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Using automated feeders to wean calves fed large amounts of milk according to their ability to eat solid feed

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ABSTRACT

Dairy calves weaned off milk at an early age show signs of hunger and can lose weight. We examined whether using automated feeders to wean calves according to individual voluntary solid feed intake reduced the effects of weaning. Female Holstein calves were housed in groups of 5 to 9. All calves were fed 12 L/d milk and ad libitum grain starter and hay from automated feeders immediately after grouping, and were allocated to 3 weaning strategies: (1) early-weaned (EW; n = 14): weaning began on d 40, and milk allowance gradually decreased until weaning was complete on d 48; (2) late-weaned (LW; n = 14): weaning began on d 80 and was completed on d 89; (3) weaned by starter intake (WSI; n = 28): weaning began when calves consumed 200 g/d of starter and was completed when the calves consumed 1,400 g/d. Each day, the automated feeders recorded quantities of milk, starter, and hay eaten by all calves, as well as the frequency of visits to the milk feeder; we used unrewarded visit frequency as a sign of hunger. Body weights (BW) were recorded weekly. We estimated daily digestible energy (DE) intake for each calf based on the milk, hay, and starter consumed. Average daily gains (ADG) were expressed as percent of BW. For calves in WSI, weaning began at 54.7 ± 18.9 d (mean ± SD) of age, the duration of weaning was 21.1 ± 10.6 d, and weaning ended at 75.8 ± 10.7 d of age. Both LW and WSI calves had better ADG from wk 3 to 13 than EW calves. Calves in the WSI group drank less milk and ate more starter than LW calves but had similar ADG. During the period of weaning, EW calves made more unrewarded visits to the milk feeder than LW and WSI calves. Three EW calves lost weight during weaning, whereas all LW and WSI calves gained weight. Calves differ greatly in when they begin to eat solid feed and how quickly they increase the intake in response to a decrease in milk allowance. An advantage of automated feeders is that calves can be weaned at variable ages depending on their ability and willingness to eat solid feed, which reduces signs of hunger and improves weight gains during weaning.
Key words: dairy calf, automated feeding, weaning, precision dairying, feeding motivation

INTRODUCTION

There is growing interest in the use of automated feeders for unweaned dairy calves partly because of potential labor savings (Kung et al., 1997). These feeders also allow greater precision in the measurement and control of individual intakes of liquid and solid feed (Roth et al., 2008; de Passillé and Rushen, 2012), and facilitate feeding unweaned dairy calves more milk or milk replacer, which leads to higher preweaning growth (Khan et al., 2011; Miller-Cushon and DeVries, 2015). There is mounting evidence that high preweaning growth rates are associated, in some way, with increased first-lactation milk yield (Bach, 2012; Soberon et al., 2012). Furthermore, the traditional amounts of milk or replacer fed to unweaned calves (8 to 15% of BW) lead to frequent unrewarded visits to a milk feeder or low levels of play behavior, which have been interpreted as signs of hunger (Jensen and Holm, 2003; De Paula Vieira et al., 2008; Borderas et al., 2009; Krachun et al., 2010). Some dairy welfare standards now recommend that milk or replacer be fed to calves at 20% of BW (Dairy Farmers of Canada, 2009).

A very common method of weaning calves in North America is to wean them at a fixed age, most commonly 6 to 8 wk (Vasseur et al., 2010), but calves weaned at this age can show a growth check at weaning (de Passillé et al., 2011; Eckert et al., 2015; Miller-Cushon and DeVries, 2015). One disadvantage with feeding more milk or milk replacer is that this can reduce the amount of starter that the calves eat (Jensen, 2006; Borderas et al., 2009), reducing growth and increasing signs of hunger during weaning (Borderas et al., 2009).

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A decrease in growth rates during weaning can erase any advantage of feeding more milk or replacer (Miller-Cushon and DeVries, 2015).

The effects of weaning on growth rates can be overcome by weaning at a later age (de Passillé et al., 2011; Eckert et al., 2015) but this, of course, increases the total amount of milk or replacer that is fed to the calves, which can be an issue when the cost of feeding milk or replacer is high. Interestingly, calves differ greatly in the age that they begin to voluntarily eat large amounts of solid feed (de Passillé and Rushen, 2012), and computer-controlled feeders can be used to adjust the weaning according to each individual calf's willingness to eat starter (Roth et al., 2008; de Passillé and Rushen, 2012). This has been shown to reduce cross-sucking during weaning compared with weaning at a fixed age but the effects on weight gain during weaning are uncertain (Roth et al., 2008, 2009).

