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Effect of feed type and method of presentation on feeding behavior, intake, and growth of dairy calves fed a high level of milk

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ABSTRACT

The objective of this study was to assess the effect of different feed types and method of feed presentation in the first 12 wk of life on the feeding behavior, intake, and growth of calves fed a high milk level. Forty-eight neonatal Holstein calves were individually housed and randomly assigned to 1 of 4 treatments and fed solid feed ad libitum: silage-based total mixed ration (TMR), concentrate (CON), and chopped hay and concentrate presented in 2 manners: mixed (MIX) or separate (SEP). All calves were offered 12 L/d of acidified milk replacer (1.8 kg of dry matter) until d 38 at which time step-down weaning by 1 L/d began. At d 50 calves no longer received milk, and all calves on SEP and CON treatments were offered the MIX diet until the end of the trial, whereas TMR and MIX calves did not change feeds. Feed intakes were recorded daily, and calves were weighed twice per week. Rumination time was observed on the last 3 d of alternate weeks (wk 3, 5, 7, 9, and 11) for 1 h beginning at 1500 h. Time spent feeding was determined for the last 2 d of alternate weeks. In the preweaning stage (d 1–37) average daily gain was similar for all calves (1.1 kg/d). The TMR calves had lower average daily gain than calves on the other 3 treatments during both the weaning (d 38–49; 0.2 vs. 0.7 kg/d) and postweaning (d 50–84; 0.5 vs. 1.2 kg/d) stages. This result is related to the lower dry matter intake of calves fed TMR in comparison with MIX, SEP, and CON calves in the weaning (0.2 vs. 0.5 kg/d) and postweaning (1.8 vs. 2.8 kg/d) stages. Given dry matter content of the feeds (TMR = 52%, other diets = 89%), the as-fed intake of the calves was similar across treatments in all 3 stages. Calves offered hay in addition to concentrate showed no difference in concentrate intake in the first 7 wk of life. Interestingly, TMR calves spent more time feeding during the postweaning stage than MIX, SEP, and CON calves (308 vs. 194 min/d) and exhibited a slower feeding rate postweaning (5.9 vs. 14.4 g of dry matter per minute). It appears that during weaning, and postweaning, calves fed TMR were attempting to maximize their nutrient intake but were unable to match that of calves in other treatments because of the high moisture content of their feed, and thus were unable to achieve similar average daily gain. Additionally, growth and total intake throughout the preweaning and weaning stages were similar for calves fed chopped hay along with concentrate and those not offered hay, suggesting no detrimental effect of feeding forage.

Key words: dairy calf, feeding behavior, forage, weaning

INTRODUCTION

Increasing the level of milk feeding for dairy calves in the early weeks of life can enhance growth rates (Appleby et al., 2001; Jasper and Weary, 2002) and may also result in development of healthier, higher-producing cows (Terré et al., 2009; Soberon et al., 2012). A potential challenge of enhanced milk feeding appears at weaning. Traditionally fed calves, consuming low quantities of milk, are encouraged to ingest higher levels of concentrate before weaning (Khan et al., 2007a). Alternatively, calves fed higher levels of milk experience a challenge at weaning because of low consumption of solid feed before weaning (Jasper and Weary, 2002); thus, some concern exists that their digestive systems are not accustomed to the digestion of such feed at weaning (Terré et al., 2007). Despite implementation of gradual weaning programs, a decrease in overall DMI is an issue for high-milk-fed calves (de Passillé et al., 2011).

The provision of forages, such as hay, may improve feed intake and rumen development (Castells et al., 2012). Previously, the inclusion of forage in the diets of milk-fed calves was discouraged, despite the fact that this ingredient aids in muscular development of the rumen (Hamada et al., 1976), because it was also thought to inhibit the development of the rumen papil-

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lae (Tamate et al., 1962). In several studies, hay intake has been reported to displace the intake of higher quality starter (Stobo et al., 1966; Kertz et al., 1979; Hill et al., 2008). However, much of the research that contributed to that idea was conducted on calves fed low levels of milk that were insufficient for optimal growth. Recently, Khan et al. (2011) showed evidence that providing hay to calves fed with high milk allowances resulted in increased solid feed intakes and normal rumen development. These authors indicated that in a situation of restricted nutrient availability, hay intake could displace starter intake because of the resultant gut fill from consuming large amounts of hay. However, in a high-milk-feeding system, a gradual weaning program is typically recommended, ensuring a gradual transition from liquid to solid feed (Sweeney et al., 2010). Additionally, an improvement in digestibility was reported by Montoro et al. (2013) when concentrate was mixed with coarsely chopped grass hay rather than the finely chopped alternative. This novel finding suggests that not only forage type, but forage particle size, may also play a role in rumen development of young calves.

