Effect of Two Bedding Conditioners on Bacteria Counts and pH in Shavings, Digested Manure Solids and Recycled Sand Bedding

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Introduction

Environmental exposure to coliform bacteria (e.g. *Escherichia coli*, *Klebsiella* spp.) and environmental streptococci species (e.g. *Strep. uberis*) presents a significant risk factor for intramammary infection (IMI) in dairy cows. Bedding materials represent an important source of teat end exposure to environmental mastitis pathogens. Research has clearly demonstrated that bedding materials such as sawdust or digested manure solids (organic), as well as recycled sand (inorganic), contain sufficient organic material to support significant bacterial growth (Bey et al., 2007). Because bacteria counts in bedding materials correlate with bacteria populations and counts on teat ends (Rendos et al., 1975; Hogan et al., 1999), management practices to control bacteria populations in bedding should reduce teat end exposure and incidence of IMI caused by environmental mastitis pathogens. Bedding conditioners represent one management tool that could be used to reduce bacteria counts in bedding. Despite the potential of bedding conditioners to reduce bacteria counts, research on their efficacy and cost-benefit is extremely limited, and studies haven’t evaluated these products in commercial dairy herds. More research is required to describe the efficacy of bedding conditioners to reduce bacteria counts in 1) a variety of commercial dairy herds, 2) using different commonly-used bedding materials (sawdust, recycled manure solids, recycled sand), and 3) using the same application rates and frequencies as are currently recommended by the manufacturer. The objective of this study was to describe the effect of two bedding conditioners on environmental bacteria counts and pH in sawdust, digested manure solids and recycled sand bedding in commercial dairy herds.

Materials and Methods

**Study Herds and Stall Treatment Assignment.** Sixteen commercial free stall dairy herds from MN and western WI were enrolled into the study. Of these, 5 used sawdust, 6 used digested manure solids, and 5 used recycled sand as bedding material for lactating cows. For each herd, a series of six sections of free stalls with 5 adjacent stalls per section, were selected in the central region of the high or mid-lactation milking pen. One empty stall separated each treatment section from the next. The six sections were randomly assigned to be treated with one of the three bedding conditioner treatment groups (i.e. two sections assigned to each treatment group):

- Group A. Conditioner A – Product A (alkalinizing)
- Group B. Conditioner B - Zorbisan™ (WestfaliaSurge, Inc.) (acidifying)
- Group C. Negative Control – nothing added to stall

**Collection of Bedding Samples for Culture.** On each sampling day, for each section of 5 stalls assigned to a treatment group, 2 stalls were randomly selected for sampling. Samples were collected from the top ½ inch of bedding at different points in the back 1/3 rd of each stall.
Samples were labeled as to date, herd, and treatment group, transported (on ice) to the U of Minnesota Laboratory for Udder Health twice per week by study technicians, then frozen (-20 °C). Samples were collected before conditioners were applied (reapplied) to the stalls. The study technician collected bedding samples on day 0 (baseline samples), prior to initial application of the bedding conditioner, and then two days per week, immediately prior to reapplication of the bedding conditioner (3-4 days after application = Day 3 sample). Furthermore, a designated and trained herdsperson collected an additional bedding sample 1 day after each herd visit by the technician (1 day after application = Day 1 sample).

**Application of Bedding Conditioners to Stalls.** After bedding samples were collected (described above), the bedding conditioner was applied to the stalls as follows:

**Shavings**

*Day 0:*

i) Collect baseline bedding samples from the back 1/3rd of the stall.

ii) Brush shavings off the back 1/3rd of the mattress.

iii) Sprinkle 480 cc (16 oz) of the treatment article over the back 1/3rd of mattress.

iv) Apply fresh shavings over the back of the stall (2-3 inches deep).

v) Sprinkle 150 cc (5 oz) of the treatment article over the back 1/3rd of stall, on top of shavings.

*Reapplication (twice per week for two weeks):*

i) Collect bedding samples from the back 1/3rd of the stall.

ii) Brush shavings off the back 1/3rd of the mattress.

iii) Apply fresh shavings over the back of the stall (2-3 inches deep).

iv) Sprinkle 150 cc (5 oz) of the treatment article over the back 1/3rd of stall, on top of shavings.

**Recycled Sand or Digested Manure Solids**

*Day 0:*

i) Collect baseline bedding samples from the back 1/3rd of the stall.

ii) Sprinkle 480 cc (16 oz) of the treatment article over the base of the back 1/3rd of the stall (approx. 3-5 inches deep).

iii) Level sand or manure solids over the back of the stall.

iv) Sprinkle 150 cc (5 oz) of the treatment article over the back 1/3rd of the stall, on top of sand or manure solids.

*Reapplication (twice per week for two weeks):*

i) Collect bedding samples from the back 1/3rd of the stall.

ii) Level sand or manure solids over the back of the stall.

iii) Sprinkle 150 cc (5 oz) of the treatment article over the back 1/3rd of the stall, on top of sand or manure solids using a broadcast spreader.

