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Sampling behavior of dairy cattle: Effects of variation in dietary energy density on behavior at the feed bunk

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ABSTRACT

Factors affecting sampling behavior of cattle are poorly understood. The objectives of this study were to measure the effects of variation in feed quality on the feeding behavior of Holstein dairy heifers. Thirty-two heifers were housed in 4 groups of 8. Each group pen had 8 distinct feeding stations. The total mixed ration (TMR) provided was low energy (TMR-L), moderate energy (TMR-M), or high energy (TMR-H). During trial 1 (d 1 to 8), heifers were offered a uniform baseline diet (TMR-M in all 8 feeding stations) interspaced with 2 uniform test diets on d 3 and 6 (TMR-L or TMR-H in all 8 feeding stations). During trial 2 (d 9 to 17) heifers were offered a nonuniform baseline diet (7 feeding stations with TMR-L and 1 feeding station with TMR-H) interspaced with 3 uniform test diets on d 11, 14, and 17 (TMR-L, TMR-M, or TMR-H in all 8 feeding stations). Heifers were observed in pairs (n = 16) for 15 min following delivery of fresh feed. Relative to the uniform baseline period of trial 1, 31% fewer switches occurred between feeding stations when offered TMR-H and 51% more switches when offered TMR-L. Relative to the nonuniform baseline of trial 2, 49% fewer, 27% fewer, and 25% more switches occurred during the TMR-H, TMR-M, and TMR-L treatments, respectively. In general, when heifers were offered a diet that was lower in energy density than that previously experienced, they spent less time at each feeding station and when offered a higher energy diet, heifers spent more time at each feeding station. The greater the contrast in energy density between the test and baseline diets, the greater the change in the behavioral response. Competitive interactions at the feed bunk were most frequent when TMR quality varied among the 8 feeding stations; during the nonuniform baseline period of trial 2, the number of competitive interactions was over 3.5 times higher than during all uniform dietary treatments. In summary, dairy heifers sample feed quality by changing feeding locations at the feed bunk and this sampling behavior is affected by variation in diet quality along the feed bunk and across days.
Key words: heifer, diet quality, agonistic interaction, feeding behavior

INTRODUCTION

In nature and pasture-based management systems, the foraging decisions of cattle occur at several levels, including (1) when to feed, (2) where to feed, (3) what to consume, and (4) how to consume it. These decisions are based on abiotic factors, such as land topography, distance from water, and environmental conditions and biotic factors such as plant composition, quality, quantity, and morphology. Intake rate and postingestive feedback can then be used to integrate information obtained through diet selection to evaluate the suitability of a particular feeding site (Provenza, 1995). Other factors such as the social environment, degree of predation risk, health status, or dominant physiological state (e.g., lactating vs. nonlactating and pregnant) can also influence how and what cattle eat; for example, with an increased threat of predation animals may decrease time spent at a feeding site, restrict movements at a feeding site, or increase vigilance behavior (Lima, 1998).

The factors influencing the feeding decisions of cattle reared indoors have received far less attention; researchers are only now beginning to recognize some of the factors that influence feeding behavior of modern dairy cows. For example, research has shown that cows are highly motivated to eat during the hours following the delivery of fresh feed (DeVries and von Keyserlingk, 2005). Dairy cattle can also be selective in their dietary choices if given the opportunity. Leonardi and Armentano (2003) found cows preferentially sort for the grain component of a TMR, avoiding the longer forage components. Cows will also eat faster in competitive feeding environments such as those encountered during periods of overstocking (Olofsson, 1999; Proudfoot et al., 2009). These findings relate to feeding decisions involving when, what, and how dairy cattle eat at a feed

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bunk; however, no work has studied factors that may influence where cattle chose to eat along the length of the feed bunk.

