



A study on cow comfort and risk for lameness and mastitis in relation to different types of bedding materials

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ABSTRACT

The aim was to obtain data regarding the effects of 4 freestall bedding materials (i.e., box compost, sand, horse manure, and foam mattresses) on cow comfort and risks for lameness and mastitis. The comfort of freestalls was measured by analyzing the way cows entered the stalls, the duration and smoothness of the descent movement, and the duration of the lying bout. The cleanliness of the cows was evaluated on 3 different body parts: (1) udder, (2) flank, and (3) lower rear legs, and the bacteriological counts of the bedding materials were determined. The combination of the cleanliness of the cows and the bacteriological count of the bedding material provided an estimate of the risk to which dairy cows are exposed in terms of intramammary infections. The results of the hock assessment revealed that the percentage of cows with healthy hocks was lower (20.5 ± 6.7), the percentage of cows with both damaged and swollen hocks was higher (26.8 ± 3.2), and the severity of the damaged hock was higher (2.32 ± 0.17) on farms using foam mattresses compared with deep litter materials [i.e., box compost (64.0 ± 10.4 , 3.5 ± 4.7 , 1.85 ± 0.23 , respectively), sand (54.6 ± 8.2 , 2.0 ± 2.8 , 1.91 ± 0.09 , respectively), and horse manure (54.6 ± 4.5 , 5.5 ± 5.4 , 1.85 ± 0.17 , respectively)]. In addition, cows needed more time to lie down (140.2 ± 84.2 s) on farms using foam mattresses compared with the deep litter materials sand and horse manure (sand: 50.1 ± 31.6 s, horse manure: 32.9 ± 0.8 s). Furthermore, the duration of the lying bout was shorter (47.9 ± 7.4 min) on farms using foam mattresses compared to sand (92.0 ± 12.9 min). These results indicate that deep litter materials provide a more comfortable lying surface compared with foam mattresses. The 3 deep litter bedding materials differed in relation to each other in terms of comfort and their estimate of risk to which cows were exposed in terms of intramammary infections [box compost:

17.8 cfu (1.0^4) \pm 19.4 /g; sand: 1.2 cfu (1.0^4) \pm 1.6 /g; horse manure: 110.5 cfu (1.0^4) \pm 86.3 /g]. Box compost had a low gram-negative bacterial count compared with horse manure, and was associated with less hock injury compared with foam mattresses, but did not improve lying behavior (lying descent duration: 75.6 ± 38.8 s, lying bout duration: 46.1 ± 18.5 min). Overall, sand provided the best results, with a comfortable lying surface and a low bacterial count.

Key words: bedding material, lying behavior, hock assessment, bacterial load

INTRODUCTION

To create an environment for dairy cows in which they feel comfortable is of great importance, both from a welfare and economic perspective. Apart from the dimensions, the comfort of freestalls depends on the type and quality of the bedding material. The bedding material should provide thermal comfort and softness, yet be durable and have sufficient friction to allow rising and lying down without slipping. Finally, bedding material should help in keeping cows clean and healthy while minimizing daily labor requirements (Chaplin et al., 2000).

Sand is a good bedding material (Norrington et al., 2008); however, sand has a few drawbacks when used in combination with slatted floors. Composted materials are gaining popularity in European farms because of the possibility of combining them with slatted floors. Box compost is a new bedding material consisting of composted biodegradable waste from households (Groot Antink, 2009). Box compost is heated for 3 d at 70°C to decrease the bacterial count and kill weed seeds. After this heat treatment, a mix of *Lactobacillus* species is added to the material to compete with possible pathogenic contaminants, thus helping to prevent IMI. Another deep litter material is horse manure, which is made from fresh horse dung and litter. This bedding material provides a soft lying surface, but most likely contains high numbers of fecal bacteria and probably supports the presence of potentially pathogenic bac-

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teria (Carroll and Jasper, 1978). The most important reason for using horse manure in the Netherlands as bedding is that it is free. Foam mattresses are considered one of the best non-deep litter beddings (Fulwider and Palmer, 2004).