**Laboratory Testing of Bedding Samples.** Frozen bedding samples were thawed at room temperature, and bedding pH recorded. Samples then underwent standardized culture procedures to quantify the total concentration of coliform bacteria, *Klebsiella* spp., and streptococci bacteria (colonies per cc of bedding).
**Statistical Methods.** Descriptive statistics were generated describing baseline bacteria counts and pH measures for the samples collected on day 0, prior to initial application of bedding conditioner treatments. Measures from samples collected on all visits after day 0 were analyzed using multiple linear regression analysis (Proc Mixed in SAS, version 9.1) to describe the effect of bedding conditioner treatment group (A, B, or Control) on $\log_{10}$ (total coliform count per cc of bedding), $\log_{10}$ (total streptococci count per cc of bedding), $\log_{10}$ (total *Klebsiella* species count per cc of bedding) and pH of bedding. Analysis was completed separately for each of the three bedding type (shavings = SH, recycled sand = RS, digested manure solids = DS). ‘Herd’ was included in the model as a random effect. Since interactions were detected, analysis was stratified by the following variables:

i) Application-Sampling Interval (1 day or 3-4 days): Variable describing the interval between most recent conditioner application and the current day of sample collection.

ii) Rebedded (Yes/No): Variable describing if new bedding had been applied to the stall between the most recent conditioner application and the current day of sample collection. (Note: it was not within the study’s ability to control or alter weekly rebedding schedules within any given herd. However, these rebedding events were recorded and investigated in the statistical analysis).

**Summary of Preliminary Results and Conclusions**

A total of 1655 bedding samples were collected from 16 herds (5 using SH, 5 using RS, 6 using DS). Baseline geometric mean counts of Coliforms, *Klebsiella* and *Streptococci* spp., respectively, were greatest in shavings (SH) bedding samples (943 cfu/cc; 18 cfu/cc; 97,994 cfu/cc), then digested manure solids (DS) (718 cfu/cc; 6 cfu/cc; 39,096 cfu/cc), and least in recycled sand (RS) (30 cfu/cc; 5 cfu/cc; 30,740 cfu/cc). Mean (± Std. Dev.) pH was greatest in DS (9.01 ± 0.29), then RS (8.33 ± 0.58), and least in SH (7.30 ± 1.23). Stalls that had been rebedded in the interval between the previous and next sampling interval had significantly reduced bacteria levels (all bacteria types, all bedding types) as compared to stalls that had not been rebedded. Therefore more frequent application of new bedding into stalls may reduce bacteria counts in all bedding types, helping to reduce bacterial exposure at the teat end.

**Conditioner A.** Conditioner A increased bedding pH. This effect was most pronounced 1 day after applying the conditioner. Overall, conditioner A reduced (P < 0.05) or tended to reduce (P < 0.10) levels of coliforms and *Klebsiella* spp. in DS, RS and SH. However, these effects could be modified by whether or not stalls had been rebedded in the interval between previous application of the bedding conditioner, and sampling the stall. Effects of conditioner A on coliform and *Klebsiella* counts in DS or RS were greatest one day after applying the bedding conditioner, but were not significant at 3-4 days after applying the bedding conditioner. Conditioner A had no effect on *Streptococci* counts in DS or RS. It reduced counts in SH one day after application of the conditioner to the stalls, but only in stalls that had been rebedded (not sure of explanation for this). Conditioner A had no effect on *Streptococci* counts in SH at 3-4 days after applying the bedding conditioner.

Producers using recycled sand or digested manure solids as bedding, and who are interested in using a bedding conditioner, might consider using conditioner A: Conditioner A reduced
coliform and Klebsiella spp. counts (but not Streptococci counts) in RS and DS bedding, while conditioner B did not. However, to maintain effectiveness, this conditioner may need to be reapplied after each event of rebedding the stalls. Furthermore, the duration of biological activity needs to be further investigated: To maintain effectiveness, this conditioner may need to be applied more frequently than twice per week.

**Conditioner B.** Conditioner B reduced bedding pH. This effect was most pronounced 1 day after applying the conditioner. Conditioner B did not reduce counts of coliforms, Klebsiella spp., or Streptococci spp. in DS or RS, regardless of the rebedding schedule or the sampling time (day 1 or day 3-4 sample). Overall, conditioner B did reduce counts of coliforms, Klebsiella spp. and Streptococci spp. counts in SH, though these effects could be modified by whether or not stalls had been rebedded in the interval between previous application of the bedding conditioner, and sampling the stall. Effects were generally greatest 1 day after applying the bedding conditioner, but were still significant at 3-4 days after applying the bedding conditioner (even though all stalls on all farms had been rebedded in the interval between application of the conditioner and sampling the stall).

Producers using shavings as bedding, and who are interested in using a bedding conditioner, might consider using conditioner B, as it reduced counts of coliforms, Klebsiella spp., and Streptococci spp. in shavings. This conditioner seemed to maintain its duration of activity for 3-4 days in SH, even in the face of reaplication of bedding over top of the conditioner during this 3-4 day interval. As such, it may only need to be applied twice per week (as is currently recommended).

The cost-benefit of adopting the use of bedding conditioners in commercial dairy herds (cost and labor of using conditioners vs. improved udder health) requires further study.

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**Selected References**


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