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Behavior of Dairy Cows in an Alternative Bedded-Pack Housing System

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ABSTRACT

The objectives of this study were to measure lying behavior and social interactions of lactating cows housed in an alternative bedded-pack system, commonly referred to as a compost dairy barn, and to investigate the association between the temperature-humidity index and lying behavior of these cows. The study was conducted in 12 compost dairy barns in Minnesota between late June 2005 and September 2005. Lying, standing, and walking behavior of 147 focal cows was measured by automatic activity monitors. The daily lying time was 9.34 ± 1.94 h. The number of daily lying bouts was 11.0 ± 3.2 and the lying bout length was 50.8 ± 35.6 min. As days in milk increased, the total number of lying bouts increased, corresponding to an increase in total daily lying time. Cows in the compost barns lay down for less time, took more steps, and reduced the length of lying bouts as the temperature-humidity index increased. Social interactions and lying positions of all cows in the bedded-pack area (total of 886 cows in the 12 dairies) were recorded using visual observations during two 4-h periods on 2 separate days. A total of 43.3% of the cows were lying down at any time. All 4 natural lying positions (head back, head up, flat on the side, and head on the ground) were observed in 9 of the bedded packs during the direct visual observation periods. The majority (84.6%) of the cows observed lying down assumed the head-up position. Of all observed lying events, the head-back lying position was assumed 8.8% of the time, the head on the ground 5.4% of the time, and flat on the side 0.8% of the time. Observations of social interactions on the bedded-pack area showed that 0.94 ± 1.5 incidents of chasing away, 0.94 ± 1.8 of pushing, 1.4 ± 1.6 of head butting, and 2.3 ± 2.9 of allogrooming (social licking) occurred per hour. Observations of lying behavior, social interactions, and natural lying positions indicated that compost dairy barns can be an adequate housing system for dairy cows.
Key words: lying behavior, bedded pack, temperature-humidity index

INTRODUCTION

Compost dairy barns are an alternative loose-housing system with a large bedded-pack (resting) area separated from a feed alley by a 1.2-m-high concrete wall. Unlike in conventional bedded-pack systems, the bedding material (predominantly dry, fine wood shavings or sawdust) is aerated twice daily with cultivator-type equipment to dry the surface and incorporate manure into the pack. Previously, we reported that the main reasons mentioned by the dairy producers for building this type of housing system were for improved cow comfort, cow longevity, and ease of completing daily chores (Barberg et al., 2007).

Loose-housing systems such as compost barns should allow cattle freedom of movement. The ability and freedom to lie down and rest at ease are important for dairy cattle welfare. Dairy cattle spend 8 to 16 h/d lying down, which emphasizes the importance of the lying surface to the animal (Haley et al., 2001). Lying time is a measurable and usable indicator of animal welfare (Fregonesi and Leaver, 2001).

Cattle movements of lying down and getting up are affected by their physical environment, such as the lying surface and stall dimensions. Increased lying times were observed when softer lying surfaces were available, particularly when large amounts of bedding were used (Krohn and Munksgaard, 1993). The number of times a cow stands up and lies down each day (i.e., the number of lying bouts) and the duration of each lying bout may be used to measure the comfort of the lying surface and housing system. Cows housed in sand-bedded free stalls had a significantly greater proportion of long lying bouts (>60 min) than did cows in mattress-bedded free stalls (Cook et al., 2004).

Type of housing can allow or hinder natural behavior. Four common lying positions are assumed by cattle: flat on the side, head back, head on the ground, and head up, the most common position (Krohn and Munksgaard, 1993). The type of housing system influences the lying position that a cow assumes. Cows spent more time lying with their heads resting on the ground or with their heads back when they were housed on pasture than in tie-stall barns (Ketelaar-de Lauwere et al., 1999), regardless of the bedding material (Haley et al., 2001).

