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A field study to determine the effect of a fatty acid blend in milk replacer or whole milk on calf health and performance

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ABSTRACT

The physiological effects of feeding a fatty acid blend to calves including health, fecal consistency, milk intake, and growth were evaluated. A total of 262 calves were enrolled from 7 different farms across southwestern Ontario and 1 farm in western New York. At birth, calves were weighed and assigned to either a control or fatty acid (FA) group. After colostrum feeding, FA calves received 1.2 g of a fatty acid blend diluted with 9.6 g of skim milk powder into whole milk or milk replacer per feeding (2 times/d) until wk 8 of life. Control calves received 10.8 g of skim milk powder in whole milk or milk replacer per feeding (2 times/d). Study technicians visited farms weekly to collect health scores and BW data on 1- to 8-wk-old calves. Blood samples were collected from each calf at wk 1, 5, and 8. The mean of the total fecal scores over the 8-wk study period was reduced ($P < 0.001$) in FA compared with control calves. In addition, more calves were given a fecal score ≥2 (loose/watery diarrhea) over the 8-wk study period in the control compared with the FA group ($P = 0.002$). The incidence of treatment for diarrhea in the control group was 32%, compared with 23% in the FA group ($P = 0.195$). There was no effect of treatment on ADG ($P = 0.83$). In conclusion, FA improved fecal consistency, but there was no significant effect on the incidence of diarrhea or growth.

Key words: dairy calf, fatty acid blend, health, growth

INTRODUCTION

Enteropathogenic infections are the most common cause of health problems in preweaned calves (Waltner-Toews et al., 1986; Kaneene and Hurd, 1990). In North America, almost 1 in 4 preweaned heifers show symptoms of diarrhea (23.9%), whereas 17.9% are actually treated with antibiotics for diarrhea (USDA, 2007). In addition, diarrhea accounted for the greatest percentage of preweaned heifer deaths (56.5%), followed by respiratory problems (22.5%; USDA, 2007). Calf morbidity and mortality have large economic consequences on the dairy industry because of the losses in feed, medication, and labor, as well as the cost of replacement heifers. There has also been a great deal of research suggesting that surviving calves might suffer from indirect long-term residual effects on growth, reproductive function, and milk production (Waltner-Toews et al., 1986; Soberon et al., 2012). Soberon et al. (2012) found that preweaning ADG decreased by 50 g/d in diarrheic calves that were treated with antibiotics compared with healthy calves. Furthermore, for every 1 kg of preweaning ADG, heifers produced an average of 1,113 kg more milk during their first lactation (Soberon et al., 2012).

To mitigate these problems and reduce the economic consequences, innovative strategies must be identified to help prevent and reduce the incidence of bacterial and viral digestive diseases in calves. There has been an abundance of research focusing on addressing these issues through the development of gut-health additives. Of these additives, short-chain (**SCFA**) and medium-chain fatty acids (**MCFA**) have been recognized for their benefits to gastrointestinal health and development. It has been shown that feeding SCFA and MCFA increases villus height, decreases crypt depth, and decreases inflammation in piglets (Dierick et al., 2004). They also have strong antimicrobial properties and immunomodulatory effects and modify the gastrointestinal microflora, aiding in the prevention of diarrhea (Partanen and Mroz, 1999; Decuypere and Dierick 2003; Wang et al., 2006; Zentek et al., 2013). Hill et al. (2007) found that calves fed milk replacer containing increased levels of SCFA and MCFA had fewer days with abnormal fecal scores and improved ADG. Because milk is delivered directly to the abomasum and lower gastrointestinal tract of preruminant calves, administering bioactive constituents through milk is particularly important because they avoid rumen degradation.

This experiment was designed to characterize the physiological effects of feeding a SCFA and MCFA blend to calves by evaluating health, fecal scores, milk intake, and growth. The hypothesis of this study was that the addition of fatty acids to whole milk or milk replacer would improve the health and performance of preweaned calves.

MATERIALS AND METHODS

Study Farms and Calf Enrollment

A convenience sample of 8 dairy farms were selected from the Shur-Gain (Shur-Gain a Nutreco Company, St.

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Mary's, ON, Canada) customer base to participate in this study. Seven farms were located in southwestern Ontario and one in western New York. On each farm, female Holstein calves were enrolled in this study from May until August 2015. One farm also enrolled male calves because they were kept on farm until after weaning at wk 8. All enrolled calves were housed individually in either outdoor hutches or indoor pens. Calves were offered milk according to existing farm protocols (6 to 11 L/d, 2 or 3 times/d) with the exception of dietary treatment. Five farms fed whole milk, and 3 farms fed commercial milk replacers [Shur-Gain Optivia Advantage milk replacer, 26% CP, 16% fat, partially acidified to achieve a pH of 5.6 (2 farms) or Shur-Gain Advantage milk replacer, 26% CP, 16% fat, pH 6.6 (1 farm) (Nutreco Canada Inc., Guelph, ON, Canada)]. Milk replacers were designed to be mixed at a rate of 150 g to 1 L of 40°C water to achieve 15% solids. All farms offered calf starter during the preweaning phase; 5 farms offered a textured starter, whereas 3 farms offered a pelleted starter. Only one farm offered chopped straw along with the calf starter.