Lying behavior is a useful criterion to measure freestall comfort (Haley et al., 2000). Cows prefer, and spend more time lying in, well-bedded, soft and dry stalls (Chaplin et al., 2000; Tucker and Weary, 2004). Cows that spend less time lying in uncomfortable stalls likely spend more time standing in concrete alleyways with the risk of developing claw diseases and injuries (Bell and Weary, 2000; Vokey et al., 2001). Furthermore, an increase in the preparation time required to lie down and a longer duration of this process was observed on a less comfortable lying surface (Müller et al., 1989; Wechsler et al., 2000). This is probably reflecting the cows' hesitation to lie down (Tucker and Weary, 2004). Cows that do not lie down due to an uncomfortable lying surface show behavioral and physiological stress responses, which most likely affect their health and production (Munksgaard et al., 1999).

The degree of hock damage reflects the degree of comfort associated with the lying surface (Rutherford et al., 2008). In several studies, more hock lesions and swellings were found on harder compared with softer surfaces (Weary and Taszkun, 2000; Wechsler et al., 2000; Vokey et al., 2001), and if the lying surface is hard, hock lesions can develop into more severe injuries due to continuous pressure and friction imposed by the lying surface (Schulze Westerath et al., 2007). The effects of lameness are negative for the profitability of a farm (Logue et al., 1993; Cha et al., 2010).

Several cow comfort indices have been developed that are easy to use in a relatively short period of time and are considered a reflection of daily lying behavior (Cook et al., 2005). In addition, an evaluation of cow cleanliness in combination with the determination of the bacteriological count of the bedding material should provide an estimate of the exposure to potential udder pathogens (Hughes, 2001; Ward et al., 2002).

In the present study, box compost, sand, horse manure, and foam mattress were compared with respect to lying behavior, occurrence and severity of hock injuries, cow comfort indices, and hygiene.

MATERIALS AND METHODS

Study Site and Subjects

Between February and May 2010, a total of 24 farms with a freestall barn were visited; all were located in the Netherlands. Nine farms used box compost (Sinige Boxcompost, Damwoude, the Netherlands), 6

farms used sand, 6 farms used foam mattresses (various manufacturers), and 3 farms used horse manure as bedding material (Table 1). All farms were visited once for a time period of 1 d (approximately from 0900 until 1700 h) and the cows studied were all lactating Holstein-Friesian.

Control for Differences

As well as the type of bedding material, 3 major factors differed between the farms. To compensate for these factors, each farm was given a score for each of the 3 factors: freestall design, bedding characteristics, and rate of overcrowding. The scores were determined on 20% of the stalls. The first score, reflecting the freestall design, was based upon 5 traits and had a maximum value of 50 (van Eerdenburg et al., 2009):

- 1 = the length of the lying surface, from the rear curb to the middle of the brisket board;
- 2 = the length of the lunge space, from the middle of the brisket board to the front of the stall;
- 3 = stall width (cm); distance between the center of the partitions;
- 4 = height of neck rail (cm); distance between stall bed and neck rail;
- 5 = diagonal distance of neck rail (cm); distance between the rear curb and the neck rail.

A score was given for each trait based upon the dimension of that measurement (Table 2).

The second score reflected the characteristics of the bedding material. This score was based upon 5 measures and had a maximum value of 35 (van Eerdenburg et al., 2009); (1) softness, (2) dryness, (3) cleanliness, (4) surface bedding material, and (5) angle of the lying surface (Table 2). The first 2 variables were measured by performing the knee test [i.e., one drops quickly on one's knees from a standing position and stays on the bedding for 10 s with all weight on 1 knee (McFarland and Graves, 1995)]. The 3 other measures were determined by observing the stalls and their lying surface and their values added to provide the score for the characteristics of the bedding material.

The last score reflected the overcrowding rate in the barn and had a maximum score of 0. Each farm was given a score describing the group that was being observed for this study. If the number of freestalls was equal to, or more than, the number of cows present, 0 points were given. When 10% more cows were present than freestalls available, -5 points were given, and if >20% more cows were present than freestalls available, -10 points were given (van Eerdenburg et al., 2009).

In summary, every farm was given 3 scores representing the 3 factors freestall design, bedding charac-

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