Applied Animal Behaviour Science 116 (2009) 21–27

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Influence of floor type in the walking area of cubicle housing systems on the behaviour of dairy cows

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ARTICLE INFO

Article history:
Accepted 7 July 2008
Available online 5 September 2008

Keywords:
Dairy cows
Floor
Behaviour
Locomotion
Self-grooming
Cow comfort

ABSTRACT

The objective of this study was to compare the behaviour of dairy cows in cubicle housing systems with different floor types (mastic asphalt, slatted concrete floor and rubber floor) in the walking area. From a total number of 18 farms, 6 farms each were equipped with one of the given floor types, and stride length and self-grooming behaviour (self-grooming caudal to the costal arch standing on three or four legs) as well as the general activity of the cows (standing and lying) was observed directly. Stride length was measured both in winter during the indoor housing period and in summer during the pasture period. The cows' stride length was longest on rubber floor, followed by mastic asphalt and slatted concrete floor, and increased from winter to summer on all floor types (interaction of floor type and season: $F_{2,101} = 4.30$, $p = 0.02$). Self-grooming behaviour and general activity of the cows were observed during summer, autumn and winter. No significant differences in self-grooming behaviour were found between the three floor types. Cows stood for longer in the walking area on rubber floor than on mastic asphalt or slatted concrete floor, with an interaction between floor type and season ($F_{4,47} = 4.55$, $p = 0.0035$). It is concluded that rubber floor is more suitable and slatted concrete floor less suitable than mastic asphalt in the walking area of cubicle housing systems for dairy cows.

1. Introduction

In intensive dairy farming in Europe and North America, many cows are kept in cubicle housing systems, where different materials are available for the floors used in the walking area. In the past, hard surfaces such as mastic asphalt and solid or slatted concrete floors were used. Recently, farmers have often preferred rubber covered floors. Deformable surfaces such as those provided by rubber covered floors or pasture are regarded as more suitable for dairy cows than hard surfaces (Benz, 2002; Telezhenko and Bergsten, 2005; Flower et al., 2007). Hard floors are often too abrasive or too slippery, which can result in claw damage or leg fractures (Webb and Nilsson, 1983). Furthermore, slippery floors may have negative effects on locomotion, on the manifestation of oestrus behaviour, self-grooming behaviour and the general activity of dairy cows (Phillips and Morris, 2000, 2001, 2002; Benz, 2002; Bendel, 2005; Telezhenko and Bergsten, 2005; Tucker et al., 2006; Boyle et al., 2007). Consequently, data on the occurrence of such behaviour patterns can also be used to assess floor quality.

Numerous recently published studies focusing on floor quality in dairy housing systems (Benz, 2002; Bendel, 2005; Telezhenko et al., 2005; Boyle et al., 2007) were limited to observations made on single herds. To allow a generalisation of results, the present study was carried out on 18 farms. Moreover, we systematically investigated

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doi:10.1016/j.applanim.2008.07.004

three floor types by including six farms each equipped with a rubber, mastic asphalt or slatted concrete floor in the walking area of a cubicle housing system. Several studies have investigated the effects of concrete and rubber floors on cow behaviour, but little attention has been paid to mastic asphalt (Telezhenko et al., 2005).

In our study, we compared the three floor types in terms of locomotion, self-grooming behaviour and the general activity of the cows. We expected cows on rubber floor to show better locomotion expressed by stride length, more self-grooming behaviour, and a different activity pattern, with more standing in the walking area and more feeding than seen in cows on hard floor surfaces (mastic asphalt and slatted concrete). Moreover, we hypothesised that cow behaviour on mastic asphalt known as a non-slippery floor type (KTBL, 2006) differs in terms of stride length and self-grooming behaviour from that observed on slatted concrete floor, as concrete floor tend to become slippery with age (Kilian, 2007).

There are studies indicating that outdoor exercise on pasture may have a positive influence on the locomotion of dairy cows (Herlin and Drevemo, 1997; Hernandez-Mendo et al., 2007). To investigate this, we compared stride length in winter during the indoor housing period and in summer during the pasture period, hypothesising that stride length would be greater during the pasture period.

2. Animals, materials and methods

2.1. Animals, housing and management

The study was conducted on 18 Swiss dairy farms with an average herd size of 35 lactating cows. Table 1 gives information on herd size, breeds, milk yield and accessibility of outdoor runs on the farms studied. All herds were kept in cubicle housing systems with at least as many lying cubicles and feeding places as there were dairy cows. On six farms each, the floor of the walking area consisted of mastic asphalt, slatted concrete or rubber. The study herds were composed of breeds selected for high milk yield (Holstein, Red Holstein, Brown Swiss). Average milk yield varied between 5507 and 9068 kg.