Experimental Design

All procedures were approved by the Animal Care Committee at Trouw Nutrition Agresearch. Immediately following birth, producers weighed each calf using a bathroom scale that was provided to each study farm, which was tested for accuracy with a check weight before being distributed (Starfrit Balance High Capacity Scale 0938520040000, Longueuil, QC, Canada). At this time, producers also completed a birth record, documenting information about the calving event, including date and time of calving; calving difficulty; and quantity, timing, and source of colostrum fed to each calf. Calves were then assigned to 1 of 2 treatment groups, a control or a commercial fatty acid blend (**FA**) to be received in whole milk or milk replacer following colostrum feeding. Treatment assignment alternated between calves (every other calf).

Control and FA powders were distributed on farm in color-coded 4.7-L buckets with lids and added to the whole milk or milk replacer via a premeasured scoop. Scoops were calibrated to hold 10.8 g of powder per calf per feeding. The control treatment was skim milk powder, whereas the FA treatment contained a blend of sorbic, benzoic, caprylic, capric, and lauric acid, as well as ethyl laurate and calcium gluconate, diluted with skim milk powder to make it easier to measure and deliver to calves. Buckets and scoops were color coded to ensure producers and calf feeders were blind to dietary treatment. At regular scheduled feedings (2 times/d), FA and control powders were mixed and fed with either whole milk or milk replacer via bucket or bottle. Calves were maintained on treatment until the final BW was collected at wk 8 of life. If calves refused to consume their entire allotment of milk during a single feeding, calf feeders recorded the approximate amount of milk refused. From the refusals that were recorded, milk intake was calculated per calf based on the milk feeding program for each farm.

During the routine weekly visit to Ontario farms, trained research technicians collected measurements and samples from previously enrolled animals from their first to eighth week of life. A blood sample was collected from each calf between 24 h and 8 d of age. Blood was collected into 10-mL sterile Vacutainer (Becton Dickinson 366430, Mississauga, ON, Canada) collection tubes via jugular venipuncture. Blood was allowed to clot on ice while it was transported and then centrifuged at 1,500 × g for 15 min at room temperature. Serum was analyzed for serum total protein (**STP**) using a digital refractometer (Model 300027; Sper Scientific Ltd., Scottsdale, AZ) and then stored at −20°C. Successful transfer of passive immunity was defined as a STP concentration of ≥5.2 g/dL from calves sampled during the first 8 d of life. Calves having a STP concentration <5.2 g/dL were considered to have failure of transfer of passive immunity.

At weekly farm visits, research technicians assessed calf health and weighed all enrolled calves that were in their first to eighth week of life. From wk 1 to 7, BW was measured using a heart girth weight tape for Holstein calves (Coburn Holstein Calf Weight Tape 44556, Whitewater, WI). For the final BW measurement during the eighth week of life, an electronic calf weight scale was used (Brecknell PS0001, Montreal, QC, Canada). To ensure accuracy, the electronic scale was validated using a calibration weight each time the scale was used. Average daily gain was calculated for the 8-wk study period based on scale weight measurements obtained at birth and during the eighth week. Health was assessed by recording scores for attitude, ear droop, nasal discharge, and fecal consistency using a graded scoring system ranging from 0 to 3 (McGuirk, 2008; Table 1). Two 10-mL blood samples (Becton Dickinson Vacutainer with EDTA 366450) were collected in the fifth and eighth week of life for each calf.

At the New York location, producers were responsible for recording birth weight using the same bathroom scale, completing the birth record, recording daily milk refusals, and weighing calves at wk 8 of life. Blood samples, health scores, and tape weights from wk 1 to 8 were not collected or recorded for this location.

During the course of the study across all farms, illness and treatment events were recorded by the producer. Treatment was defined as the administration of a product to an animal in response to an illness event during the study period. Incidence, duration, and treatment for health events including diarrhea, respiratory disease, increase in body temperature, drop in intake, inflamed navel, bloat, and swollen legs or joints were recorded.

Statistical Analysis

Data were entered in Excel and exported into Stata-IC 13.1 (StataCorp, College Station, TX) for variable screening and statistical modeling. All variables were examined

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