



EFFECTS OF MANURE BEDDING ON THE RATE OF CLAW DISEASES IN DAIRY COWS

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ABSTRACT

This study was conducted to determine the prevalence of claw diseases in dairy cows housed on two different bedding systems: deep straw bedding and unsterilized recycled manure solids. On the farm (farm A) with the straw bedding, 403 and on the farm (farm B) with manure solid bedding, 226 dairy cows were examined. The prevalence of cows with one or more claw lesions on the farm with straw bedding and with manure solids were 37 % and 69 %, respectively ($P < 0.001$). In both bedding systems, two claw lesions dominated: digital dermatitis and inflammatory disorders of corium (white line diseases, toe ulcer, and sole ulcer). The prevalence of the digital dermatitis housed in deep-bedded freestalls and in freestalls with manure solids were 17.8 % and 53.1 % ($P < 0.001$), respectively. The prevalence of the white line diseases and toe ulcer were 12.1 % and 15.7 % on farm A and 3.88 % and 2.59 % on farm B, respectively ($P < 0.001$). There was no significant difference in the prevalence of the sole ulcer between farms. These data indicate a relatively high prevalence of claw lesions on

the studied dairy farms. Moreover, a long-term contact of claws with manure (boxes and corridors) on the farm with unsterilized recycled manure solids seems to be associated with a higher prevalence of digital dermatitis.

Key words: claw diseases; dairy cows; lameness; manure bedding

INTRODUCTION

Claw diseases, especially injuries and infections of the feet, constitute one of the most serious and painful, yet least well-managed categories of diseases for the modern high yielding dairy cow. This problem has been recognised and studied for many years, but is not getting any better. Approximately 70 % of intensively managed dairy cattle in North America were affected by claw diseases [6], and the recently reported lameness prevalence in the U. K. dairy herds ranged from 0–80 % [1].

A high proportion of cows becomes lame within the first two months of their first lactation and regularly re-

lapse. This indicates quite clearly that conventional, accepted practices for housing, feeding and managing of the modern Holstein-Friesian dairy cow lead to injury or otherwise affect the feet to a degree where 50 % of the animals will experience the chronic pain of lameness in any one lactation [30].

The obvious consequences of lameness are: less time spent eating, less movement to bunks, subsequent weight and production losses, and failure to show heat. Extreme lameness with weight loss causes a negative energy balance and can cause anoestrus [16]. Assessing the effect of such diseases on milk yield is a difficult task [10]. Milk production before disease incidence can confound the effect of such disease on overall milk yields. Milk yield was higher before than after a lameness occurrence; high milk production was associated with lameness [13]. Lameness prevention remains a significant priority for the dairy industry as consumer demand drives changes in housing and management to promote improved wellbeing, and farmers strive to improve productivity. Providing a clean, dry, and comfortable surface for cows to rest on is important for the welfare of dairy cows, as they spend approximately 12 h per day resting [15]. The lameness prevalence appears to be greater in freestall facilities compared with other management systems such as tie-stall housing [3, 23]. Leg lesions were observed less frequently in cows housed in deep-bedded sand stalls than cows on mattresses [11] and severe lesions were less prevalent in sand beds than on mattresses [28]. The exposure to concrete walking surfaces in alleys and other changes such as the regrouping of cattle around the time of calving are potential differences typical of freestall design and management that may be important factors elevating lameness risk [5]. Increased costs and reduced availability of other common bedding sources has prompted many dairy producers to search for more feasible alternatives such as sand or recycled manure solids. Although sand can be considered the ideal bedding source for dairy cows, not all producers are willing and able to convert to sand bedding, as it presents several challenges related to manure management [17].

The aim of this study was to compare the prevalence of claw diseases in dairy cows housed on two different bedding systems: straw bedding and recycled manure solids.

