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Association of bedding types with management practices and indicators of milk quality on larger Wisconsin dairy farms

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ABSTRACT

The objective of this study was to identify associations of bedding type and selected management practices with bulk milk quality and productivity of larger Wisconsin dairy farms. Dairy herds (n = 325) producing ≥11,340 kg of milk daily were surveyed during a single farm visit. Monthly bulk milk SCC and total bacteria counts were obtained from milk buyers for 255 farms for a 2-yr period. Of farms with the same type of bedding in all pens during the study period, most used inorganic bedding (IB), followed by organic nonmanure bedding (OB) and manure products (MB). Almost all bulk milk total bacterial counts were <10,000 cfu/mL and total bacterial count was not associated with bedding type. Bulk milk somatic cell score (BMSCS) was least for farms using IB, varied seasonally, and was greatest in the summer. The BMSCS was reduced when new bedding was added to stalls at intervals greater than 1 wk and when teats were dried before attaching the milking unit. The BMSCS for farms using OB was reduced when bedding in the backs of stalls was removed and replaced regularly and when fewer cows with nonfunctioning mammary quarters were present. The BMSCS for farms using MB was reduced when the proportion of cows with milk discarded was less. The rolling herd average (RHA) of herds using IB was 761 and 1,153 kg greater than the RHA of herds using OB and MB, respectively. The RHA was 353 kg greater on farms where farmers understood subclinical mastitis and 965 kg greater on farms milking 3 times daily. Each 1% increase of cows with nonfunctioning mammary quarters was associated with a decrease of 57 kg of RHA. The BMSCS, proportions of cows with milk discarded and proportion of cows with nonfunctioning mammary quarters were least for herds using IB and were associated with increased productivity. Large Wisconsin dairy farms that used inorganic bedding had greater productivity and better milk quality compared with herds using other bedding types.
Key words: bedding, mastitis, milk quality, management

INTRODUCTION

Demand for dairy products is driven by consumer desire for inexpensive food that is safe, high quality, and produced using socially responsible management practices (Rollin, 2004; Fulwider et al., 2008; Sapp et al., 2009). Bulk milk somatic cell count (**BMSCC**) and total bacterial count (**BMTBC**) are international reference indicators of raw milk quality (Costello et al., 2003). Production of high quality milk from healthy animals is a requirement for market access (Europa, 2009; Wisconsin Administrative Code, 2013), and processors are increasingly demanding milk that meets international standards for these indicators.

Bulk milk SCC is associated with prevalence of IMI (Schukken et al., 2003) and is often used as a determinant for payment of premiums by milk purchasers (Rowbotham, 2000; Jayarao et al., 2004). Increased premiums for milk with low BMSCC directly increases milk price and gross farm revenue. Reduced prevalence of IMI (often measured as BMSCC) is associated with increased productivity and profitability and improved animal welfare (Ott and Novak, 2001; Schukken et al., 2003). Somatic cells migrate to the mammary gland in response to infection, so reducing the prevalence of IMI is crucial to reducing BMSCC (Deluyker et al., 1993; Schukken et al., 2003). Through adoption of modern milking practices, many farms have controlled transmission of contagious mastitis pathogens and have reduced the prevalence of intramammary infections caused by these organisms (Makovec and Ruegg, 2003). Currently in the United States, environmental mastitis pathogens account for the greatest proportion of IMI, whereas only 2 decades ago most IMI were caused by contagious pathogens (Lago et al., 2011; Pinzón-Sánchez and Ruegg, 2011; Oliveira et al., 2013).

