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Introducing structural elements into the free resting area in loose-housing systems with horned dairy cows: Effects on lying behaviour and cleanliness

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ABSTRACT

The transition of tie-stalls to loose housing systems is often accompanied by starting dehorning. Deep-litter and straw-flow systems can be more cost-effective and advantageous for various aspects of the welfare of dairy cows than cubicle loose housing. However, the number of social encounters and disturbances of lying animals can be higher in these systems especially for animals with horns. The use of structural elements may improve the situation and the aim of this project was to investigate the potential effects of structural elements in the free resting area on resting behaviour, animal cleanliness and straw usage in herds of horned dairy cows.

On five commercial farms that keep horned dairy cows in a deep-litter system, data were collected in situations without and with a structural element present. Lying behaviour was recorded by scan sampling for each individual animal every 5 min. The cleanliness of the cows was assessed at the beginning and end of the four-day recording period. The proportion of scans in which animals were lying in 24 h, during day and at night as well as the change in cleanliness were analysed using linear mixed models. Straw usage was evaluated by counting the number of bales used on each of the four days on four farms.

The proportion of lying was higher with the structural elements present than without for 24 h ($p<0.001$) and at night ($p<0.001$), while no effect was found during the day ($p=0.964$). This was particularly true for high-ranking and middle-ranking animals (interaction rank*structure: $p=0.007$), for which lying time increased by about 1 h on average, while for low-ranking animals it increased only about 10 min. The strength of the effect, however, varied considerably between individual farms. Animals were also less dirty with the structural element present than without ($p=0.008$). For straw usage, no uniform trend was found on the farms.

In conclusion, the results indicate a positive effect of the presence of a Y-shaped structural element in the free resting area of straw yard systems on lying time and cleanliness of horned dairy cows. The use of structural elements in straw yard or comparable systems thus has the potential to improve the welfare of horned dairy cows and furthers keeping of horned cows as an alternative to dehorning.

1. Introduction and aims

In mountainous regions, tie-stall systems were traditionally used for dairy cattle. Even though many cows are still kept in tie stalls, there is a clear trend towards loose-housing systems (Schütz, 2011). The transition to loose housing is often accompanied by starting with the practise of dehorning animals. In Europe, about 50% of the cows kept in tie-stalls still have horns, while in loose housing about 85% are dehorned (Cozzi et al., 2015). The practise of dehorning, however, is more and more questioned, especially in organic farming, where in some countries about one fifth of the farms with loose housing refrain from dehorning (Cozzi et al., 2015). Dehorning in loose housing is argued for by a high risk of injuries by horn butts in both animals and humans and

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higher levels of stress and behavioural restrictions for low ranking animals (Waiblinger et al., 2011). Several on farm studies identified factors influencing the level of aggression and injuries when keeping horned cows in loose housing (Menke, 1996; Baars and Brands, 2000; Schneider, 2010), but open questions remain.

In addition to cubicle loose-housing systems, which are often used due to a low straw usage, systems with a free resting area, i.e. deep-litter or straw-flow pens, represent cost-effective solutions that are easier to install in old buildings, which is advantageous for small farms with low space and capital resources (Schütz et al., 2011). Deep-litter and straw-flow systems are also advantageous over cubicle loose housing with regard to various aspects of the welfare of dairy cows. In contrast to cubicles, a free resting area not only provides dairy cows with the possibility of lying down, standing up and assuming all resting positions without hindrance (Fregonesi and Leaver, 2002; Hörning, 2003), thus also reducing the risk of injuries, but also with an optimum floor for resting and locomotion. Correspondingly, deep-litter systems are advantageous over cubicle housing in terms of claw health (Somers et al., 2003; Webster, 2002). With respect to keeping horned cows Baars and Brands (2000) describe a beneficial effect of a free resting area in terms of lower injuries by horn butts, which, however was not confirmed in two larger studies (Menke et al., 1999; Schneider, 2010). Instead, due to the mix of functions in the resting area (mainly resting and locomotion) the number of social encounters and disturbances of lying animals by other animals is higher in free resting areas than in cubicle housing (Metz and Wierenga, 1984; Rist, 1989) and this might reduce lying time. Accordingly, in a study involving 35 horned dairy cow herds, activity in the resting area was higher in free resting area systems compared to cubicles, i.e. a lower proportion of animals was lying (Menke, 1996). Especially low-ranking animals may suffer from disturbances and reduced lying time (Wierenga, 1983; for review Bouissou et al. (2001)).

