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Efficacy of colostrum replacer versus maternal colostrum on immunological status, health, and growth of preweaned dairy calves

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ABSTRACT

Commercially available colostrum replacers (CR) are commonly used when maternal colostrum (MC) is unavailable, for managerial convenience, to ensure quality consistency at first feeding, or in disease control and eradication programs. The objective of this study was to determine the efficacy of feeding First Day Formula (Accelerated Genetics, Baraboo, WI) CR versus pooled MC on immunological status, growth, and health of preweaned dairy calves. A total of 1,220 Jersey and Jersey × Holstein calves born on a California Central Valley dairy farm were assigned after birth to receive either CR or MC following a systematic allocation procedure. Calves assigned to MC were tube fed 2.8 L of MC, and calves assigned to CR were tube fed a total of 500 g of CR (150 g of immunoglobulin G; IgG) mixed into 1.9 L of water at 1 h ± 5 min after the calf was born. A subset of calves was selected for passive transfer (n = 592) and growth (n = 268) analyses. Although both coliform count and total bacteria count were low for MC and CR fed to calves during the study, the predicted probability of calves receiving contaminated liquid feed (coliform count >10,000 cfu/mL) at first feeding was reduced for calves fed CR (1.5%) compared with calves fed MC (6.1%). The mean blood concentration of IgG was lower for calves fed CR than for calves fed MC (19.6 vs. 23.4 mg/mL). However, the apparent efficiency of absorption of IgG did not differ between treatments (34.4 and 35.9% for CR and MC, respectively). Total proteins were lower in calves fed CR compared with MC at 24 h (5.16 vs. 5.84 g/dL, respectively). Calves fed CR were 1.5 kg lighter at weaning and gained 0.03 kg less per day (0.30 vs. 0.33 kg/d, respectively) than calves fed MC before weaning. Height at weaning did not differ between the 2 treatment groups. Calves fed CR tended to have a higher predicted probability of not being treated for diarrhea than calves fed MC (0.142 vs. 0.110, respectively). However, when the disease was present, CR had a higher number of treatment days compared with MC (11.6 vs. 10.8 d, respectively). The hazard ratio of dying did not differ between MC and CR; however, CR calves had a numerically higher risk (hazard ratio = 1.347) of dying compared with calves that received MC. In conclusion, IgG absorption and serum concentration of calves were adequate when calves were fed either CR or MC. The CR-fed calves had a lower probability of receiving contaminated liquid feed and performed similar in terms of health compared with calves receiving high-quality MC, although they were slightly lighter at weaning. Therefore, the CR evaluated in this study is a valid alternative to high-quality (>50 mg of IgG/mL) MC.
Key words: calf, colostrum, colostrum replacer, passive transfer

INTRODUCTION

Maternal colostrum (**MC**) is an important source of nutrients and immune factors for the newborn calf. Additionally, the importance of achieving successful passive transfer to the young calf cannot be denied (Davis and Drackley, 1998). To achieve successful passive transfer of immunity (>10 mg of IgG/mL of serum; Godden, 2008), it has been suggested that a calf needs to receive at least 150 to 200 g of IgG within 2 h of birth (Chigerwe et al., 2008). This normally can be achieved by feeding 3 to 4 L of high-quality MC (>50 mg of IgG/mL; McGuirk and Collins, 2004). Current industry recommendations for high-quality MC specify that it should (1) contain >50 mg of IgG/mL, (2) have

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a total bacteria count (**TBC**) <100,000 cfu/mL, and (3) have a coliform count (**CC**) <10,000 cfu/mL (McGuirk and Collins, 2004). In a nationwide study of 67 farms in 12 states, almost 43% of samples collected had a TBC >100,000 cfu/mL, and 16.9% of the samples had a TBC >1 million cfu/mL (Morrill et al., 2012). Only 39.4% of the samples collected met industry recommendations for both IgG concentration and TBC.

