J. Dairy Sci. 95:6677–6686
http://dx.doi.org/10.3168/jds.2012-5605

An alkalinizing oral rehydration solution containing lecithin-coated citrus fiber is superior to a nonalkalinizing solution in treating 360 calves with naturally acquired diarrhea

G. M. Goodell,* J. Campbell,† L. Hoejvang-Nielsen,‡ W. Stansen,§ and P. D. Constable#[1]
*The Dairy Authority, Greeley, CO 80634
†Boehringer Ingelheim Vetmedica, St. Joseph, MO 64506
‡Boehringer Ingelheim Vetmedica, DK-2100 Copenhagen, Denmark
§Boehringer Ingelheim, 55216 Ingelheim, Germany
#Department of Veterinary Clinical Sciences, School of Veterinary Medicine, Purdue University, IN 47907

ABSTRACT

The aim of this field study was to compare the efficacy and cost of 2 commercially available oral rehydration therapy (ORT) solutions in treating dairy calves with naturally acquired diarrhea. A total of 1,349 newborn Holstein-Friesian calves were prospectively enrolled in the study. Calves were housed in individual hutches and fed a mixture of pasteurized hospital milk and an all-milk protein milk replacer twice per day. Calves were monitored twice each day from d 2 of life until 30 d of age for the presence or absence of diarrhea, and were assigned a fecal score and a hydration score at each examination. Calves that developed mild to severe diarrhea that did not need intravenous fluids and did not have clinical evidence of concurrent disease (n = 360) were assigned randomly to receive 1 of 2 commercial ORT solutions: a hypertonic alkalinizing ORT containing lecithin-coated citrus fibers (Diaque, group D, n = 180; Boehringer Ingelheim, Ingelheim, Germany), and an isotonic nonalkalinizing ORT (RE-SORB, group R, n = 180; Pfizer Animal Health, New York, NY) for 2 to 8 d; the duration of treatment depended on whether diarrhea was still present. No significant differences were observed in mortality rates or treatment failure rates between the 2 treatment groups. Fecal consistency returned to normal more quickly in group D calves than in group R calves; consequently, group D calves were treated for 1 d less than were group R calves. The increase in body weight after 4 d of treatment was larger in group D than in group R. The average daily gain from birth to weaning in calves that did not develop concurrent disease (such as pneumonia) during the study period tended to be higher in group D calves (0.53 ± 0.11 kg/d) than in group R calves (0.51 ± 0.09 kg/d). The smaller number of treatments at a lower cost per treatment produced a cost advantage of $4.82 per treated calf in group D calves compared with group R calves. Our findings support the concept that milk should continue to be fed to diarrheic calves that are being administered an ORT solution in order to maintain growth.

Key words: calf diarrhea, oral electrolyte rehydration solution, strong ion difference

INTRODUCTION

Neonatal calf diarrhea is a major source of economic loss to the cattle industry and is the leading cause of dairy calf mortality (Svensson et al., 2003; USDA, 2010) and an important cause of beef morbidity (Busato et al., 1997) in most countries. The United States Department of Agriculture estimates that 7.8% of dairy heifers die between d 2 of life and weaning, with the majority of deaths attributable to diarrhea or other digestive problems (USDA, 2010). Calf diarrhea has the highest annual costs for treatment and control of any disease in US dairy cattle, exceeding the treatment and control costs for mastitis, respiratory disease, or lameness (Weigler et al., 1990). Diarrhea in neonatal calves can lead to dehydration, hyponatremia, hyper D-lactatemia, strong ion (metabolic) acidosis, hyperkalemia, and impaired cardiovascular and renal function (Constable, 2003; Constable et al., 2005; Sen et al., 2009). Oral rehydration therapy (**ORT**) solutions provide a practical and inexpensive method for treating mild to moderate strong ion (metabolic) acidosis and dehydration in neonatal calves with diarrhea; however, the energy content in ORT solutions is inadequate to meet the needs of the calf, even when high-glucose ORT solutions are fed (Constable et al., 2001). Uncertainty remains about the optimal electrolyte concentrations, type of buffer, and type and amount of energy source,

Received April 9, 2012.
Accepted July 5, 2012.
[1]Corresponding author: constabl@purdue.edu

as well as the pH and osmolality of the ORT solution (Constable et al., 2001; Constable, 2003; Smith, 2009). Studies in the late 1970s and 1980s demonstrated that milk withdrawal and concurrent administration of an ORT solution decreased mortality in calves with diarrhea (Bywater, 1977, 1980; Booth and Naylor 1987). Continued milk feeding to calves showing mild to moderate signs of diarrhea does not exacerbate diarrhea (Naylor et al., 1990) and is recommended to maintain growth and support the repair of damaged intestinal mucosa (Heath et al., 1989; Garthwaite et al., 1994).

