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Short communication: Feed sorting of dairy heifers is influenced by method of dietary transition

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ABSTRACT

This study investigated the effect of exposing heifers to individual feed components on the extent and pattern of feed sorting upon transition to a novel ration. Holstein heifers (394 ± 62 d old, weighing 409.8 ± 37.3 kg; mean ± SD), consuming a familiar mixed silage-based ration [55% corn silage and 45% haylage, dry matter (DM) basis], were transitioned to a novel total mixed ration [TMR; 41.6% haylage, 36.5% corn silage, 14.6% high-moisture corn, and 7.3% protein supplement, DM basis] by 1 of 2 treatments: direct transition to novel TMR (DIR; n = 5) or exposure to novel TMR components individually before receiving novel TMR (COM; n = 6). During the baseline period (d 1 to 4), all heifers were offered the familiar silage-based ration. During transition (d 5 to 12), DIR heifers received the novel TMR, whereas COM heifers received the novel TMR components offered separately, in amounts according to TMR composition (target 15% orts). After transition (d 13 to 20), all heifers received the novel TMR. Feed intake and feeding time were determined daily and fresh feed and individual orts were sampled every 2 d for particle size analysis and neutral detergent fiber content. The particle size separator consisted of 3 screens (18, 9, and 1.18 mm) and a bottom pan, resulting in 4 fractions (long, medium, short, and fine). Sorting activity for each fraction was calculated as actual intake expressed as a percentage of predicted intake. We detected no effect of treatment on dry matter intake or feeding time. After transition to the novel TMR, COM heifers sorted to a greater extent than did DIR heifers, sorting against long particles (95.4 vs. 98.9%) and for short particles (101.7 vs. 100.6%). Differences in sorting patterns resulted in COM heifers tending to have lower neutral detergent fiber intake as a percentage of predicted intake (98.9 vs. 100.5%). The results of this study suggest that the degree of feed sorting may be influenced by method of transition to a novel ration.

Key words: feed sorting, dairy heifer, diet transition, feeding

Short Communication

Feed sorting by dairy cattle is of ongoing concern due to its effect on the nutrient composition of the ration consumed and, consequently, on rumen fermentation (DeVries et al., 2008) and milk fat production (Sova et al., 2013). Feed sorting behavior is typically addressed through feed management strategies applied at the herd level, such as adjusting ration DM content (Leonardi et al., 2005; Miller-Cushon and DeVries, 2009), feeding level (Miller-Cushon and DeVries, 2010), and feeding frequency (DeVries et al., 2005).

Considerable individual variability exists in the extent and pattern of feed sorting in both adult cattle (Leonardi and Armentano, 2003) and growing calves (Miller-Cushon et al., 2013b). Recent work has shown that differences in prior feed experiences can have persistent effects on feed sorting. For example, feed sorting in weaned dairy calves has been found to be influenced by prior exposure to different feed types (Miller-Cushon and DeVries, 2011), feed presentations (Miller-Cushon et al., 2013a), and ration forage particle sizes (Miller-Cushon et al., 2013b). Further, differences in feed sorting in weaned calves have been found to persist through transition to a novel TMR (Miller-Cushon et al., 2013a).

Dairy cattle undergo several dietary transitions at different stages of growth and lactation, yet it is unclear how feed experiences during transition to a novel diet influence the development or persistence of feed sorting. The objective of this study was to assess how the method of introducing a novel diet affects feed sorting in dairy heifers after transition to a novel TMR. We hypothesized that exposing heifers to individual ration components before offering a novel TMR would influence the extent of feed sorting for or against those ration components.

This study used 12 Holstein heifers (mean ± SD) 394 ± 62 d of age, weighing 409.8 ± 37.3 kg at the beginning of the experiment and 451.5 ± 43.2 kg at the end

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of the experiment. Animals were housed, 6 at a time, at the University of Guelph Kemptville Campus Dairy Education and Research Centre (Kemptville, ON, Canada) in a 39.2-m^2 wood shaving bedded-pack pen, and were managed in accordance with the guidelines and policies set by the Canadian Council of Animal Care (CCAC, 2009) and the University of Guelph Animal Care Committee (AUP #1913). Wood shaving bedding was removed and replenished twice weekly. Heifers had ad libitum access to water via a communal water bowl. All animals were given a free-choice mineral supplement. Feed was provided ad libitum amounts (target 15% orts) using roughage intake control feed bins (Insentec B.V., Marknesse, the Netherlands; Chapinal et al., 2007). Each heifer was assigned to and trained to eat exclusively from a single feed bin.

