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Determining suitable dimensions for dairy goat feeding places by evaluating body posture and feeding reach

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ABSTRACT

Confined goats spend a substantial part of the day feeding. A poorly designed feeding place increases the risk of feeding in nonphysiological body postures, and even injury. Scientifically validated information on suitable dimensions of feeding places for loose-housed goats is almost absent from the literature. The aim of the present study was, therefore, to determine feeding place dimensions that would allow goats to feed in a species-appropriate, relaxed body posture. A total of 27 goats with a height at the withers of 62 to 80 cm were included in the study. Goats were tested individually in an experimental feeding stall that allowed the height difference between the feed table, the standing area of the forelegs, and a feeding area step (difference in height between forelegs and hind legs) to be varied. The goats accessed the feed table via a palisade feeding barrier. The feed table was equipped with recesses at varying distances to the feeding barrier (5–55 cm in 5-cm steps) at angles of 30°, 60°, 90°, 120°, or 150° (feeding angle), which were filled with the goats' preferred food. In 18 trials, balanced for order across animals, each animal underwent all possible combinations of feeding area step (3 levels: 0, 10, and 20 cm) and of difference in height between feed table and standing area of forelegs (6 levels: 0, 5, 10, 15, 20, and 25 cm). The minimum and maximum reach at which the animals could reach feed on the table with a relaxed body posture was determined for each combination. Statistical analysis was performed using mixed-effects models. The animals were able to feed with a relaxed posture when the feed table was at least 10 cm higher than the standing height of the goats' forelegs. Larger goats achieved smaller minimum reaches and minimum reach increased if the goats' head and neck were angled. Maximum reach increased with increasing height at withers and height of the feed table. The presence of a feeding area step had no influence on minimum and maximum reach. Based on these results, the goats' feeding place can be designed to ensure that the animals are able to reach all of the feed in the manger or on the feed table with a relaxed posture, thus avoiding injuries and nonphysiological stress on joints and hooves. A feeding area step up to a maximum of 20 cm need not be taken into account in terms of feeding reach. However, the feed table must be raised at least 10 cm above the standing area to allow the goats to feed in a species-appropriate, relaxed posture.

Key words: goat, feeding behavior, body posture, dimensions of feeding place

INTRODUCTION

Goats feed for a substantial part of the day, consuming several meals over 2 main periods (early and late in the daytime). Depending on the diet, daily feeding time is 6 to 9 h/d in confined housing (Abijaoudé et al., 2000) and 7 to 10 h/d on pasture (Ferreira et al., 2013). Agonistic interactions in the feeding area are common among goats; because of their browsing feeding behavior they forage selectively, and higher-ranking goats chase lower-ranking herd members away from preferred food (Barroso et al., 2000). In intensive housing conditions, these interactions can be mediated by the feed (e.g., quality, amount, distribution) and spatial conditions (e.g., number and size of feeding places, size of lying area) available in the pen (Barroso et al., 2000; Loretz et al., 2004; Andersen and Boe, 2007; Aschwanden et al., 2008). However, encounters also lead to frequent changes of feeding place, and hence to repeated entry into and exit from the feeding barrier. Given the hours spent feeding each day, this means that the animals are in frequent contact with the feeding barrier, which poses a risk of injury if poorly designed (Kielland et al., 2010).

In dairy goat housing, several types of feeding barriers are used. Neck rails are continuous horizontal rails or boards that lack physical separation between single feeding places, resulting in frequent displacements

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(Nordmann et al., 2013). With diagonal feed fences or self-locking feeding barriers, goats are physically separated by vertical bars but must twist their heads to pass them through the openings; therefore, duration for leaving this type of barrier is increased (Nordmann et al., 2013). By contrast, the more goat-friendly palisade or tombstone feeding barriers—characterized by upright (wooden or metal) posts spaced at intervals that allow insertion of the neck but not the head from above—reduce the risk of being hindered by the bars of the opening. Animals can easily enter or exit these barriers simply by lifting or lowering their heads, respectively. This is particularly important when a lower-ranking animal needs to free its head from the feeding barrier to give way to a higher-ranking herd member (Nordmann et al., 2013).