Respect from low-ranking animals for the individual distances of dominant ones seem to be more pronounced in horned animals, as reflected in a smaller amount of agonistic interactions with body contact (in goats: Aschwanden et al., 2008b; Nordmann et al., 2011; in cattle: Graf, 1974). That is, visual signs or the mere approach of a higher ranking animal are more effective in causing a subordinate animal to withdraw. The disadvantages of a free resting area without structural elements in terms of disturbances of lying animals thus might appear even more clearly in horned dairy cows. In their previous study in horned dairy herds CM and SW frequently observed a large part of the animals rising quickly due to disturbance by an animal walking through the free resting area. However, no study investigated lying behaviour in horned dairy herds in deep litter or straw flow pens systematically so far.

Undisturbed lying and sufficient lying time is not only beneficial for production (Munksgaard and Simonsen, 1996), but is a necessary precondition for a good quality of life. Thus, solutions for reducing disturbances of animals in free resting area systems will increase animal welfare and economic viability of keeping horned dairy cows in these systems.

Cubicle housing systems constitute an extreme form of structuring the resting area. Results in other species (for review Waiblinger (2009)) suggest that the use of physical and/or visual barriers in a free resting area for dairy cows might also reduce activity in that area and disturbance of lying animals. This is expected to result not only in longer durations of undisturbed lying, but also by reducing locomotion, in a reduction in straw usage (Groenewold, 2006), without losing the benefits of deep-litter and straw-flow systems. For example, enriching pens for small groups of goats (8 animals/group) with structural elements providing visual cover and with elevated platforms positively affected feeding, resting and agonistic behaviour (Aschwanden et al., 2009a). In horses, Pollmann (2001) observed longer lying times in animals with structural elements present in the resting area. However, the use of structural elements in the resting area did not affect resting time in very small groups (4 animals/group) of goats (Ehrlenbruch et al., 2010) or sheep (Jørgensen et al., 2009). The impact of structuring the free resting area on cattle is largely unknown, and, to our knowledge, no study has been published on this subject.

Thus, the aim of this project was to investigate the potential effects of structural elements in the free resting area on resting behaviour, animal cleanliness and straw usage in herds of horned dairy cows. We expected a beneficial effect of the presence of structural elements on lying time, cleanliness and straw usage. Further we expected low-ranking animals to benefit most with respect to lying time. The results should help to further develop economically viable loose-housing systems for keeping horned dairy cows and further increase the welfare of cows in systems with a free resting area.

2. Animals, material and methods

2.1. Farms, animals and housing

The potential effects of structural elements were investigated on five commercial farms keeping horned dairy cows in a deep-litter system. Farms were selected where farmers expected both a constant herd composition and no or a small number of cows in heat during the observation period. Herd size on the farms ranged from 19 to 36 animals/herd. Three of the farms were located in Switzerland (farm 1 with a herd of 22 cows and 1 bull, Swiss Fleckvieh (SF) cattle; farm 3 with 19 Braunvieh (BV) cows (Brown Swiss (BS) × Original Brown (OB)-crosses) and 1 bull; farm 5 with 23 Brown Swiss cows and 1 bull), and two were located in Germany (farm 2 with 13 Brown Swiss cows and 6 heifers; farm 4 with 36 German Simmental cows). For individual identification cows were marked with numbers by tinting or bleaching their hair. The shape and structure of the deep-litter systems varied between the farms (Fig. 1).

2.2. Study design and structural element

In the five dairy cow herds described above, data were collected in situations without and with a structural element present for four days each. First, the situation without a structural element was recorded for four days (4 × 24 h). Then, a structural element was installed in the resting area, and, after a habituation period of six days, data were collected (with a structural element present) for four days. No other changes in housing or management except the installation of the structural element were undertaken. Data collection started in December 2011 on farm 1 and ended in April 2012 on farm 5.

Following a pre-study on one farm where three different structural elements were tested, a Y-shaped structural element was selected. This structural element was built of three solid wooden walls (2.50 m long and 1.5 m high) arranged in a Y-shape and placed in the centre of the resting area (Fig. 1).

2.3. Data recording

2.3.1. Resting behaviour

For recording the resting behaviour, the entire deep-litter area was filmed by three to four video cameras using a digital video recording system by Mobotix®. Infra-red lights were installed to allow recording at night. To reduce the hard drive space required, a time-lapse mode at 4 fps was chosen, which resulted in an amount of data of about 100–150 GB per day for all cameras. To be able to