This study was conducted in 2 replicates, with 6 heifers tested in each replicate. Within each replicate, heifers were assigned to 1 of 2 treatments, balanced by age and weight: (1) exposure to TMR components individually and sequentially before receiving a novel TMR (**COM**), and (2) direct transition to the novel TMR without exposure to individual components (**DIR**). During the first 8 d of each replicate, heifers received a familiar silage-based ration (Table 1) and were allowed 4 d to acclimate to the pen and feed bins (d −4 to −1) before baseline measurements of feed sorting (d 1 to 4) were collected. During the dietary transition period (d 5 to 12), DIR heifers were offered the novel TMR, whereas COM heifers were introduced to the separate ration components of the novel TMR. Ration components were provided in proportions consistent with the formulation of the novel TMR, with offered amounts of ration components calculated based on total intake of individual heifers. Components were presented individually in the feed bins sequentially during each day, according to the feeding schedules described in Table 2, with heifers rotating through all feeding schedules at 2-d intervals. As such, each heifer on the COM treatment was exposed to each of 4 feeding schedules for 2 d during the 8-d transition period. Before each feed was offered, remaining quantities of the previous feed type were weighed and removed. Feeding schedules (Table 2) were designed to partly randomize the order of exposure to ration components, while interspersing provision of high-forage and high-energy ration components to support rumen health. Greater time was allotted for consumption of forage components compared with protein supplement and high-moisture corn to account for differences in the quantity provided and expected rates of intake. From d 13 to 20, all heifers received the novel TMR (Table 1). Both rations provided during the study were formulated for a nonbred Holstein heifer to maintain 0.90 kg/d of growth (NRC, 2001).

Table 1. Ingredient composition, chemical composition,[1] and particle size distribution[2] of diets

Composition	Diet	
	Familiar ration	Novel TMR
Ingredient composition, % of DM		
Corn silage[3]	55.0	36.5
Haylage[4]	45.0	41.4
High-moisture corn[5]	—	13.8
Protein supplement[6]	—	8.3
Chemical composition, % of DM		
CP	13.6 ± 1.4	14.05 ± 1.6
ADF	29.2 ± 2.0	23.6 ± 0.55
NDF	45.0 ± 2.2	37.6 ± 1.4
NFC	34.3 ± 3.1	38.9 ± 0.35
TDN	62.1 ± 1.2	68.4 ± 0.85
Particle size distribution, % of DM		
Long	16.8 ± 5.1	14.0 ± 4.4
Medium	44.5 ± 2.3	39.6 ± 1.6
Short	31.6 ± 3.3	35.4 ± 2.4
Fine	7.1 ± 1.3	11.0 ± 2.0

[1]Values were obtained from chemical analysis of TMR samples. OM = 100 − % ash; NFC = 100 – (% CP + % NDF + % fat + % ash).

[2]Particle size was determined by a Penn State Particle Separator, which has a 19-mm screen (long), 8-mm screen (medium), 1.18-mm screen (short), and a pan (fine).

[3]Corn silage had a DM of 40.7 ± 3.7% and chemical composition (DM basis) of 8.0 ± 0.2% CP, 19.6 ± 1.7% ADF, 34.8 ± 1.9% NDF, and 74.5 ± 1.0% TDN. Particle size (determined by a Penn State Particle Separator) distribution of corn silage (DM basis) was 11.0 ± 4.1% long, 48.2 ± 3.1% medium, 35.8 ± 2.4% short, and 4.9 ± 1.5% fine.

[4]Haylage had a DM of 56.1 ± 7.3% and chemical composition (DM basis) of 16.0 ± 2.5% CP, 35 ± 2.8% ADF, 49.2 ± 1.3% NDF, and 57.1 ± 2.2% TDN. Particle size distribution of alfalfa haylage (DM basis) was 16.2 ± 5.0% long, 45.0 ± 3.2% medium, 30.7 ± 3.5% short, and 8.1 ± 2.5% fine.

[5]High-moisture corn had a DM of 80.6 ± 0.9% and a chemical composition (DM basis) of 9.0 ± 0.2% CP, 4.0 ± 0.29% ADF, 12.4 ± 1.9% NDF, and 86.8 ± 0.8% TDN.

[6]Supplied by Dundas Feed & Seed Ltd. (Dundas, Ontario, Canada), containing (on as-is basis): 35% wheat shorts, 18% canola meal, 15% corn distillers, 13.5% wheat, 10% barley, 2.8% calcium carbonate, 2% cane molasses, 2% corn gluten meal, 1% pelleting agent, 0.62% salt, 0.04% trace minerals, 0.025% flavor, and 0.015% vitamins.

Throughout the study, the automated feed bins (Insentec B.V.) continuously measured individual feed intakes and feeding time. For determination of diet DM and nutrient content, representative samples of fresh feed and orts were taken on d 1, 5, 9, 13, and 17 of each replicate. To assess baseline sorting activity of the familiar silage-based ration, fresh feed and orts were sampled on d −1, 2, and 4. To assess sorting activity during the dietary transition period, fresh feed and orts samples were taken on d 6, 8, 10, and 12 of the TMR for heifers on the DIR treatment and of corn silage and haylage for COM heifers. To assess sorting activity after dietary transition, fresh and orts samples were taken of the novel TMR for all heifers on d 14, 16, 18, and 20. Samples taken for DM and chemical analysis were oven-dried at 55°C for 48 h and then ground through a