



## Effect of early exposure to different feed presentations on feed sorting of dairy calves

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### ABSTRACT

This study examined how early exposure to different feed presentations affects development of feed sorting in dairy calves. Twenty Holstein bull calves were exposed for the first 8 wk of life to 1 of 2 feed presentation treatments: concentrate and chopped grass hay (<2.5 cm) offered ad libitum at a ratio of 7:3 as a mixture (MIX), or as separate components (COM). Calves received 8 L/d of milk replacer (1.2 kg of dry matter), with the amount progressively reduced after 5 wk to facilitate weaning by the end of wk 7. All calves received the MIX diet in wk 9 to 11 and, subsequently, a novel total mixed ration (TMR; containing 40.5% corn silage, 22.0% haylage, 21.5% high-moisture corn, and 16.0% protein supplement) in wk 12 to 13. Intake was recorded daily and calves were weighed twice a week. Fresh feed and orts were sampled on d 1 to 4 of wk 6, 8, 9, 11, 12, and 13 for analysis of feed sorting, which was assessed through nutrient analysis for the MIX diet and particle size analysis for the TMR. The particle separator had 3 screens (19, 8, and 1.18 mm) producing long, medium, short, and fine particle fractions. Sorting of nutrients or particle fractions was calculated as the actual intake as a percentage of predicted intake; values >100% indicate sorting for, whereas values <100% indicate sorting against. Feed presentation did not affect dry matter intake or growth. Prior to weaning, all calves selected in favor of hay; MIX calves consumed more neutral detergent fiber (NDF) than predicted (103.6%) and less non-fiber carbohydrates (NFC) than predicted (92.6%), and COM calves consumed, as a percentage of dry matter intake, 40.3% hay (vs. 30% offered rate). In wk 8, calves fed COM consumed more NFC than calves fed MIX (1.0 vs. 0.95 kg/d) and less NDF (0.43 vs. 0.54 kg/d), indicating greater selection in favor of concentrate. However, when provided the MIX diet, calves previously fed COM did not sort, whereas calves previously

fed MIX consumed more NFC intake than predicted (103.2%) and less NDF intake than predicted (97.6%). Calves previously fed MIX maintained increased sorting after transition to the novel TMR, sorting against long particles (86.5%) and for short (101.8%) and fine (101.2%) particles. These results indicate that initially providing dairy calves with solid feeds as separate components, compared with as a mixed ration, reduces the extent of feed sorting in the weeks after transition to a common ration.

**Key words:** dairy calf, feed sorting, feed presentation, learning

### INTRODUCTION

It is common practice to provide dairy cattle a TMR with the goal of ensuring that a balanced ration is available over the course of the day (Coppock et al., 1981). However, both immature and mature dairy cattle actively sort TMR against long forage particles and in favor of the smaller grain particles, which are higher in starch and energy (Leonardi and Armentano, 2003; Greter et al., 2010a). Sorting of the ration affects nutrient content of the ration over the course of the day (DeVries et al., 2005), resulting in cows consuming an unbalanced ration. Due to the effects of feed sorting on nutrient composition and consistency of the ration, various recent studies have addressed factors that influence feed sorting. Problems associated with feed sorting are typically addressed by attempting to thwart sorting at the herd level, through nutrition and feeding management (Leonardi et al., 2005; Miller-Cushon and DeVries, 2009; DeVries et al., 2005). However, dairy cattle vary both in the degree and pattern of feed sorting (Leonardi and Armentano, 2003), suggesting that feed and flavor preferences, sorting ability, and sorting inclination may vary between animals.

It is possible that early experiences may influence the development of feed sorting, contributing to the individual variability in feed sorting observed in adult cattle. There is substantial evidence that early feed experiences have the potential to shape feed prefer-

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ences and feeding behavior of ruminants later in life. For example, when tested later in life, ruminants have been found to exhibit preferences for flavors (Simitzis et al., 2008) and feed types (Arnold and Maller, 1977; Provenza and Balph, 1988) to which they were exposed in the first months of life. There is also evidence that motor skills develop in response to early feed exposure, with animals feeding more efficiently when they have had previous experience with that type of plant (Arnold and Maller, 1977; Flores et al., 1989).

