



Feed intake and behavior of dairy goats when offered an elevated feed bunk

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ABSTRACT

Goats are browsers and select vegetation at various heights when foraging. On commercial farms, dairy goats are typically fed from low-level feed bunks. The objective of this study was to determine how feed intake and feeding behavior vary when goats are offered feed at variable heights, with the potential of evaluating the benefits of offering an elevated feeder to dairy goats. Thirteen Saanen X dairy goats were housed in a home pen with a lying area of wood shavings, where they were pre-exposed for 24 d to 3 feeder heights designed to result in differences in head height while feeding: floor level (head lowered relative to body), head level (head level relative to body), and elevated level (head and neck angled upward). Nine groups of 3 goats each were randomly selected and housed for 24 h in a test pen identical to the home pen except that it contained 1 of each of the 3 feeder heights. Each feeder contained *ad libitum* chopped alfalfa silage and a top-dressed corn-based supplement, refreshed twice daily. Refusals from inside and under each feeder were weighed to calculate intake. Feed intake increased with increasing feeder height (mean \pm SE; 0.18, 0.29, and 0.34 ± 0.04 kg of DM/goat for floor-level, head-level, and elevated-level feeders, respectively). Total feeding time did not vary with feeder height, but feeding rate tended to be faster at the elevated-level feeder (14.5 ± 2.1 g of DM/min) compared with head-level (9.2 ± 2.3 g of DM/min) and floor-level (8.9 ± 2.1 g of DM/min) feeders. Goats visited the floor-level feeder (36.4 ± 8.4 visits/goat) less than the head-level (79.4 ± 8.4 visits/goat) and elevated-level (74.8 ± 8.4 visits/goat) feeders. The number of displacements per minute of feeding time (physical removal of another goat from the feeding place) was greater at the elevated-level feeder (0.46 ± 0.06 displacements/min) compared with the floor-level feeder (0.23 ± 0.06 displacements/min) and tended to differ from the head-level feeder (0.27 ± 0.06 displace-

ments/min). We conclude that goats eat more from an elevated feeder and compete more to access this feeder.

Key words: foraging, natural behavior, welfare, browsing

INTRODUCTION

Goats are selective foragers of “browse” (e.g., foliage, buds, flowers, and stems of shrubbery; Askins and Turner, 1972). Although this browsing behavior can include some low-level feeding, different body positions are used to access the browse when located at variable heights; these positions include eye-level feeding and rearing onto the rear legs (Tölü et al., 2012). The inclusion of browsing behavior allows for an expansion of the foraging area by accessing browse above head level. There is a wealth of evidence indicating that when goats are faced with a variety of browse, forbs, and grasses in their environment, they will consume a diet containing much more browse than sheep or cattle (reviewed by Goetsch et al., 2010; Solaiman, 2010). Sanon et al. (2007) reported that goats browsed forage that was located on average at a height of 1.65 m (maximum = 2.1 m)—more than double their body height. Goats have also been reported to climb trees when given the opportunity (El Aich et al., 2007). Feeding with the head elevated may aid in predator detection; grazing with the head lowered is known to limit visual identification of threats (Beauchamp, 2015). Feeding at head or elevated level may also reduce the risk of infection, as parasite eggs are typically situated at or near ground level (Lu, 1988).

Extensively managed goats housed in complex naturalistic environments will browse for a considerable portion of their daily feeding time. However, when intensively managed on commercial farms, goats are typically fed using a floor-level feeder. In cattle, different feed bunk designs can affect aggression (DeVries and von Keyserlingk, 2006), feeding time (Huzzey et al., 2006), and access to the feed bunk for subordinate animals (Endres et al., 2005). There have been limited studies on feeder design for goats. Aschwanden et al. (2009a) showed reduced aggression between goats when

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partitions between feeding places were provided; however, it has been suggested that some partitions may restrict goat mobility into and out of the feed bunk (Nordmann et al., 2011a).

