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Effects of bedding with recycled sand on lying behaviors, udder hygiene, and preference of lactating Holstein dairy cows

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ABSTRACT

Effects of bedding with recycled sand and season on lying behaviors, hygiene, and preferences of late-lactation Holstein cows were studied. It was hypothesized that recycled sand will decrease lying time and increase hygiene scores due to increased moisture content and organic matter, and thus a preference for the control sand will be evident. Cows ($n = 64$) were divided into 4 groups ($n = 8$ per group) per season. In summer (August to September), cows were balanced by days in milk (268.1 ± 11.9 d) and parity (2.0 ± 0.2). In winter (January to February), mean DIM was 265.5 ± 34.1 d. Cows were assigned to 1 of 2 treatments using a cross-over design with each treatment lasting 7 d (no-choice phase): bedding with recycled sand (RS; $n = 32$) or control (CO; clean sand; $n = 32$). Stocking density was maintained at 100%. The choice phase allowed cows to have access to either treatment with stocking density at 50%. Accelerometers recorded daily lying time, number of lying bouts per day, lying bout duration (min/bout), and total steps per day. Teat swabs, milk, sand samples, and udder hygiene scores were collected on d 0, 3, and 7 of each experimental week. Samples were cultured for streptococci, staphylococci, and gram-negative bacteria. Video data were used to assess bedding preferences. All data were analyzed using the MIXED and GLIMMIX procedures of SAS 9.4 (SAS Institute Inc., Cary, NC). Lying time was not affected by treatment, but cows did take more steps during winter. Bacterial counts were elevated for cows on recycled sand. A preference was observed for clean sand during the summer, but no preference was observed for sand during the winter. Regardless of bedding, the most commonly observed behavior was lying in the stalls, which suggested either bedding might be suitable. Caution should be used with this interpretation of preference, as sand was recycled

only once. This limited reclamation was still sufficient to potentially alter the composition of sand, driving the observed preference. If these changes in composition continue, then the strength of the preference may also change. However, considering all variables within the current study, recycled sand is a viable bedding source to use for dairy cows.

Key words: dairy cows, bedding, behavior, hygiene, preference

INTRODUCTION

The interaction between a cow and her environment is critical for overall welfare and production. There is a very wide range of approaches for cow housing. One way to determine the suitability of a cow's environment is by evaluating her ability to achieve the recommended 12 to 13 h/d of lying (Jensen et al., 2005). Because cows spend a large portion of their day lying, the bedding surface is one of the primary, direct interactions she has with her environment. Although many different types of bedding are used within dairy farms, inorganic bedding such as sand can have less bacterial growth than organic bedding (Hogan et al., 1999a) and can increase lying time.

The bedding the producer chooses can affect the lying behavior of cows. Farms where sand was used for bedding had 50% of cows lying down at any given time compared with farms that used straw, sawdust, or composted manure, where only 40% of cows were observed lying down (Lombard et al., 2010). Lying bout durations have also been reported to be greater on sand-bedded stalls (92.0 ± 12.9 min) than with mattress (47.9 ± 7.4 min) or box compost stalls (46.1 ± 18.5 min; van Gastelen et al., 2011). This suggests that a greater comfort level could be associated with sand bedding.

Dry matter of bedding can also play a critical role in lying behaviors and cow health. When cows were housed in freestalls bedded with sawdust with a DM of 26.5%, lying time decreased by 5 h relative to freestalls with a bedding DM of 86.4% (Fregonesi et al., 2007). When cows were exposed to beddings with a DM of

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89.8 ± 3.7, 74.2 ± 6.4, 62.2 ± 6.3, 43.9 ± 4.0, and 34.7 ± 3.8%, lying time was decreased by 1 h on the wettest bedding relative to the others (Reich et al., 2010). Lying time was modestly affected until DM was reduced to 34% or below (Reich et al., 2010). This suggests bedding quality plays a role in lying behaviors.