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The social structure of dairy cattle can be described as a series of dominance relationships and social bonds characterized by agonistic (aggressive) and positive social interactions. Several farm conditions contribute to and affect the social behavior of a dairy herd, including the type of housing, the number of cows, and the space allowance per cow (Menke et al., 1999). Allogrooming (social licking) is a positive social interaction that causes a calming effect between cows, reducing the amount of social tension and stabilizing dominant and subordinate relationships in a herd. Agonistic interactions between cattle are composed of pushes, threats, head butts, chasing, and avoidance. Most displacements, head butts or pushing, are a result of competition for resources, such as feed or water, space at the feed bunk, or resting space.

Weather, mainly temperature and humidity, or the temperature-humidity index (**THI**), has an impact on lying time. The THI has been used to estimate the level of heat stress in dairy cattle. Arnold and Dudzinski (1978) reported that as humidity increased, cattle had a greater level of stress when the temperature increased above 28°C. Overton et al. (2002) found that high environmental temperatures had a negative impact on the proportion of eligible cows observed lying.

The objectives of this study were to measure lying behavior and observe social interactions of lactating cows housed in compost dairy barns. Additionally, we investigated the association between THI and lying behavior of cows housed in compost dairy barns.

MATERIALS AND METHODS

Farms

We studied 12 dairies in Minnesota that used compost bedded-pack barns for housing lactating cows. The study was conducted between late June and September 2005. Each farm was visited twice, 1 wk apart, to collect on-farm data. The experimental protocol of this study was approved by the Institutional Animal Care and Use Committee of the University of Minnesota.

Individual herds were selected on the basis of the producers having used the alternative housing system for their milking herd for at least 6 mo prior to our visit. Dairy producers using this housing system were identified by extension educators. Following the identification of all the compost barn herds in the state, letters of invitation were sent to the 12 producers identified to confirm whether they met the study criteria of occupancy date and use of the barn for their entire milking herd. The dairies represented approximately 92% of all Minnesota dairies with this system that met the study criteria. One dairy had had cows housed in this system since fall 2001, 5 since fall 2003, and 5 since fall 2004. Only 1 dairy had been using this system for 6 mo at the time of the visit. Dairy herd records for the time of the visit were obtained from the DHIA for 11 of the dairies. Days in milk for the herd not using DHIA recording were calculated from on-farm records.

Measurement of Behavior

Lying, standing, and walking behavior was measured with automatic activity monitors (IceTag, IceRobotics, Roslin, UK), which were validated for use in dairy cattle by Munksgaard et al. (2006). Automatic monitoring of lying, standing, and walking behavior was performed for approximately 1 wk in each herd. The monitors had a tough plastic housing designed to withstand the farm environment and a simple strap mechanism for easy attachment and removal from the rear leg of the cows. IceTags are activity monitors that use an electronic accelerometer to automatically determine the percentage of time spent standing, lying, and active. The behavior referred to as "active" was measured when a cow moved her leg but was not necessarily taking a step. This type of behavior could be registered when a cow was restless or being pushed around among a group of animals. The monitors log data 8 times/s, and algorithms are used to generate the average percentage of time allocated to each of the behaviors.

For our analysis, data were downloaded from the monitors on a per-minute basis with the IceTagAnalyser software (IceRobotics) and were exported to an Excel spreadsheet (Microsoft Corp., Redmond, WA). Data downloaded from on-board memory included percentage of time spent lying, standing, or active, and number of steps taken by each cow. The data were converted to minutes per hour and minutes per day by using the actual percentage of the behavior (e.g., percentage of lying) within the minute or hour. Number of lying bouts per day and per hour were determined as the mean number of times a cow stood up and lay down in a period of 24 h or 60 min, respectively. Lying bouts of <2 min were discarded by recommendation of the manufacturer as possibly being incidences when the cow lifted the leg on which the IceTag was attached. Lying bouts of <2 min occurred <1.5% of the time. We caution that in approximately 10.4% of per-minute data downloaded from the monitors, "active" was recorded at the same time as lying was recorded. This happened either during the minute immediately preceding or following a lying bout, which would reflect the transition between lying and standing (4.4% of the data), or during a lying bout (6% of the data), which could result in an underestimation of lying time. Yet the latter error should be minimal, because in the instances when "ac-