J. Dairy Sci. 99:1–11
http://dx.doi.org/10.3168/jds.2015-10675

Associations of selected bedding types with incidence rates of subclinical and clinical mastitis in primiparous Holstein dairy cows

R. F. Rowbotham*†[1,2] and P. L. Ruegg*
*Department of Dairy Science, University of Wisconsin, Madison 53706
†Grande Cheese Company, Brownsville, WI 53006

ABSTRACT

The objective of this observational study was to determine the association of exposure to selected bedding types with incidence of subclinical (SM) and clinical mastitis (CM) in primiparous Holstein dairy cows housed in identical pens at a single facility. At parturition, primiparous cows were randomly assigned to pens containing freestalls with 1 of 4 bedding materials: (1) deep-bedded new sand (NES, n = 27 cows), (2) deep-bedded recycled sand (RS, n = 25 cows), (3) deep-bedded manure solids (DBMS, n = 31 cows), and (4) shallow-bedded manure solids over foam-core mattresses (SBMS, n = 26 cows). For 12 mo, somatic cell counts of quarter milk samples were determined every 28 d and duplicate quarter milk samples were collected for microbiological analysis from all quarters with SM (defined as somatic cell count >200,000 cells/mL). During this period, duplicate quarter milk samples were also collected for microbial analysis from all cases of CM. For an additional 16 mo, cases of CM were recorded; however, no samples were collected. Quarter days at risk (62,980) were distributed among bedding types and most quarters were enrolled for >150 d. Of 135 cases of SM, 63% resulted in nonsignificant growth and 87% of recovered pathogens (n = 33) were identified as coagulase-negative staphylococci. The distribution of etiologies of pathogens recovered from cases of SM was associated with bedding type. Coagulase-negative staphylococci were recovered from 12, 38, 11, and 46% of quarters with SM from cows in pens containing NES, RS, DBMS, and SBMS, respectively. A result of nonsignificant growth was obtained for 81, 59, 89, and 46% of quarters with SM from cows in pens containing NES, RS, DBMS, and SBMS, respectively. Quarters of primiparous cows bedded with NES tended to have greater survival time to incidence of CM than quarters of primiparous cows bedded with RS or DBMS.

Key words: mastitis, dairy, environment, housing, bedding

INTRODUCTION

On modern dairy farms, most cases of clinical mastitis (**CM**) are caused by bacteria of environmental origin (Lago et al., 2011; Pinzón-Sánchez and Ruegg, 2011; Oliveira et al., 2013) and understanding and managing exposure of teats to bacteria in bedding materials is crucial to maintaining udder health (Hogan and Smith, 2012). Teats of dairy cattle may be in direct contact with bedding materials for 40 to 60% of the day (Tucker and Weary, 2004; Cook et al., 2005; Hogan and Smith, 2012), making bedding materials an important potential source of exposure to mastitis pathogens. Research has indicated that fresh and recycled sand and forestry byproducts (such as sawdust and wood shavings) are the most common types of bedding materials used on large Wisconsin dairy farms, but a small number of the largest herds use recycled manure products (Rowbotham and Ruegg, 2015). As compared with organic bedding materials, use of sand bedding has been associated with reduced exposure to bacteria (Fairchild et al., 1982; Hogan et al., 1989; Zdanowicz et al., 2004). Recycling bedding on-farm may provide economic opportunities for dairy producers. However, some recycled bedding materials (such as manure and recycled sand; Janzen et al., 1982; Hogan et al., 1989; Rowbotham, 2015) contain greater number of bacteria than numbers found in inorganic bedding (such as new sand). The greater numbers of bacteria in bedding have been associated with increased numbers of bacteria on teats of cows exposed to these materials (Zdanowicz et al., 2004).

The magnitude and type of exposure to bacteria has been associated with bedding type at this facility (Rowbotham, 2015). Large numbers of streptococci were recovered from new sand (**NES**), recycled sand (**RS**), deep-bedded manure solids (**DBMS**), and shallow-bedded manure solids over foam-core mattresses (**SBMS**) and on teats of cows housed on all 4 bedding types; however, the greatest numbers of bacteria were