Recently, interest exists in providing calves fed higher milk levels with a silage-based TMR. Not only would TMR be practical for the dairy farmer, as they could potentially use the same TMR given to the lactating cows, but it could also provide a balanced, palatable source of nutrients for the developing young ruminant. This type of high-fiber ration could potentially encourage rumen development and, therefore, create a smoother transition to solid feed. Thus, the objective of this research was to investigate a feeding strategy that could be used to ease the transition to solid feed using different types of higher forage diets. It was hypothesized that incorporating a silage-based TMR into the diets of calves fed high levels of milk before weaning would have no detrimental effects on calf growth and result in a positive effect on feeding behavior. Similarly, it was hypothesized that calves fed diets including forage would exhibit more rumination behavior. Calves provided with forage were hypothesized to consume more solid feed than calves fed only concentrate. As a result it was expected that calves fed forage and mixed diets would devote a greater portion of the daily time budget to feeding than calves fed no forage.

MATERIALS AND METHODS

Animals and Housing

Forty-eight male Holstein calves were used in this study in 2 blocks of 24 calves. Each block was run over a 12-wk period. The first block ran from April to July and the second from July to October. Calves were purchased from local dairy farms in Eastern Ontario (Canada) before 1 d of age. National Livestock Identification for Dairy tags (Allflex Canada, St. Hyacinthe, Canada) were applied before removal from the farm of origin. It was confirmed that calves received at least one feeding of colostrum before pickup. At the time of purchase each calf was assessed by the study technicians, and only calves deemed healthy and alert were included in the study. Calves were transported <25 km, in a well-bedded compartment, from their farm of origin to the University of Guelph Kemptville Campus Dairy Education and Research Centre (Kemptville, ON, Canada). The date of arrival at the research center was marked d 0 for each calf. Upon arrival calves were managed under standard operating procedures of the research center, in accordance with the guidelines set by the Canadian Council on Animal Care (CCAC, 2009) and as approved by the University of Guelph Animal Care Committee. Calves each received a 2-mL injection (i.m.) of a supplement containing vitamin E and selenium (Dystosel; Pfizer Animal Health, Kirkland, Canada) and a 1-mL injection of tulathromycin (Draxxin; Pfizer Animal Health) on d 0 to protect from illness (Stanton et al., 2013). In addition, they were given 2 mL of Inforce 3 (Pfizer Animal Health) intranasally for the prevention of respiratory disease caused by bovine respiratory syncytial virus, infectious bovine rhinotracheitis, and parainfluenza virus 3 (Ellis et al., 2013).

The calf barn at the research facility was a 3-sided building allowing for natural ventilation while protecting the pens from direct exposure to the elements. Calves were housed individually in pens (1.2 × 1.8 m; width × depth) with 3 solid sides (1.3 m high) and a metal gate at the front that allowed calves to reach through for feed. The gate had 2 openings under which a bucket mount was fastened to hold feed pails. Preweaning calves had access to two 8-L capacity pails containing their solid feed. After weaning these pails were replaced with two 20-L capacity pails, one contained solid feed and the other was filled with fresh water. During the preweaning phase 20-L pails were fastened to the rear corner of the pen for access to water. Pens were bedded with straw for the first week of life for added warmth and then switched to wood shavings thereafter, as per standard protocol at the research farm. Bedding was completely replaced twice weekly and replenished as needed.

Milk Feeding Procedure

Calves were offered acidified milk replacer daily at 0900 h from wk 1 through wk 7. The milk feeding apparatus consisted of an artificial teat (Peach Teats,