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Short communication: Effect of diet changes on sorting behavior of weaned dairy calves

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ABSTRACT

Dairy cows sort mixed rations; in some cases sorting can lead to digestive disorders. How sorting behavior develops in calves is poorly understood. The objective of this observational study was to determine if sorting behavior of total mixed ration (TMR)-fed dairy calves was affected by the removal of supplementary concentrate. Dairy bull calves (n = 18) were provided access to both a TMR (49.1% dry matter) and calf starter fed separately during the preweaning period starting at 3 d of age. Sorting of the TMR was assessed after weaning when calves were provided both feeds at 65 d of age, and again at 70 d immediately following the removal of calf starter from the calf pen. Sorting was measured by comparing the particle size composition of the TMR offered with that of the orts following 24 h of feed access. Feed particle fractions were measured using the Penn State Particle Separator with 3 screens (19, 8, and 1.18 mm) and a bottom pan to separate the TMR into long, medium, short, and fine fractions, respectively. At d 65, calves sorted for long particles (133 ± 9%) and against small particles (92 ± 3%), with no differences for the remaining fractions (99 ± 5% for medium; 107 ± 5% for fine); these preferences were reversed at d 70 when calf starter was no longer available with calves preferentially selecting fine particles (113 ± 4%), but showing no preference for other fractions (101 ± 11% for long; 99 ± 6% for medium; 97 ± 4% for short). These results indicate that young dairy calves are capable of sorting a TMR and they adjust this behavior in response to the availability of grain.
Key words: diet selection, ruminant, feed preference, motivation, ruminal acidosis

Short Communication

Domestic ruminants balance their intake of high-energy grain components with forage that helps buffer the rumen against the acidic byproducts of carbohydrate fermentation (Krause and Oetzel, 2006). Unlike grazing cattle that spend between 7 and 13 h/d grazing, adult dairy cows in intensive production systems typically spend only 3 to 5 h/d feeding (Dado and Allen, 1994; Hosseinkhani et al., 2008). In indoor systems, both dairy and beef cattle are generally fed a TMR once or twice daily (Krause and Oetzel, 2006). The TMR generally contains forage and grain components that vary in physical (i.e., particle size) and nutritional attributes (Coppock et al., 1981). Cattle often selectively consume small, energy-dense grain particles (Leonardi and Armentano, 2003; Miller-Cushon and DeVries, 2009) when offered a TMR. Feed sorting in cattle can result in unbalanced nutrient intake and increases the risk of digestive disorders including ruminal acidosis (DeVries et al., 2008). Many studies have reported feed sorting in adult dairy cattle (e.g., Leonardi and Armentano, 2003).

Calves are also sometimes fed mixed rations, both before and after weaning from milk, but little research to date has examined feed sorting in young cattle. Consistent with the research on adult cattle, some work has found that calves will consistently sort for short particles across a range of dietary treatments (Overvest et al., 2016). However, other work has shown that sorting can be affected by dietary choices and previous experience. For example, Miller-Cushon and DeVries (2011) found that calves fed either concentrate or hay during weaning selectively consumed the familiar feed when switched to a mixed ration. Calves fed separate components (forage and concentrate) before weaning, compared with those fed a mixed ration, showed reduced feed sorting after weaning (Miller-Cushon et al., 2013). How calves are transitioned between feeds can also affect sorting. For example, a gradual dietary transition over 7 d resulted in more sorting compared with calves transitioned abruptly to a novel feed (Miller-Cushon et al., 2015).

Dairy calves are typically provided free access to concentrates before weaning, but in the weeks after weaning, access to supplementary concentrates is removed and the animals are often switched to a TMR. The objective of this observational study was to determine if sorting behavior of TMR-fed dairy calves

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was affected by the removal of supplementary concentrate. Removing access to supplementary concentrate increases the value of the grain that can now be only acquired through the mixed ration. We predicted that calves would show more sorting for grain within the TMR when the supplementary concentrate was no longer available.

This experiment was conducted between October 2012 and May 2013 at the University of British Columbia (**UBC**) Dairy Education and Research Centre in Agassiz, British Columbia, Canada (49°N, 121°W). The UBC Animal Care Committee (Animal Use Protocol A12–0337) approved the procedures used in this study. All the animals were cared for according to the guidelines outlined by the Canadian Council of Animal Care (2009).

