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Effects of milk replacer program fed 2 or 4 times daily on nutrient intake and calf growth[1]

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ABSTRACT

The aims of this study were to determine if feeding frequency (FF) of milk replacer (MR; meals/d) alters starter intake, growth, and efficiency of growth in nursery calves fed a conventional or accelerated MR. We hypothesized that smaller and more frequent MR meals would increase starter intake and growth when greater amounts of MR nutrients are fed to nursery calves. Forty-eight Holstein and Holstein-cross heifer and bull calves were assigned to treatments in a 2 × 2 factorial arrangement of MR and FF. Treatments included (1) standard 20% CP and 20% fat MR fed at 1.5% of body weight (BW; 2 meals/d; STD2), (2) standard 20% CP and 20% fat MR fed at 1.5% of BW (4 meals/d; STD4), (3) modified 26% CP and 18% fat MR fed at 2.0% of BW (2 meals/d; MOD2), and (4) modified 26% CP and 18% fat MR fed at 2.0% of BW (4 meals/d; MOD4; n = 12). All calves were fed at 0600 and 1700 h and STD4 and MOD4 calves were fed 2 additional meals at 1100 and 1400 h, resulting in the same amount of MR offered for the 2× and 4× treatments. Treatments were fed from d 2 to 42 of age and all MR feeding rates were adjusted weekly to maintain MR solids intakes at 1.5 or 2.0% of BW for STD and MOD diets, respectively, and were reconstituted to 15% total solids. Milk replacer FF was reduced by 50% on d 36 and calves were weaned on d 42. Calves were housed in hutches bedded with straw and offered water and a texturized 18% CP starter ad libitum. Calf body weight and body structure were measured weekly and starter intake and fecal scores were measured daily. Through both 42 and 56 d, calves fed MOD had greater CP and fat intake, resulting in increased average daily gain, heart girth, circulating nonesterified fatty acids (NEFA), and muscle total lipid compared with calves fed STD diets. Calves fed MOD diets consumed less starter grain than STD calves but total dry matter intake was similar among treatments. Increased FF for STD calves resulted in greater starter intake at weaning but increasing FF of MOD calves did not have this effect. Due to differences in starter intake, total dry matter by calves through d 56 was similar across treatments. Additionally, increased FF tended to increase serum NEFA concentrations. Serum NEFA concentration was negatively correlated with starter intake. The BW of calves fed STD2 and STD4 treatments almost doubled and the BW of calves on the MOD2 and MOD4 treatments doubled by d 56. Increased FF of the conventional MR program but not accelerated MR program increased starter intake. Increased FF did not affect growth, starter intake, or gain:feed ratio.
Key words: nursery calf, accelerated milk replacer, feeding frequency

INTRODUCTION

Current industry practice is to provide calves with whole milk or milk replacer (**MR**) at approximately 10% of the calf's BW divided into 2 meals per day (Jasper and Weary, 2002). Conventional calf-rearing systems historically have restricted the amount and frequency of feeding (**FF**) of MR to about 0.25 kg in 2 L of water fed twice per day. Under this feeding program, a 40-kg calf would receive 2 meals per day of approximately 2 kg as fed. In contrast, a calf left with its dam will suckle, on average, 7 to 10 times per day and consume substantially larger quantities of milk (Albright and Arave, 1997). Additionally, the cow and calf interaction plays a major role in controlling the duration and frequency of each suckling event and, thus, total MR intake (von Keyserlingk and Weary, 2007). Furthermore, in cold climates, increasing the number of feedings from 2 to 3 times/d and increasing the amount of DM fed has improved weight gain and calf health (Schingoethe et al., 1986). The objective of earlier calf-rearing systems was to encourage starter intake (**SI**), promote development of a functional rumen, and reduce the age at weaning (Kertz et al., 1979). Increasing the intake of nutrients from MR generally delays or reduces starter and forage intake (Jasper and Weary, 2002; Terré et al., 2009; Davis Rincker et al.,

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2011; Morrison et al., 2012). An inverse relationship between milk or MR and SI has been demonstrated in earlier research (Raeth-Knight et al., 2009; Terré et al., 2009). However, over the past several years, research has shown that improvements in growth and feed efficiency can be obtained by feeding greater quantities of MR or increased concentration of nutrients in MR (Diaz et al., 2001; Flower and Weary, 2001; Jasper and Weary, 2002; Brown et al., 2005).