MATERIALS AND METHODS

This study was conducted on two dairy farms. All the animals were housed in a free stall system. On the farm with the deep straw bedding (Farm A), 403 and on the farm with manure solid bedding (Farm B), 226 Holstein-Friesian dairy cows were examined. The dairy cows on the farm A with deep straw bedding (group size of 60 cows per pen, approximately) had lying areas with 80 cm of straw available. The farm B with manure solids was equipped with cubicles with concrete basement floor. Recycled manure solids were obtained from the mechanical separation of raw manure and used for cubicle bedding without any chemical and thermal processing. The depth of this bedding varied from 20–30 cm.

The average yearly milk yield on the Farm A and B was 7,400 and 8,200 kg, respectively. The dairy cows were fed by total mixed ration (TMR) on both farms with maize and alfalfa silage as the main components. Claw trimming was performed twice a year by external professional claw trimmers. No claw bathing was performed on either farms.

All the dairy cows were examined and treated in the trimming crush for claw lesions by one person. The clinical examination was focused on the following claw lesions [29]: digital dermatitis, heel horn erosions, white line diseases, toe ulcer, sole ulcer (pododermatitis circumscripta specifica), interdigital fibroma, sole haemorrhage, and chronic laminitis (horizontal horn fissures and concave wall). The cases of digital dermatitis were recorded for each leg and other lesions for each claw (eight claws per cow).

The statistical analysis was performed by running a chi-squared test using the statistical software StatSoft, version 8.0. P-values ≤ 0.05 were considered significant.

RESULTS

The prevalence of cows with one or more claw lesions on the farm with straw bedding (A) and with manure solids (B) were 37 % and 69%, respectively ($P < 0.001$). The dairy cows of farm B had more than one lesion per head, demonstrating a higher prevalence of claw diseases in the herd with manure solids (Table 1).

The results from the chi-squared test describing individual claw lesions on deep straw bedding versus manure solids are shown in Table 2.

Table 1. Prevalence of claw lesions in dairy cows on different beddings

Variable	Number of dairy cows	Cows with lesions	Lesion count	Lesion count per cow	Lesion count per cow with lesions
Deep straw bedding	403	151 (37 %)a	223	0.55	1.48
Manure solids	226	156 (69%)	309	1.37	1.98

a — $P < 0.001$ **Table 2. Prevalence of individual claw diseases in dairy cows on different beddings**

Variable	Deep straw bedding	Manure solids
Number of dairy cows	403	226
Lesion count (100%)	223	309
Digital dermatitis	17.5 %	53.1 %a
Heel erosion	21.5 %	18.8%
White line diseases	12.1 %	3.88 %a
Toe ulcer	15.7 %	2.59 %a
Sole ulcer	9.43 %	3.23 %
Interdigital fibroma	17.9%	12.3 %
Sole haemorrhage	3.59 %	5.83 %
Chronic laminitis	2.24 %	0.32 %

a — $P < 0.001$

In both bedding systems, two types of claw lesions dominated: digital dermatitis and inflammatory disorders of the corium (white line diseases, toe ulcer, and sole ulcer). The prevalence of the contagious digital dermatitis on farm A and B were 17.8 % and 53.1 % ($P < 0.001$), respectively. The prevalence of the white line diseases and toe ulcer was 12.1 % and 15.7 % on farm A and 3.88 % and 2.59 % on farm B, respectively ($P < 0.001$). There was no significant difference in the prevalence of the sole ulcer between the farms.

No acute laminitis could be observed in the examined dairy cows. In addition, several cases of sole haemorrhage and chronic laminitis were found on both farms (Table 2).

DISCUSSION

Bovine lameness can be based from 85 % on claw lesions associated with painful inflammatory processes. The remaining 15 % of lameness cases are due to other locomotory disorders, including: diseases of joints, tendons, tendon sheets, muscles, and bones or animals suffering from neurological disorders [29].