Eighteen Holstein dairy bull calves were enrolled in the study. Calves were separated from their dam immediately after birth, weighed [44.0 ± 6.1 kg of BW (mean ± SD)], and housed in sawdust-bedded pens (1.2 m × 2.0 m) with no visual, but auditory contact with other calves. Within 6 h of birth, calves were fed by bottle at least 4 L of colostrum with >50 g/L of IgG. Serum from blood samples collected from a jugular vein 24 h after the first feeding of colostrum was analyzed using a Reichert AR 200 Digital Hand-held Refractometer (Reichert, Depew, NY). Only calves that had serum protein >5.5 g/dL were included in the study. Pens were cleaned and new sawdust replaced once per week.

Calves were bottle-fed 8 L/d of pasteurized whole milk divided in 2 feedings, at approximately 0800 and 1630 h from birth until 28 d of age. From d 29 to 49, calves were fed 6 L/d, using the same procedure as described above. Milk volume was reduced by 20%/d from d 50 to 55, with milk weaning occurring on d 55. Calves remained in the experiment until d 71. Starting at 3 d of age, all calves had ad libitum access to water, TMR (described in Table 1), and calf starter (Hi-Pro Medicated Calf Starter, Chilliwack, BC, Canada; Table 1). The TMR and calf starter were fed for a target orts of 1 kg/d; feeding was increased by 0.5 kg when orts dropped below this threshold. Over the study, TMR orts averaged (± standard deviation) 1.3 ± 0.7 kg/d and calf starter orts averaged 1.6 ± 0.9 kg/d. Feeding level (% orts) was compared between test days to ensure that it was not a confounding factor, as sorting can be affect by the percentage of orts (see Miller-Cushon and DeVries, 2010). Feed refusals were removed daily before fresh feed and water delivery at approximately 0830 h. Daily calf starter and TMR intakes were determined each morning by disappearance.

Daily representative samples of both the offered feed (taken immediately before feeding) and orts (after 24 h of feed access) were taken. Sorting was assessed after weaning when calves were 65 d old and had access to both TMR and calf starter, and again at 70 d of age the first day, after which concentrate was no longer available. On both days, sorting was measured over a 24-h period. A Penn State Particle Separator with 3 screens (19, 8, and 1.18 mm) and a bottom pan was used to separate samples for particle size analysis into long (>19 mm), medium (<19, > 8 mm), short (<8, > 1.18 mm), and fine (<1.18 mm) fractions (Kononoff et al., 2003; see Table 1 for distribution of particle sizes in the TMR).

Samples for nutrient and DM analysis were oven-dried at 55°C for 48 h. Dried samples were ground to pass through a 1-mm screen and sent to A&L Canada Laboratories Inc. (London, ON) for analysis of DM (135°C; AOAC International, 2000, method 930.15), ADF (AOAC International, 2000: method 973.18), NDF with heat-stable α-amylase and sodium sulfite (Van Soest et al., 1991), and CP (N × 6.25; AOAC International, 2000: method 990.03; Leco FP-528 Nitrogen Analyzer, Leco, St. Joseph, MI).

Sorting behavior was quantified as the actual intake of each fraction (long, medium, short, and pan), expressed as a percentage of the predicted intake of each fraction (Leonardi and Armentano, 2003); the predicted intake of each fraction was calculated as the product of the DMI of the feed offered multiplied by the DM percentage of that fraction in the fed TMR. Values >100% indicated sorting for that particle size, and values <100% indicated sorting against that particle size.

Prior to analysis, data were screened for outliers using the UNIVARIATE procedure in SAS and probability distribution plots. All analyses were performed with

Table 1. Chemical and particle size composition of concentrate and TMR (mean % ± SD; DM basis)

Item	Concentrate[1]	TMR[2]
Chemical composition[3]		
DM (%)	89.5 ± 0.7	49.1 ± 1.5
CP (% of DM)	20.6 ± 1.13	16.9 ± 0.95
ADF (% of DM)	7.84 ± 0.45	20.4 ± 1.77
NDF (% of DM)	16.5 ± 0.39	31.8 ± 2.68
Particles[4]		
Long particles	—	12.8 ± 3.6
Medium particles	—	35.7 ± 2.57
Short particles	—	37.6 ± 3.6
Fine particles	—	13.9 ± 1.58

[1]Hi-Pro Medicated Calf Starter (Chilliwack, BC, Canada); medicated with a coccidiostat (50 mg/kg of lasalocid sodium).

[2]TMR containing 26.1% corn silage, 14.8% grass silage, 10% alfalfa hay, and 49% concentrated mix on a DM basis.

[3]Values obtained from chemical analysis of feed samples (A&L Canada Laboratories Inc., London, ON).

[4]Particle separated, using a Penn State Particle Separator, into 4 fractions: long (>19 mm), medium, (<19, >8 mm), short (<8, >1.18 mm), and fine (<1.18 mm).