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Bacterial exposure at the teat end is a primary source of exposure to potential mastitis pathogens, and reducing this exposure is an important aspect of controlling environmental mastitis. Teats become contaminated with environmental bacteria through contact with bedding and other environmental risk factors (Rendos et al., 1975; Schreiner and Ruegg, 2003; Zdanowicz et al., 2004; DeVries et al., 2012). Teats may be in direct contact with bedding materials for 12 to 14 h per day, making bedding a primary reservoir for environmental pathogens (Tucker and Weary, 2004; Cook et al., 2005; Hogan and Smith, 2012). The number of bacteria on teat skin has been shown to represent the level of exposure to some mastitis pathogens (Zdanowicz et al., 2004), and increased exposure has been associated with increased rates of clinical mastitis (Hogan et al., 1989).

Bulk milk total bacterial count is a measure of the microbial content of milk, is associated with animal hygiene and milk quality, and is frequently used as a basis for determining milk quality premiums (Pantoja et al., 2009; Velthuis and van Asseldonk, 2011). Bacteria in raw milk can originate from IMI, contamination during milking, inadequate cleaning of milking equipment, or failure to properly cool and store milk (Reinemann et al., 1997).

For several decades the proportion of milk produced by large dairy farms in the United States has been increasing. Herds containing ≥200 milk cows currently produce 75% of all milk and those containing ≥500 cows produce 63% of US milk (USDA-NASS, 2014b). This segment of herds will continue to produce the majority of milk sold in the United States, so it is imperative that we understand the effect of housing and management decisions used on these larger farms. The objective of this study was to determine associations of bedding type and selected management practices with bulk milk quality and productivity of larger Wisconsin dairy farms.

MATERIALS AND METHODS

Herd Recruitment and Inclusion Criteria

A list of licensed dairy producers was purchased from the Wisconsin Department of Administration (2012). Farms on this list had been previously categorized by size from processor records or farm visits. Inclusion criteria required farms to be producing at least 11,340 kg of milk (1/2 of a milk tanker truck) daily and to be actively selling milk from May 1, 2010, to April 30, 2012. Between June 2012 and October 2013, researchers mailed postcards to potentially eligible farms (n = 428), advising them that they would be soon be visited by a researcher. These farms were visited between June 26, 2012, and December 1, 2013, resulting in the identification of 387 eligible farms, after excluding farms not meeting inclusion criteria (n = 41). Survey administrators also excluded 27 farms after failing to make contact with farm owners after 3 or more visits. Thirty-five farmers refused to participate, resulting in participation of 325 (84.0%) of eligible farms in the survey (Table 1).

Data Collection

Survey of Management Practices. Survey administrators (n = 5) were trained as a group and practiced administering questionnaires during a 1-d training session. Following training, each survey administrator observed the administration of the questionnaires by the trainer (R.F.R.) on at least 2 farms followed by being observed on at least 2 farms by the trainer before administering questionnaires on their own. During the 18 mo when the survey was conducted, survey administrators met as a group monthly to discuss progress and to avoid procedural drift.

Five trained survey administrators (including the first author) administered a 60-question survey instrument (http://milkquality.wisc.edu/association-of-milk-quality-to-bedding/) including herd profile, inventory, and production (6 questions); bulk milk cooling and cleaning (8 questions); use of DHI, California Mastitis Test (**CMT**), and bacteriologic culturing of milk samples (6 questions); milking management and routine (17 questions); level of management expertise (5 questions); types and management of bedding (8 questions); and parlor design and management (10 questions). Most questions were close-ended, but some questions (such as those collecting information on brands and trade names of teat dips) were open-ended with responses categorized postsurvey.

Collection of Milk Quality Test Results. For each farm, survey administrators requested a release of bulk milk test results from milk buyers for the period from May 1, 2010, to April 30, 2012. Information obtained from processors included date of shipment, milk weight, BMSCC, and BMTBC. Bulk milk test results were delivered to the senior author (P.L.R.) who removed all potentially identifying information and merged the survey data with the bulk milk results. This blinding was used to avoid any potential conflict of interest due to the first author's employment within the dairy processing industry.

Bulk milk test results received for farms using the same bedding in all pens during the entire study (n = 230) were used to analyze associations among indicators of milk quality and bedding. Some processors reported individual BMSCC and milk weights for each