Our objectives were to compare weaning according to individual calf starter intake with weaning both at a fixed earlier age (d 48) and a fixed later age (d 89) on feed and energy intakes, weight gains, and behavior during and after weaning. We examined whether this method of weaning would reduce the age at which calves were weaned and the amount of milk used during the milk-feeding period but improve weight gains and reduced behavioral signs of hunger during weaning.

MATERIALS AND METHODS

Animals and Housing

We used 56 female Holstein calves (birth weight = 40.50 ± 4.48 kg; mean ± SD), born at the University of British Columbia (UBC) Dairy Education and Research Centre over a 1-yr period. The calves were born in individual calving pens and given 4 L of colostrum within 6 h of birth. Blood samples were collected from the jugular vein 24 h after the first feeding of colostrum, and serum was analyzed using a digital handheld refractometer (Reichert AR 200; Reichert, Depew, NY). Only calves having a serum protein level >5.5 g/dL were included.

Calves were moved to individual pens (2.0 × 1.1 m, with sawdust bedding on concrete) within 24 h of birth, and remained there until d 5 of age. In the individual pens, calves were allowed ad libitum access to pasteurized waste milk from the dairy herd. Calves had continuous access to milk provided in plastic buckets connected by a hose to a nipple, with fresh milk served at around 0900 and 1500 h. No water or starter was provided from d 2 to 4 of age following normal farm practice. At 5 d of age, while still in individual pens, the calves were disbudded using caustic paste after sedation with xylazine (Vickers et al., 2005).

At 5 to 6 d of age, the calves were transferred to 7- × 4.68-m group pens with a sawdust-bedded resting area (4.47 × 4.68 m) and plastic-coated expanded metal floors (2.53 × 4.68 m) in front of the feeders (Sweeney et al., 2010). They were kept in groups of 5 to 9 individuals. Calves were fed milk and starter from automated feeders, with both feeders controlled by a single computer (CF 1000 CS Combi, DeLaval Inc., Tumba, Sweden). Calves were allowed 12 L/d pasteurized milk from the UBC dairy herd (herd averages of 3.97% fat, 4.10% protein, 3.30% lactose from bulk tank samples) at 40°C and had ad libitum access to a textured calf starter (90% DM: 5.04% fat, 38.5% starch, 5.86% water-soluble carbohydrate, 6.8% crude fiber, 8.56% ADF, 22.4% NDF, and 20% CP on a DM basis, with the main ingredients being 16% wheat, 14% barley, 13% canola meal, 13% oats, 10% soy, 10% corn, and 4% molasses: Unifeed Ltd., Chilliwack, BC, Canada). Grass hay (DM = 90.8%; CP = 15.1%; NDF = 51.1%; ADF = 33.6%) and water were available ad libitum from automated feeders that weighed the intake of each calf at each meal (RIC, Insentec B.V. Marknesse, the Netherlands). Calves were weighed using an electronic scale once a week.

Weaning Treatments

The calves were allocated to 3 different weaning strategies as follows: (1) early weaned (**EW**; n = 14): the calves were fed 12 L/d of milk from arrival in the group pens until weaning began on d 40, when the milk allowance was gradually reduced until the calves were fully weaned on d 48; (2) late weaned (**LW**; n = 14): the calves were fed 12 L/d of milk from arrival in the group pens until d 80; milk was gradually reduced until d 89 when no milk was available to the calves; and (3) weaned by starter intake (**WSI**; n = 28): weaning began when the calves had consumed an average of 200 g/d of starter during the preceding 3 d, and was completed (i.e., milk allowance reduced to zero) when the calves had consumed an average of 1,400 g/d of starter during the preceding 3 d. Once a calf began to be weaned, milk allowance was progressively decreased according to when the calf's intake of starter reached certain set intermediate targets. Intermediate targets for starter intakes were calculated so that the calves would progress from the start target to the end target in 4 steps. The calves had intermediate targets of 600 and 1,000 g/d. Once the calf had reached the target over the preceding 3 d, the milk allowance was reduced by 3 L/d.