At the same time, however, for the sake of species-appropriate feeding and goat welfare, it is essential that the feeding place be correctly sized so as to avoid bruising or hematomas from the feeding barrier, and to not restrict the animals' freedom of movement during feeding or social interactions. It is only when goats can feed in a relaxed posture without having to brace themselves against the feeding barrier to reach the feed that the pressure of the feed barrier on the animals' bodies is minimized (Dumelow, 1987) and skin lesions and nonphysiological stress on joints and hooves are prevented.

The literature recommends an animal-to-feeding place ratio of at least 1:1 (Loretz et al., 2004; Jørgensen et al., 2007) and feeding place widths of 35 to 40 cm per goat (Toussaint, 1997; Loretz et al., 2004). However, other dimensions known to be relevant in cattle, such as the height of the feeding barrier (e.g., neck rail), the height of the partition between pen and feed table, the depth of a feed table or manger, and the height of a feed table (Fernández et al., 2006; Huzzey et al., 2006; Kielland et al., 2010), have not been scientifically investigated to any great extent in goats (Muhikambele et al., 1998).

Adequate dimensions for a feed barrier must be based on the animals' body measurements (Fernández et al., 2006). In goats, height at withers is an appropriate predictor, as it is easy to measure as well as highly correlated with other body dimensions and weight (Muhikambele et al., 1998). For the height of the feeding barrier, for example, it is reasonable to assume that a neck rail must be at least slightly higher than the animals' height at withers (Kielland et al., 2010). For feed table height and depth, determining adequate dimensions is not as simple, as they are mutually dependent. The depth of a feed table or manger determines the maximum distance at which feed is made available to the animals. Hence, the depth of the feed table is adequate when the animals can reach and consume all of the feed across the entire width of the feeding place with a relaxed posture. It can be assumed that larger animals have a greater reach and can thus reach the feed more easily than smaller animals, and that reach decreases toward each side of the feeding place when the goats need to twist their necks. It can also be assumed that increasing the height of the feed table increases the reach of the animals. Here, work economics considerations also highlight the importance of finding a suitable combination of feed table height and depth, as these 2 dimensions, together with the height of the partition between pen and feed table, determine loading capacity (the maximum feed volume that can be dispensed at any one time).

With regard to reach, depending on the system, feeding places for goats do not always have solid flooring, but pens are often bedded with straw up to the feeding barrier. In barns of this type, the growing layer of manure constantly reduces the height of the feeding barrier. For this reason, the dimensions of the feed barrier generally take account of the maximum height of the manure layer. Particularly after dung removal, the feeding barrier is unsuitably high, which is why a feeding area step is often provided. The animals can stand with their forelegs on the step to lift their bodies, thereby overcoming the height difference, but the ensuing change in posture (in which the forelegs are higher than the hind legs, and the line of the back is bent) could limit the goats' reach at the feed table.

The aim of our study was, therefore, to investigate the reach of feeding goats in relation to their height at withers by varying the height of the feed table (difference in level between the standing area of the forelegs and the feed table) and of a feeding area step (difference in level between fore and hind legs). Using a similar approach here to Muhikambele et al. (1998), who specified the maximum vertical and horizontal reach of goats, we determined the feeding reach for feed table dimensions of practical relevance and included the goats' posture during feeding to ensure species-appropriate feeding.

MATERIALS AND METHODS

Experimental Animals

Ethical approval to conduct the study was obtained from the Cantonal Veterinary Office, Thurgau, Switzerland (Approval No. F4/09). A total of 27 adult, lactating, healthy dairy goats in average body condition on 2 dairy goat farms with loose housing and a barrier feeding system were chosen for the data collection process. Breeds represented were Appenzeller (14 animals), Grisons Striped (3 animals), Chamois Colored (6 animals),