 ± 64.3), milk production (mean = 43.2 ±8.4 kg/d), and SCC (mean = 25,100 cells/mL). All animals had previously been housed in freestalls with mattresses and sawdust bedding. In addition, all animals on the study were vaccinated with a commercial vaccine to control coliform mastitis pathogens. Within each pair, cows were randomly assigned to 1 of 2 treatment groups in a 2-period crossover design. Each period consisted of 21 d of data collection, with 13 d between periods.

Cows were housed in 2 separate freestall pens (9 stalls per pen) with mattresses covered with heavy canvas and filled with shredded rubber. Each stall was 213 cm long and 127 cm wide and bedded with 10 cm of sawdust. Sawdust was stored indoors and 2 different batches of sawdust were used during each period. Cows were milked 3 times daily and were fed a corn silage-based TMR. Before the start of each period, stalls were cleaned, washed with a high-pressure hose, and sanitized with a 10% bleach solution. Treatment groups consisted of stalls with untreated sawdust (control, **CON**) and stalls with sawdust and the addition of a clay-based acidic bedding conditioner (**ABC**) containing 45 to 65% sulfuric acid. The 9 stalls of treatment group CON were bedded with untreated sawdust to a depth of 10 cm. Following the manufacturer's directions, 448 g of bedding conditioner was applied to the back one-third of each stall for treatment group ABC and sawdust was added to a depth of 10 cm. An additional 140 g of bedding conditioner was applied to the sawdust in the back one-third of each stall. Visible manure was removed from stalls and alleys 3 times daily during milking. On d 3, 7, 10, 14, and 17 of each period, sawdust was added to both treatment groups to maintain a depth of 10 cm, and 140 g of bedding conditioner was reapplied to treatment group ABC at the same time, according to the manufacturer's directions. Daily environmental high and low temperatures and dew points were recorded throughout the study.

Teat Cleanliness

Teat cleanliness scores were recorded for each cow at each milking throughout the study. Teat cleanliness was scored over a range of 1 to 4, based on cleanliness of each teat (1 = no bedding or manure; 2 = teat with less than one-fourth of teat surface area observed with any foreign material; 3 = teat with one-fourth to one-half of teat surface area observed with any foreign material; 4 = teat with greater than one-half of teat surface area observed with any foreign material). Daily averages were calculated for teat cleanliness for each cow within treatment groups.

Stall Cleanliness

Stall cleanliness was recorded daily during each milking prior to stall cleaning and scores were averaged by pen and day. The amount of manure in each stall was used as a criterion for cleanliness. A separate 127- × 127-cm grid made of PVC pipe and nylon rope to create a 3 × 3 arrangement of 9 equal squares was used for each treatment group. The grid was placed in the back half of each stall, and the 9 squares were scored on the basis of visible manure or moisture (adapted from Zdanowicz et al., 2004). The scores ranged from 0 to 5 (0 = clean sawdust; 1 = small amount of manure