Many dairy producers feed ORT solutions to diarrheic calves between milk feedings or at the time of milk feeding. In the past, ORT solutions were not mixed with milk because of concerns about changes in intestinal morphology and bacterial flora leading to fermentation of undigested and unabsorbed nutrients, inhibition of chymosin clot formation in the abomasum, and decreased abomasal emptying rate because of increased osmolality of the ORT (Heath et al., 1989; Svensson et al., 2003; Sen et al., 2006; Nouri and Constable, 2006; Bachmann et al., 2009; Constable et al., 2009). These concerns led to recommendations that milk should be withdrawn from feeding for the first 2 d of treatment (Svensson et al., 2003) and that ORT solutions should be administered at least 1 h before or after the milk feeding. Although the separate feeding of ORT solutions has proven effective in treating calves for diarrhea, the added labor to visit diarrheic calves 1 to 2 additional times each day has increased the expense and reduced treatment compliance. Two ORT solutions, Diaque (Boehringer Ingelheim, Ingelheim, Germany) and RE-SORB (Pfizer Animal Health, New York, NY), are labeled to be fed directly with the milk of calves during their normal feeding, thereby eliminating the need for extra visits to calves with diarrhea. The 2 ORT solutions differ in their label recommendations in that Diaque can be fed immediately with milk, whereas milk must be withheld for the first 4 feedings (48 h) that RE-SORB is fed; after 48 h, 0.95 L of RE-SORB can be mixed with 0.95 L of milk or milk replacer, and the 1.89-L mixture can be fed for the next 4 feedings (feedings 5 through 8). The main objective of this study was therefore to compare the effectiveness of 2 commercially available ORT solutions for the initial treatment of dairy calves with diarrhea. A secondary purpose was to perform a partial budget analysis of the 2 treatments. We hypothesized that continued milk feeding in calves with diarrhea that were administered an ORT solution would result in a shorter treatment duration, lower treatment costs, and increased BW, relative to withholding milk for the first 4 feedings.

MATERIALS AND METHODS

Animals and Management

The study was conducted at a 12,000-cow dairy in northern Colorado. Holstein-Friesian calves were processed within 5 h of birth in the maternity area of the dairy. Processing consisted of dipping the navels with 7% tincture of iodine, ear tagging, collecting a skin sample (ear notch) for antigen capture ELISA for bovine viral diarrhea virus, and measuring BW. Calves were fed 3.89 L of colostrum at processing and an additional 1.89 L of colostrum at a second feeding.

Processed calves were transported one-half mile from the maternity area to the calf ranch twice each day. Calves were housed individually at the calf ranch in hutches with panels that permitted nose-to-nose contact with calves in adjacent hutches. Calves were fed twice a day with a fixed volume of 1.89 L of a mixture of pasteurized nonsalable milk and milk replacer in a bottle with a nipple. Milk was pasteurized at 71.1°C for 30 min by using a vat pasteurizer. The milk mixture consisted of approximately 60% pasteurized nonsalable milk (estimated as 27% fat and 25% protein on a DM basis), 40% dry all-milk protein milk replacer (20% fat and 20% protein on a DM basis, 0.567 kg of milk replacer powder per 3.785 L of water; IBA Instant Milk Replacer, IBA Inc., Milbury MA), and water. A commercial calf starter ration (18% CP, as-fed basis) was offered at 1 wk of age, but consumption was not monitored.

A jugular venous blood sample was collected from calves at approximately 48 h of age for determination of serum total protein concentration by refractometry (Jor-Vet J351 Clinical Refractometer; Jorgensen Laboratories, Loveland CO). Transfer of passive immunity was considered failed if serum total protein concentration was <5.0 g/dL (Tyler et al., 1996). Calves were vaccinated and treated according to standard protocols for the dairy. Calves were weighed when weaned at approximately 8 wk of age.

Enrollment and Treatment

An observer walked through the calf ranch twice each day with the calf ranch staff and examined all calves <30 d of age. The observer identified calves that had uncomplicated diarrhea [defined as diarrhea but the absence of fever (rectal temperature >39.7°C or other systemic signs of illness) and notified the investigator of the calf's ear tag and location. Calves were initially assigned a fecal score of 0 to 4 (0 = normal; 1 = normal consistency but may include specks of fresh blood or