Although bedding plays an important role in lying behaviors, it can potentially pose a threat to cow health. The relative risk of hygiene may vary depending on bedding because different bedding sources have different bacterial loads. Bacterial counts on teat ends were relatively low with cows housed on sand compared with cows housed on sawdust. However, more streptococci were found on teat ends when cows were housed on sand bedding (Zdanowicz et al., 2004), but clean sand was found to have the lowest growth of *Klebsiella pneumoniae* (Godden et al., 2008). These differences in bacterial loads are important because they give an indication of growth in sand. Bacterial counts for clean and recycled sand were comparable a week after bedding was added (Kristula et al., 2005), and Harner et al. (2009) reported that bacteria in recycled sand peaked at 72 h. Justice-Allen et al. (2010) found that recycled sand bedding is a source for *Mycoplasma* spp. bacteria, which can cause mastitis; however, when recycled sand was cleaned with a common disinfectant, *Mycoplasma* spp. could no longer be isolated.

Cow health is critical when assessing a bedding source; however, when taking into account cow comfort, preference should also be considered. Although both straw and sand were deemed sufficient based on the recommended 12 to 13 h/d lying time, when cows were given a choice, a preference was evident for straw over sand (Norrington et al., 2008). However, previous exposure with straw likely drove the observed preference. Cows that had previous exposure to sand spent equal amounts of time on sand and sawdust, whereas cows that spent most of their time on sawdust had previous exposure to sawdust (Tucker et al., 2003). Although recycled sand was suggested to be safe as a bedding source for dairy cows, this conclusion was based only on bacterial types and populations (Kristula et al., 2005). Evaluating recycled sand with a cow component to assess cow health has yet to be determined. Furthermore, the current understanding of cow preference has tended to focus on organic versus nonorganic bedding and quality of beddings. Conversely, no research has evaluated the preference of cows strictly between nonorganic beddings. Kristula et al. (2005) concluded there are differences between recycled and clean sand OM, particle size, and DM. This suggests that these factors may help drive a preference for clean or recycled sand and may alter the hygiene of cows. Determining the suitability

of a bedding source involves multiple factors such as cow behavior, cow preference, and cow health. The first objective of this study was to determine the effects of using recycled sand as bedding on lying behaviors and hygiene of late-lactation Holstein dairy cows. The second objective was to determine the preference between recycled sand and clean sand among late-lactation Holstein dairy cows.

MATERIALS AND METHODS

Animal Housing and Management

This study was conducted at the University of Tennessee's Little River Animal and Environmental Unit (Walland, TN). Sixty-four cows were used with 32 enrolled from August to September 2014 to evaluate summer response and 32 enrolled from January to February 2015 to evaluate winter response. Within each season, cows were assigned to 1 of 4 groups of 8 cows, which were balanced by DIM and parity during the summer (268.1 ± 11.9 d; 2.0 ± 0.2, respectively). In the winter, cows were only balanced by DIM (265.5 ± 6.0 d). All cows were pregnant during the summer; however, in the winter, 16 cows were nonpregnant. The breeding program used timed AI for all nonpregnant cows enrolled on the study. However, if cows were not successfully bred during the first cycle, visual heat was monitored. No evidence was observed of behavioral changes due to heat within the nonpregnant cows used in this study. Cows were milked twice daily between 0700 and 0900 h and 1730 and 1900 h. Cows were housed in a 4-row free stall barn. Cows were moved into experimental pens 2 d before the start of the study to allow for a habituation period. Two experimental pens were split into 2 smaller pens, where stalls were blocked off with gates to obtain 1 stall per cow totaling 8 useable stalls per pen. An equal number of freestalls were available on the back and feed bunk alley. The bed length was 2.4 m with a width of 1.2 m. Neck rail height was 1.2 m with the brisket board 1.7 m from the rear curb. Alleyways were flushed with water at 0730 and 1930 h to rid alleys of manure and other debris.

Feed bunk headlocks were blocked off to provide 8 useable headlocks per experimental pen. Cows were fed fresh TMR 2 times/d (0700 and 1530 h), and feed was pushed up twice daily. The TMR consisted of 60% corn silage, 25% pelleted premix grain concentrate, 12% small grain silage, and 3% dry hay. Water was available for ad libitum consumption from a ball trough (Ritchie Industries Inc., Conrad, IA). All procedures described were approved by the University of Tennessee Institutional Animal Care and Use Committee.

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