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The effect of palatability of protein source on dietary selection in dairy calves

E. K. Miller-Cushon,* M. Terré,† T. J. DeVries,* and A. Bach†‡[1]
*Department of Animal and Poultry Science, University of Guelph, Kemptville Campus, 830 Prescott Street, Kemptville, ON, K0G 1J0, Canada
†Department of Ruminant Production, IRTA (Institut de Recerca i Tecnologia Agroalimentàries), 08140, Caldes de Montbui, Spain
‡ICREA (Institució Catalana de Recerca i Estudis Avançats), 08010 Barcelona, Spain

ABSTRACT

Evidence has shown that soybean meal is perceived as more palatable than canola meal by dairy calves in short-term preference tests. This study evaluated the effect of protein source on longer-term dietary selection of dairy calves. In experiment 1, 40 Holstein bull calves (11.4 ± 4.3 d of age) were randomly assigned to 1 of 2 choice diets for 6 wk: base starter pellet (S; 12% crude protein; CP) and high-protein pellet (40% CP) containing either (1) soybean meal (SB) or (2) canola meal (CM). In wk 7 to 8, all calves were offered a single pelleted diet containing the protein source to which they were previously exposed. In experiment 2, 22 Holstein bull calves (9.9 ± 4.6 d of age) were offered, for 6 wk, a choice of 2 mixed pelleted diets: (1) 70% S and 30% SB (SB mix), or (2) 70% S and 30% CM (CM mix). In wk 7 to 8, calves were randomly assigned to 1 of 2 choice diets, as in experiment 1: (1) SB + S, or (2) CM + S. All feeds were provided ad libitum. Calves received 6 L/d of milk replacer [0.75 kg/d of dry matter (DM)] for the duration of both experiments. Feed intake was recorded daily and calves were weighed every 14 d. Feeds were sampled weekly to analyze DM and nutrient intake. Mixed diets in experiment 2 were analyzed for CP in wk 4 and 6 to assess feed sorting (calculated as actual CP intake as a percentage of predicted intake). In experiment 1, calves offered SB + S in wk 1 to 6 consumed more high-protein pellet than calves offered CM + S [73 vs. 42% of DM intake (DMI)] and, consequently, more CP (168 vs. 117 g/d). Solid feed DMI and average daily gain were similar between treatments. When offered a single diet in wk 7 to 8, calves offered starter containing soybean meal increased intake to a greater extent than calves offered the starter containing canola meal. In experiment 2, calves preferred the SB mix to CM mix (preference ratio: 0.7). Calves consumed more CP than predicted from SB mix in wk 4 and 6 (108 ± 2.0%), indicating that they were sorting in favor of SB. In contrast, calves consumed less CP than predicted from CM mix in wk 4 (81.48 ± 4.1%), indicating that they were sorting against CM. When assigned to choice treatments in wk 7 to 8 of experiment 2, calves offered SB + S consumed more protein pellet than calves offered CM + S (81 vs. 31% DMI) and consumed more CP (378 vs. 196 g/d). Average daily gain was greater for calves offered SB + S but DMI was similar. Overall, these results suggest that dietary selection was influenced by innate feed preferences, and milk-fed calves may not be sensitive to protein imbalances in their diet.
Key words: dairy calf, feed intake, feed sorting, palatability, protein

INTRODUCTION

Performance of dairy calves early in life depends on adequate solid feed intake, which is necessary for rumen development (Warner et al., 1956; Baldwin et al., 2004) and allows calves to maintain growth through the transition of weaning (Jasper and Weary, 2002; Terré et al., 2007). Due to the importance of encouraging solid feed intake, palatability of feed is considered to be crucial in formulating rations for dairy calves (Drackley, 2008). When provided with choices of different feed types in short-term preference tests, calves exhibit different relative preferences for a variety of feed types (Montoro et al., 2012; Miller-Cushon et al., 2014), indicating that perception of palatability affects short-term intake. It is, however, less clear to what extent palatability of provided feed types may affect longer-term dietary choice and nutrient intake of dairy calves.

Although evidence indicates that calves and adult cattle possess innate preferences for flavors and feed types that may be considered most palatable (Nombekela et al., 1994; Montoro et al., 2012), some studies indicate that ruminants are able to associate sensory properties of feed with positive or negative postingestive feedback and select nutritionally balanced diets from a variety of foods (Provenza and Balph, 1987; Forbes, 2007; Bach et al., 2012). For example, lambs offered a low protein food and a high protein food were able to choose a mixture that provided optimal amounts of protein for growth (Kyriazakis and Oldham, 1993). This suggests

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[1]Corresponding author: alex.bach@irta.es

that longer-term dietary choices of dairy calves may be affected by nutrient composition of offered feed types in addition to innate preferences for sensory properties of feed.