During the summer, cows on all farms were at pasture for several hours a day (2.5–8 h, median 4 h). Also connected to the cubicle housing was an outdoor run, to which the cows had permanent access on 14 farms and restricted access on 4 (Table 1). Where access was restricted, cows were able to use the outdoor run for at least 13 days a month during the winter housing period. On most farms, floor type in the outdoor run differed from that of the walking area inside the cubicle housing (Table 1). Behavioural observations and floor slip-resistance measurements were only carried out indoors, however. Mechanically driven rotary cow brushes were present in the outdoor run on 12 farms and indoors on 2. Farms differed in terms of feeding a hay- or silage-based diet, but feed type did not differ systematically between farms with different floor types in the walking area.

2.2. Behavioural observations

On each farm, the stride length of the cows was recorded during the winter housing period in January and February 2006, and the summer pasture period in July and August 2006. One farm (herd 13) with slatted concrete floor could not be visited for the stride length measurements during the summer pasture period.

To determine stride length, 10–17 (median 14.5) individuals were chosen as focal animals on each farm. In order to select these cows, the presence and severity of lameness was assessed with a scoring system adopted from Garbarino et al. (2004) which distinguished six categories: "normal" (0), "barely lame" (1), "mildly lame" (2), "moderately lame" (3), "lame" (4) and "severely lame" (5). Cows with a lameness score above 2 were not considered as focal animals for the stride length measurements.

Stride length was measured from footprints using a modified version of the method described by Telezhenko and Bergsten (2005), and defined as the average distance between two consecutive imprints of the right rear foot. Measurements were taken in the passageways between the feeding rack and the lying cubicles, or in the passageways between rows of lying cubicles, and under average soiling conditions, so that cows' footprints were clearly visible in the slurry layer on the floor surface.

Cows were repeatedly walked down the passageways of the cow shed. An experienced handler followed the cow at a distance to ensure that she walked without pause. A footprint of the right rear claw was marked for the measurement. As the animal walked, strides were counted. At the end of the walk, the last footprint of the right rear claw was marked and the distance between the two markings measured using a laser distance meter (Leica Disto plus®). The average stride length was calculated from the distance per walk divided by the number of strides per walk. If gaits with extreme movements such as galloping, trotting, jumping, stopping or slipping occurred during measurement, data were discarded for the analysis of the stride length. Slipping during stride length measurements was recorded separately. Stride length was measured three times per animal both in the winter and summer observation period. To take account of cow size and its influence on stride length, each test animal's height at sacrum was also measured.

Self-grooming behaviour and general activity were observed in two periods, however these were not identical with the observation periods of the stride length measurements. The first observation period of self-grooming behaviour and general activity started in December 2005 and ended in February 2006; the second period ran from June 2006 to January 2007. The observation periods of self-grooming behaviour and general activity were subdivided into the seasons summer (21 June–22 September), autumn (23 September–20 December) and winter (21 December–20 March). Behavioural elements were observed continuously for a median of 12 h per herd (range 6–18), divided into observation units of 3 h each. The observations during winter were carried out systematically after the morning and the evening feeding period (observation on 17 of 18 farms; median observation duration: 6 h, range 6–12 h). In autumn (observation on 9 of 18 farms, median observation duration: 6 h, 3–6 h) and in summer (observation on 6 of 18 farms, median observation duration: 6 h, range 3–6 h) when cows were at pasture in the morning, observations were also conducted in the afternoon. The main part of the observations was carried out after morning feeding (141 h) followed by the observation in the evening (60 h) and the afternoon (15 h).

One farm (herd 13) with slatted concrete floor could not be visited in the second observation period for the observation of self-grooming behaviour and general activity. One herd (herd 2) was observed for a total of 18 h because it had been split into two groups according to milk yield: both groups were observed during the first observation period, while only the group with the higher milk yield was considered during the second.

Self-grooming behaviour parameters were recorded individually for the cows by continuous behaviour sampling. Cows were marked with coloured numbers on their back for purposes of identification. In this study only elements of self-grooming behaviour were recorded when the cows were self-licking. From this self-grooming behaviour two parameters with extreme body flexion were recorded individually by direct continuous behaviour sampling (Martin and Bateson, 1993): "self-grooming caudal to the costal arch standing on four legs" and "self-grooming caudal to the costal arch standing on three legs". One event of self-licking was described as licking bout. The frequency and the duration of the lickings bouts were recorded. Licking bouts were divided into short bouts lasting under 5 s, and long bouts lasting over 5 s. We differentiated between self-grooming in the walking area inside the cubicle housing, and self-grooming in the lying cubicles. Behaviour displayed in the outdoor run was not considered. If cows slipped while self-grooming, this was noted separately. Normally, one observer monitored the entire herd from an elevated position in the feeding passage; however, if there were over 46 cows in a herd (Table 1) or if the cubicle housing system consisted of two buildings, observations were performed by two observers. During recording of the self-grooming behaviour, general activity of the cows was sampled every 10 min (scan sampling, Martin and Bateson, 1993). The following mutually exclusive activities were differentiated: feeding (head through the feed rail), lying in a cubicle, standing in the walking area, standing in a cubicle (all four legs inside), half standing inside a cubicle (two legs inside) and staying in the outdoor run.