In addition to nutrient intake and quantities of milk or MR offered, FF also can be manipulated to alter nutrient intake and modify the amount of delivery of nutrients throughout the day. Increased FF or feed push-up increased DMI in lactating cows (Bach et al., 2008). There is a paucity of data describing the effects of increasing MR FF on calf growth and health.

We hypothesized that increased FF would result in increased SI and calf growth when calves were fed an accelerated MR program. The objectives of this study were to determine if the MR program: standard (20% CP and 20% fat fed, at 1.5% of BW) versus modified accelerated (26% CP and 18% fat fed, at 2.0% BW) and FF (2 vs. 4 times daily) would alter calf SI, growth, and health of manually fed calves.

MATERIALS AND METHODS

Animals

The experimental protocol was reviewed and approved by the University of Minnesota (St. Paul) Institutional Animal Care and Use Committee. Forty-eight (n = 12) Holstein and Holstein-cross female (n = 24) and male (n = 24) calves averaging 41.8 ± 1.6 kg of BW at birth were used. Calves were born between October 21, 2009, and February 1, 2010, at the University of Minnesota Dairy Research and Teaching Facility (St. Paul).

At birth, calves were removed from their dams and weighed. Each calf was identified with a unique ear tag and placed in a calf hutch (Calf-Tel; Hampel Corp., Germantown, WI and PolyDome, Litchfield, MN) bedded with straw within 24 h of birth. Calves received approximately 1.9 L of colostrum at each of the first 2 feedings (within 2 h after birth and again approximately 12 h after the first feeding) and were trained to drink MR from buckets during the first 2 d of life. A blood sample was collected via jugular venipuncture into evacuated serum collection tubes (SST; Vacutainer; Becton, Dickinson and Co., Franklin Lakes, NJ) 24 h after birth and centrifuged at 2,000 × g for 20 min. Serum was separated and analyzed for total serum protein concentration using a refractometer (Reichert Rhino VET360; Reichert Inc., Depew, NY).

Assignments to Treatments and Feeding

Calves were balanced by birth BW, sex, breed, and serum total protein content across the 4 treatment combinations. The MR treatments were as follows: control (**STD2**; standard 20% CP and 20% fat MR fed at 1.5% of birth BW in 2 meals/d); standard 20% CP and 20% fat MR fed at 1.5% of birth BW in 4 meals/d (**STD4**); modified 26% CP and 18% fat MR fed at 2.0% of birth BW in 2 meals/d (**MOD2**); and modified 26% CP and 18% fat MR fed at 2.0% of birth BW in 4 meals/d (**MOD4**). Milk replacer feeding rates of STD were increased above the typical daily 0.40 to 0.55 kg of DM per calf to minimize the risk of adverse health events during cold stress typical during winter in the upper Midwest.

Of the 48 calves assigned to treatment, 3 calves were replaced during the trial. Two calves assigned to STD2 were replaced; 1 calf was replaced at d 35 of age due to extremely poor performance and an abscess on its lower jaw and the second calf was replaced at d 14 of age after it died. A third calf on STD4 was replaced at d 28 of age due to a leg injury.

All MR were manufactured by Milk Products Inc. (Chilton, WI), were medicated (220 g of oxytetracycline and 485 g of neomycin base per metric tonne; fed before the 2009 Food and Drug Administration ruling on medicating MR), and contained whey protein as the protein source and edible-grade lard as the fat source. All MR was reconstituted to 15% solids and offered to calves in buckets. Treatments were fed from d 1 to 42 and all MR feeding rates were adjusted weekly to maintain 1.5 or 2.0% of BW for STD and MOD treatments, respectively. Calves on treatments STD4 and MOD4 were fed 4 meals/d at 0600, 1100, 1400, and 1700 h and 2 meals at 0600 and 1700 h from d 37 to 42. Calves on treatments STD2 and MOD2 were fed 2 meals/d at 0600 and 1700 h from d 1 to 36 and 1 meal/d at 0600 h from 36 to 42. Calves on treatments MOD2 and MOD4 were fed at 1.5% of BW from d 1 to 10 and MR was adjusted to 2.0% of BW from d 11 to 42. At 5 wk of age, the total volume of reconstituted MR offered was reduced by 50% for all calves.

All calves were fed a common starter grain (**SG**) to meet or exceed nutrient requirements for a preweaned and early weaned Holstein calf to achieve adequate growth as suggested by the NRC (2001) and others (Davis and Drackley, 1998). Texturized SG (Table 1) was fed once daily in the afternoon for ad libitum intake during the first 56 d of age. Starter refusals were recorded daily and refusals of MR were recorded at each feeding. Warm fresh water was available to calves for ad libitum consumption after each feeding.