Few studies have investigated the effect of feeder height on feeding and social behavior of goats. Aschwanden et al. (2009a) allowed goats to feed from a vertically elongated hayrack that required them to stand on a platform and found decreased agonistic behavior and increased feeding time compared with feeding at floor level. In a companion study, Aschwanden et al. (2009b) found that goats provided housing containing structural elements, including elevated platforms for feeding, had longer feeding bouts and fewer interrupted resting bouts. The structure of feed bunks has also been adjusted to allow for a comfortable posture and reach while feeding (Keil et al., 2017). However, these studies did not offer elevated feeders that resemble heights found in natural browsing situations, nor did they allow multiple goats to feed together from the same height. Elevated feeding areas that resemble how goats naturally forage may be preferred and promote increased feed intake.

The objective of this study was to determine whether goats prefer to feed from a browsing position. We predicted that goats would consume more feed and spend more time feeding from feeders that permit a browsing position. Furthermore, we expected that more competitive displacements would occur at the higher feeders as a result of the preference for these feeding positions. Overall, our aim was to evaluate the effects of offering dairy goats an elevated surface for feeding.

MATERIALS AND METHODS

The study was conducted in August 2016 at the Ruakura Research Centre in Hamilton, New Zealand. All procedures were approved by the Ruakura Animal Ethics Committee (Hamilton, New Zealand; no. AE13930) under the New Zealand Animal Welfare Act 1999 and by the University of British Columbia Animal Care Committee (Vancouver, BC, Canada; no. A16-0213).

Animals, Housing, and Diet

Thirteen nonlactating, nulliparous, nonpregnant, and disbudded Saanen X dairy goats were enrolled from the AgResearch herd at approximately 13 mo of age with a mean (\pm SD) BW of 37.6 ± 3.6 kg. Goats were previously housed on pasture as a single group and were given 6 d to habituate to the indoor facility. This began with an initial period of indoor housing at night only, followed by 5 d of continuous indoor housing. Goats were then

housed as a single group for the next 24 d in a home pen with plywood walls measuring 11.3×3.0 m (offering $2.6 \text{ m}^2/\text{goat}$); half of the pen was equipped with a plywood box bedded 40 cm deep with wood shavings (offering $1.3 \text{ m}^2/\text{goat}$), and the other half of the pen floor was metal grating (Figure 1). In the home pen, goats were fed *ad libitum* alfalfa silage (Fiber Protect, Fiber Fresh Feeds, Reporoa, New Zealand) top-dressed with 3 kg of pellets ($0.23 \text{ kg}/\text{goat}$; Fiber Grow, Dunstan Horse Feeds Ltd., Hamilton, New Zealand) twice daily at 0800 and 1600 h (per requirements for 40-kg nonlactating goat; NRC, 2007). Feed was provided from 1 of 3 feeder heights (floor, head, and elevated levels; see Figure 2A–C for design details). Each morning at 0800 h, the feeder height was changed to a different feeder height following a randomized schedule such that only 1 feeder height was offered during a given 24-h period. Goats received fresh water from a wall-mounted waterer, and *ad libitum* hay was provided and replenished daily at 1200 h in 2 hayracks positioned at 72 cm above the pen floor at either end of the pen.

Experimental Design

Following 24 d in the home pen, individual preference for feed bunk height was tested over 10 d. On the first day, all goats were moved as a group to the test pen for 24 h of habituation. The test pen was identical to the home pen except that all 3 feeder heights were offered simultaneously. Goats were able to choose which feeder to feed from and could feed alongside other goats if they wished (offering 20 cm of feeding space per goat per feeder). Feed offered in the test pen was identical to that offered in the home pen, with each feeder providing *ad libitum* chopped alfalfa silage top-dressed with 0.23 kg of pellets/goat refreshed at 0800 and 1600 h each day.

Following the 24-h habituation period in the test pen, all the goats were returned to the home pen. Over the next 9 d, 3 goats were selected each morning before feeding to enter the test pen, where they remained for 24 h. Goats were selected pseudorandomly such that all goats entered the test pen as a triad at least twice, but no goat remained in the test pen for 2 consecutive days and all triads were unique. The order of feeder heights presented from left to right was changed each morning; order was randomized such that each combination was presented at least once and no more than twice over the 9-d testing period. At each feeding, feed refusals from inside each feeder were collected and weighed to calculate feed intake. Any feed that fell out of the feeder was collected from a tray that was placed underneath each feeder under the metal grating of the pen and added to the total refusals calculation. Samples of of-

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