Most intensive dairy farms feed cattle a TMR that is intended to be well mixed; the assumption is that all cattle will have access to a diet of uniform quality. Several factors, however, may introduce unexpected variation in diet quality both in space (i.e., along the length of a feed bunk) and in time (i.e., within and among days). These factors could be management related such as improper mixing or chopping of the TMR and not placing feed along the entire length of the feed bunk or be cow-level factors such as sorting behavior. Sampling behavior allows animals to locate feeding sites of higher quality (Stephens et al., 2007), but to sample animals must move between feeding locations, which increases time that the animal is not feeding. Abrupt changes in dietary energy density may increase short-term sampling frequency to the point that time available for feeding is compromised. The objective of this study was to measure the effects of unexpected variation in the energy density of the diet on sampling behavior of indoor-housed cattle.

MATERIALS AND METHODS

Animals and Housing

This study was conducted at the University of British Columbia's Dairy Education and Research Center (Agassiz, BC, Canada) from November to December 2009. All animals were cared for according to the guidelines of the Canadian Council on Animal Care (CCAC, 2009). Thirty-two Holstein dairy heifers were enrolled in this study. The average ± standard deviation (range) BW and age of the experimental animals was 232.6 ± 55.1 kg (152–330 kg), and 207.1 ± 45.3 d (135–271 d), respectively. The experimental animals were further divided into 4 groups of 8 heifers; groups were balanced for BW and age.

In sets of 2 (experimental design was replicated over time), groups were randomly assigned to 1 of 2 identical experimental freestall pens. Each pen (Figure 1) consisted of 13 deep-bedded sand stalls arranged in a 3-row formation. The feed barrier consisted of 15 headlock feeding stations. Along this feed barrier every second headlock was blocked to prevent access to the feed; this allowed for a total of 8 functional feeding stations within each experimental pen, each separated by 0.8 m (from center to center of nearest available feeding station). Feed bins (high-density polyethylene box measuring: 0.45 × 0.35 × 0.40 m in length, width and height) were positioned in front of each feeding station and secured to the headlock partitions with a chain. This arrangement of feed bins prevented a heifer at one feeding station from accessing feed from a neighboring feeding station; heifers had to physically move to a new feeding station to sample the feed at that location.

Experimental Design

This study was conducted as 2 trials that occurred in immediate succession. Groups were formed at least 7 d before the beginning of the first trial so that heifers could acclimate to grouping. Both trials were conducted over a period of 17 d, with the first trial occurring

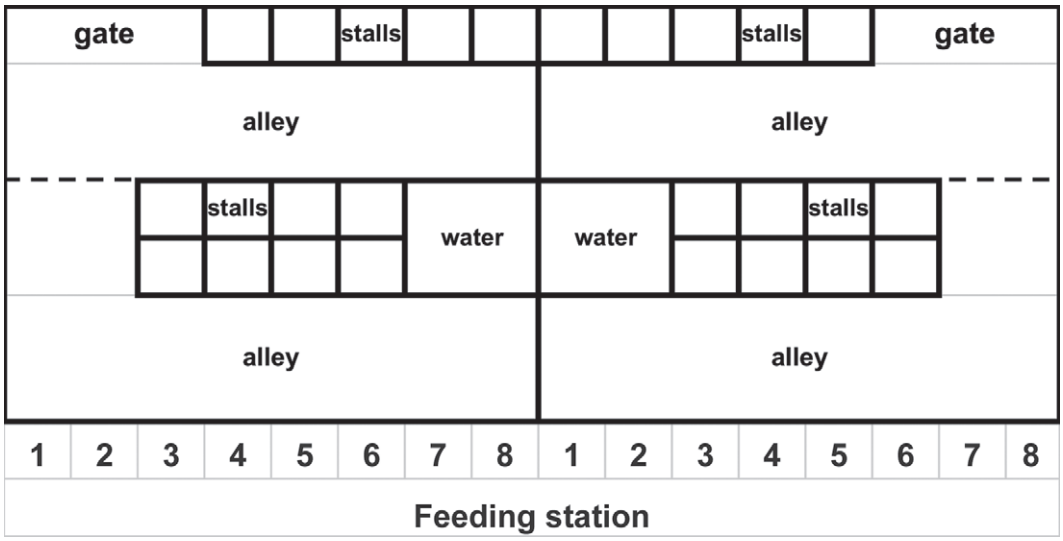

Figure 1. Experimental pen layout. Dashed line represents a movable gate.