Received November 23, 2015.
Accepted February 22, 2016.
[1]Robert F. Rowbotham, 630 W. Madison St., Waterloo, WI 53594.
[2]Corresponding author: rob.rowbotham@grande.com

recovered from SBMS and on teats of cows bedded with RS and SBMS. In that portion of the study detailed in Rowbotham (2015), with the exception of DBMS (where numbers of gram-negative and streptococcal bacteria were similar), numbers of gram-negative bacteria in bedding were approximately 2 to 3 log fewer than numbers of streptococci. Similarly, numbers of gram-negative bacteria were much less in NES and on teats of cows bedded with NES. A linear relationship between total rates of CM during lactation and the number of both total gram-negative bacteria and *Klebsiella* spp. in bedding was identified in a year-long observational study of 9 commercial dairy herds (Hogan et al., 1989). In another study, rates of new coliform IMI and numbers of coliform bacteria in recycled manure bedding were both greatest in the summer (Smith et al., 1985). Rendos et al. (1975) reported associations between the numbers of bacteria in bedding and recovered from teat skin, but also cautioned against extrapolation to explain rates of new IMI caused by these same bacteria. The authors stated that the relationship between bedding bacterial populations and mastitis needs to be investigated directly through a lengthy and controlled study of incidence of IMI of cows bedded with various materials. Two other studies failed to find associations between coliform bacterial numbers in bedding and coliform IMI (Natzke and LeClair, 1976; Fairchild et al., 1982); however, treatment groups contained only 3 to 10 cows and trial lengths were only 3 to 4 wk. The objective of this cohort study was to determine the association of exposure to 4 selected bedding types with incidence of subclinical mastitis (**SM**) and CM in primiparous Holstein dairy cows housed in identical pens at a single facility. The primary hypothesis was that exposure to different bedding types was associated with the occurrence of CM and SM.

MATERIALS AND METHODS

Facility Design

The study was conducted at the University of Wisconsin–Madison Marshfield Research Station. Four bedding types were tested in a freestall barn 29.3 m wide by 59.4 m long with 4.3-m-tall open side walls that contained identical pens (n = 4) each 11.3 m wide by 26.1 m long. Each pen of housed up to 32 lactating cows in 2 rows of 16 head-to-head freestalls. Freestall dimensions were 1.65 m from rear curb to brisket locator, 1.78 m from rear curb to neck rail, 0.23 m curb height, and 1.28 m width (divider mounting on center). Alleys between freestalls and feed bunks were 4.04 m wide, and alleys between freestalls and outside walls were 2.44 m wide. Throughout the period of the study, each of the 4 pens contained a single type of bedding material: (1) NES, which was deep-bedded, previously unused pit sand; (2) RS, which was deep-bedded sand recycled on the farm using a screw-type sand separator designed to recover 80 to 90% of sand from manure for reuse as bedding (McLanahan, Hollidaysburg, PA); (3) DBMS, which was deep-bedded manure solids recycled on the farm using a screen press; and (4) SBMS, which was the same recycled manure solids as DBMS, shallow bedded over foam-core mattresses. Twice daily while cows were milked, bedding was manually groomed and leveled in all stalls, and alleys were scraped. The base of all deep-bedded stalls consisted of approximately 20 cm of compacted limestone covered with approximately 30 cm of bedding. Immediately after bedding, the depth of noncompressed bedding (measured by inserting a ruler vertically into beds with light pressure) was 10 to 13 cm (NES), 10 to 15 cm (RS), and 7 to 13 cm (DBMS) with a greater depth of noncompressed bedding in the fronts of stalls with all bedding types. Stalls with mattresses and SBMS were bedded to a depth of approximately 1.5 to 3 cm with additional bedding in front of the brisket board drawn onto the mattresses during grooming to a maintain a depth of approximately 1.5 to 3 cm at the time of grooming. Fresh bedding was added to all stalls on Tuesday and Friday afternoons. All cows were fed the same TMR consisting of 20.8% corn silage, 17.5% alfalfa haylage, 5.8% alfalfa hay, 21.4% high moisture corn, 20% soybean protein mix, 5.2% corn gluten pellets, 3.6% cottonseed, and 5.8% liquid sugar and mineral mix. This barn was specifically designed to accommodate research about different lactating dairy cow bedding materials.

Weekly bedding culture and teat skin swab culture results have been previously described in Rowbotham (2015).

Population of Pens and Enrollment of Quarters

Prior to the study, all 4 pens in the newly constructed barn were populated with multiparous cows from another University of Wisconsin research facility. During 2012, before the beginning of the study, all except 15 of the multiparous cows were gradually replaced with primiparous Holsteins, which were randomly assigned to the 4 pens after parturition. Our study consisted of 2 periods. An initial sampling period (**ISP**) that included collection of milk samples for microbiological analysis began on January 1, 2013, and was completed on December 17, 2013. An extended observation period (**EOP**) that did not include collection of milk samples was conducted from December 18, 2013, until April 30, 2015. At the beginning of the ISP the initial population of cows in the pens consisted of primiparous Holsteins