Despite commonly being fed a TMR later in life, dairy calves are often provided a limited number of feed types separately early in life. It is common practice to provide milk-fed calves with concentrate and, occasionally, forage (Coverdale et al., 2004). Provision of a mixed ration to calves before weaning has not yet been widely explored. It has been suggested that use of a TMR for young heifers may result in better balance of nutrient intake by avoiding individual preferences for forage or concentrate (Borland and Kesler, 1979). When provided concentrate and forage as separate components or as a top-dressed ration, weaned heifers consumed the concentrate component before consuming the forage (DeVries and von Keyserlingk, 2009; Greter et al., 2010a). In contrast, provision of a TMR has been found to increase NDF intake due to reduced selection in favor of concentrate (Greter et al., 2010a). Greter et al. (2010b) followed 11-mo-old heifers previously exposed to either concentrate and hay as a top-dressed ration or as a TMR and found no long-term differences in feed sorting once all heifers were fed a novel TMR. It is possible, however, that differences in dietary selection resulting from previous feed presentation exposure may persist for a longer period of time if the experience with feed presentation occurs at a younger age. Weaning is considered a formative period in the development of feeding behavior, as animals are rapidly increasing intake of solid feed, developing feeding motor skills, and forming feed preferences that can be quite persistent (Arnold and Maller, 1977; Squibb et al., 1990). Thus, exposure to different feed presentations at this stage may have a longer-term influence on feeding behavior.

Therefore, the objective of this study was to determine how feed presentation may affect development of feed sorting in dairy calves. Specifically, this study determined the effect of feed presentation on the dietary selection of dairy calves during the milk-feeding stage. Postweaning, the effects of prior exposure to different feed presentations on feed sorting was assessed once all calves were provided, first, a mixed ration composed of familiar feed components and, second, a novel TMR. We hypothesized that calves provided hay and concentrate as separate components early in life would select greater quantities of concentrate than calves provided

hay and concentrate as a mixture and, consequently, consume a diet higher in carbohydrates and lower in fiber. Thus, we hypothesized that, upon transition to the mixed ration, calves previously exposed to these feed types as separate components would sort to a greater extent than calves previously familiar with the mixed ration to maintain this pattern of selection in favor of the concentrate component. Further, we hypothesized that differences in feed sorting would persist after transition to a novel TMR.

## MATERIALS AND METHODS

### *Animals and Housing*

Twenty male Holstein calves were used in this study. Calves received colostrum and were enrolled in the study within 24 h of birth. All calves received intramuscular injections of 2 mL of a vitamin supplement containing vitamins A, D, and E (E-Master, Vétoquinol Canada Inc., Lavaltrie, Canada) and 1 mL of selenium (Dystosel, Pfizer Animal Health, Kirkland, Canada) and a subcutaneous injection of 1 mL of tulathromycin (Draxxin, Pfizer Animal Health) as a preventive measure to reduce incidence of illness (Stanton et al., 2013).

Calves were housed in individual pens (1.2 × 1.8 m; width × depth) at the University of Guelph, Kemptville Campus Dairy Education and Research Centre (Kemptville, Canada) and were managed according to the standard operating procedures of this research station, in accordance with guidelines set by the Canadian Council on Animal Care (CCAC, 2009). The front of each pen had 2 openings for access to pails (diameter = 25.4 cm, height = 23.0 cm, capacity = 8 L) mounted on the outside. A third pail of the same size was mounted at the rear of the pen and filled with fresh water daily. The interior of each pen was bedded with wood shavings; bedding was replaced weekly and fresh bedding was added as needed. Pens were located under a 3-sided, roofed shelter to protect from excessive exposure to the elements.

### *Milk Feeding Procedure*

During the milk-feeding stage (wk 1–7), all calves were fed acidified milk replacer via an artificial teat (Peach Teats, Skellerup Industries Ltd., Woolston, New Zealand). The feeding setup involved the teat mounted at the front of the pen, attached to a tube fitted with a one-way valve running into buckets placed outside the pen. All buckets, lines, and teats were cleaned daily. Calves were fed 22% CP and 18% fat milk replacer (Shur-Gain High Performance Milk Replacer, Nutreco Canada Inc., Guelph, Canada) mixed as indicated at

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