Cows housed in the deep straw-bedded freestalls ($n = 403$) had a lower prevalence of claw lesions (37 %) than cows housed in the freestalls with manure solids (69%; $n = 226$). This difference was based on a high occurrence

of digital dermatitis on the farm with manure solids. Digital dermatitis represents a lesion that is frequently affecting more than one leg. However, some forms of digital dermatitis like M3 and M4 [8, 24] are not associated with painful conditions. Digital dermatitis prevalence was clearly on the farm with manure solids in the present study. We can speculate that the mixture of straw and faeces can represent in the case of deep straw bedding, a lower risk of skin infection with causative agents. Bovine digital dermatitis is a common, worldwide, painful, infectious disease of the feet of intensively managed cattle [21]. The cause of digital dermatitis is multifactorial with an essential spirochaetal bacterial component. Several cultural, phenotypic and molecular studies have demonstrated that the spirochetes belong to a diverse phylogenetic group of *Treponema* spp. [20]. Acute digital dermatitis lesions were reproduced experimentally in Holstein heifers, thus, a systematic method to determine the efficacy of interventions aimed at the control of acute digital dermatitis is now available [12]. A new hypothesis about the participation of *Dichelobacter nodosus* in the development of skin lesions typical for digital dermatitis has been demonstrated recently [22]. The authors hypothesise that external noxious stimuli allow *D. nodosus* to break down the epidermal barrier creating a suitable environment for the secondary invaders, *Treponema* species, which gradually take over the infection site. In agreement with the prevalence of the claw diseases in our study, a recent observation has revealed that the two most frequent claw diseases in dairy cows were digital dermatitis and septic corium inflammation [19].

Significant effects of stall surface on lameness prevalence have been reported [4, 9]. In both studies, the lameness prevalence was compared between herds with deep-bedded sand and mattress-based freestalls. A lower lameness prevalence could be observed in the sand stalls in comparison with the non-sand ones [4]. Similarly, high producing Holstein cows had a lameness prevalence of 17.1 % in herds with sand-based freestalls compared with 27.9% in herds with mattresses [9]. It is interesting to note that the claw lesion prevalence for deep straw beds in the current study was much lower than the lesion prevalence observed with manure solids bedding. Differences in lameness prevalence likely occur between deep-bedded and mattress based stalls due to greater resting comfort in deep-bedded stalls. When provided the choice between deep beds with either sand or

sawdust bedding and mattresses with 2 to 3 kg of bedding, cows showed a preference for deep beds [27]. Several studies have shown cows prefer stalls with greater surface cushion and spend more time lying down and less time standing when stall surfaces provide a greater degree of comfort [15, 26]. The use of mattresses as a stall surface has been implicated as a risk factor for lameness in dairy cows [7]. Deep-bedded freestalls likely provide greater comfort than mattresses with small amounts of bedding.

The higher prevalence of the white line diseases and toe ulcers in dairy cows on the farm A with deep straw bedding might be related to the inappropriate walking surfaces of farm alleys. Risk factors for increased lameness were: the presence of damaged concrete in yards, cows pushing each other or turning sharply near the parlour entrance or exit, cattle grazing a pasture that is also grazed by sheep, the use of automatic scrapers, and delayed treatment of lame cows [2].

There are several preventive measures against high lameness prevalence, including: feeding, welfare, hoof trimming, and foot baths. Studies have shown that long intervals between hoof trimmings, or a lack of routine hoof trimming, is associated with an increased lameness [18, 25]. Professional trimming was found to be more effective on farms with no nutritional disorders and where refurbishment works were carried out. The greatest decrease in the prevalence of claw lesions was observed on farms which provided: professional trimming, effective footbathing, improved walking and resting surfaces, and which treated severely lame cows between regular trimmings [14]. However, claw trimming remains the most effective method available to facilitate producers to prevent claw disorders from evolving from the subclinical to the clinical stage.

These data of the present study indicate a relatively high prevalence of claw lesions on the studied dairy farms. In addition, a long-term contact of claws with manure (boxes and corridors) on the farm with unsterilized recycled manure solids seems to be associated with a higher prevalence of digital dermatitis. Generally, there was no overall effect of the manure solids on claw diseases rate in dairy cows.

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