The objective of the present study was to evaluate the effect of protein source palatability, as previously determined in short-term preference tests, on intake and dietary selection of calves over an extended period of time. Calves have been found to prefer soybean meal to a variety of other protein sources, including canola meal, in short-term preference tests (Montoro and Bach, 2012; Miller-Cushon et al., 2014), suggesting that soybean meal is perceived as highly palatable. In a first experiment, we evaluated the effect of protein source on nutrient intake and performance of calves over the first 6 wk of life. Calves were offered a choice of a base starter pellet and either a soybean meal or canola meal high-protein pellet. In the second experiment, we evaluated preference and feed sorting of calves offered a choice of 2 pelleted mixed diets, 1 containing the soybean pellet and 1 containing the canola meal pellet. Finally, we assessed the effect of protein source on intake and performance when dietary choice was restricted: in the first experiment, ability to select preferred levels of protein from the provided protein source was restricted through provision of a single ration with a fixed protein level. In the second experiment, ability to select the preferred protein source was restricted through provision of a single protein source.

The overall hypothesis of this study was that if dietary selection is driven by nutrient requirements protein intake over time would be similar regardless of protein source. Alternatively, if dietary selection is driven by sensory properties of feed choices, calves may consume less protein when provided a less preferred protein source or, if provided a choice, select against the less preferred source. In addition, it was hypothesized that, if palatability affects diet selection to a greater extent than protein requirements, total intake and growth may be negatively affected when only a less preferred protein source is provided.

MATERIALS AND METHODS

Animals and Housing

A total of 62 Holstein bull calves were used in 2 experiments, run concurrently in January to March, 2013. The first experiment was conducted with 40 calves (11.4 ± 4.3 d of age and 44.6 ± 4.5 kg of BW; mean ± SD) and the second experiment was conducted with 22 calves (9.9 ± 4.6 d of age and 43.2 ± 4.4 kg of BW). Calves were acquired on loan from a commercial rearing operation (Agricola Mas Jonquer, Girona, Spain) and raised in the facilities of Institut de Recerca i Tecnologia Agroalimentàries (IRTA; Barcelona, Spain) in Torre Marimon (Caldes de Montbui, Spain) managed under the guidelines and approval of the Animal Care Committee of IRTA. At arrival, calves were given a broad-spectrum antibiotic (tulathromycin, Draxxin, Pfizer Animal Health, Madrid, Spain) as a preventive measure to reduce incidence of illness (Stanton et al., 2013). Calves were housed in individual hutches (1.0 × 1.6 m; width × depth). The interior of each hutch was bedded twice weekly with wood shavings. All calves had access to 3 buckets (capacity of 6 L) located at the front of the hutches, suspended in a horizontal surface, and spaced 10 cm apart. Water was provided ad libitum in 1 bucket and solid feed was provided in the remaining 2 buckets according to treatment. Fresh feed was delivered daily at 1000 h.

Milk replacer (25% CP and 19.2% fat, Sprayfo Excellent 60, Sloten BV, Deventer, Holland) was offered in teat feeding bottles twice daily at 0800 and 1700 h. Calves were allowed a 6-d adaptation period to the milk replacer; the feeding level and DM concentration of the offered milk replacer were incrementally increased from 4 L/d at 10% DM on d 1 to 6 L/d at 12.5% DM on d 7. After adaptation, all calves received 6 L/d at 12.5% DM (750 g/d of DM) for the remaining 7 wk of both experiments. Calves usually finished their entire milk replacer allotment and, thus, intake was held constant across treatments (after adaptation week, 0.749 kg/d of DM, SE = 0.0013, $P = 0.9$).

Experiment 1: Effect of Protein Source on Intake and Performance

In experiment 1, calves were offered a choice of 2 pelleted feeds in 2 separate buckets: a base starter pellet (**S**), formulated to be low in protein (Table 1), and a protein supplement pellet. Calves were randomly assigned to receive 1 of 2 types of protein pellets: (1) soybean pellet (**SB + S**; n = 20 calves), or (2) canola pellet (**CM + S**; n = 20 calves). Thus, calves in the SB + S treatment had access to a bucket of water, a bucket containing S, and a third bucket containing SB, whereas calves in the CM + S treatment had access to a bucket of water, a bucket containing S, and a third bucket containing CM. Both protein pellets were formulated to have similar nutrient content, particularly with respect to CP content (Table 1). To prevent any effect of particle size on preference for the protein source and to provide a physical basis for the calves to differentiate nutrient content between base starter and protein pellet, both protein pellets were 5 mm in diameter, whereas the base starter pellets were 3 mm in diameter. Calves were offered the 2 feed types ad li-