When colostrum quality is poor or unavailable, colostrum replacers (**CR**) may be an alternative. Although some studies have reported that feeding one package of some commercial CR products was successful (Quigley et al., 2001; Jones et al., 2004; Foster et al., 2006; Pithua et al., 2013; Priestley et al., 2013), other products failed to achieve mean concentrations of 10 mg/mL of IgG in serum of calves fed CR (Mee et al., 1996; Quigley et al., 2001; Foster et al., 2006; Smith and Foster, 2007; Swan et al., 2007; Godden et al., 2009; Fidler et al., 2011; Priestley et al., 2013). Researchers have reported that the risk of *Mycobacterium avium* ssp. *paratuberculosis* infections was reduced by almost 50% when using a plasma-derived CR compared with using MC (Pithua et al., 2009). Previous studies have not reported a difference in bacteria counts of CR compared with MC when fed to calves. The objective of this study was to determine the effect of feeding a commercially available CR versus pooled MC on immunological status, growth, and health of preweaned dairy calves.

MATERIALS AND METHODS

Dairy Farm and Calf-Raising Facility

The study was conducted on a commercial freestall dairy farm in California with about 9,000 Jersey, Jersey × Holstein cross, and Holstein lactating cows from July to August 2014. Cows in maternity pens were continuously monitored (every 10 min) for calving by research technicians from DairyExperts (Tulare, CA). No later than 10 min after parturition, calves were separated from dams and kept in a group until being transported to another location where calves were raised in California-style wooden hutches. After the initial feeding, calves were fed by farm personnel with 1.9 L of waste milk enriched with a milk balancer (26% CP, 15% fat) to 15% solids twice a day until weaning and offered calf starter after 3 d of age. Weaning occurred at 46 ± 3 d of age, and calves were fed milk once a day for 1 wk until they were moved out of the hutch. Water was offered by farm personnel to calves starting at 3 d of age. Experimental procedures during the first 1 to 2 h of life were performed at the dairy, and additional procedures occurred at the calf-raising facility.

Study Design

A randomized field study was designed to determine the efficacy of feeding First Day Formula (Accelerated Genetics, Baraboo, WI) CR versus pooled MC. Newborn female Jersey and Jersey × Holstein calves and male Jersey × Holstein calves were enrolled in the study by research technicians. Newborn male Jersey calves and male and female Holstein calves were excluded from enrollment. Calves were born from multiparous and primiparous dams. Following birth, calves were systematically assigned following birth order to MC (2.8 L of colostrum; n = 609) or CR (500 g of CR containing 150 g of colostrum-derived IgG mixed into 1.9 L of water; n = 606). All treatments were given via an esophageal feeder at 1 h ± 5 min after birth. Both MC warming and CR preparation as well as feeding were done by research technicians.

MC Management

Colostrum fed to MC calves was harvested twice a day from individual cows at the milking parlor, pooled, and poured into 2.8-L bottles by farm personnel. Bottles were then transported to the maternity area and stored in a refrigerator within 1 h after collection by the same farm personnel. When a calf was born, colostrum was removed from the refrigerator by research technicians and warmed up by immersing bottles in hot water not exceeding 60°C. The temperature of colostrum was checked about 10 min before feeding. Temperature of colostrum was targeted at about 41°C.

CR Preparation

Fifteen minutes before feeding CR, a 3.8-L container of bottled water (DS Waters of America, Atlanta, GA) was immersed in a bucket with hot tap water. Ten minutes before feeding, the temperature of the water in the container was measured with a thermometer to ensure it reached a target temperature of 41°C. The bucket used to mix the replacer was filled with 1.9 L of water. One package of CR powder was added while the mix was stirred using a whisk for 40 to 60 s to ensure complete dispersal. Afterward, the mix was poured into an esophageal feeder container. Tasks related to CR preparation were done by research technicians.

Sample Collection and Laboratory Analyses

MC and CR. Volumes of 40 mL of MC and CR were collected by research technicians into 60-mL plastic tubes from the esophageal feeder before feeding every