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Supplemental trace minerals (zinc, copper, and manganese) as sulfates, organic amino acid complexes, or hydroxy trace-mineral sources for shipping-stressed calves

A. W. Ryan,* E. B. Kegley,*[1] PAS, J. Hawley,* J. G. Powell,* J. A. Hornsby,* J. L. Reynolds,* and S. B. Laudert†

*Department of Animal Science, Division of Agriculture, University of Arkansas, Fayetteville 72701; and †Micronutrients, Indianapolis, IN 46231

ABSTRACT

Crossbred calves (n = 350; average BW 240 ± 1 kg) were obtained from regional livestock auctions. Within each set (block, n = 4), calves were stratified by BW and arrival sex into 1 of 8, 0.42-ha pens (10 to 12 calves per pen). Pens were assigned randomly to 1 of 3 treatments consisting of supplemental Zn (360 mg/d), Mn (200 mg/d), and Cu (125 mg/d) from inorganic (zinc sulfate, manganese sulfate, and copper sulfate; n = 2 pens per block), organic (zinc amino acid complex, manganese amino acid complex, and copper amino acid complex; Availa-4, Zinpro Corp., Eden Prairie, MN; n = 3 pens per block), and hydroxy (IntelliBond Z, IntelliBond C, and IntelliBond M; Micronutrients, Indianapolis, IN; n = 3 pens per block) sources. During the 42- to 45-d backgrounding period calves had ad libitum access to bermudagrass hay and were fed corn and dried distillers grain–based supplements that served as carrier for the treatments. After removal of data for chronic (n = 6) and deceased (n = 1) calves, trace-mineral source had no effect on final or intermediate BW (P = 0.86) or ADG (P ≥ 0.24). With all data included in the analysis, dietary treatments had no effect on the number treated once (P = 0.93), twice (P = 0.71), or 3 times (P = 0.53) for bovine respiratory disease or on the number of calves classified as chronic (P = 0.55). Based on these results, trace-mineral source had no effect on total BW gain, ADG, or morbidity during the receiving phase in shipping-stressed cattle.

Key words: beef cattle, copper, manganese, trace mineral, zinc

INTRODUCTION

In the beef cattle industry, calves are often weaned between 6 and 8 mo of age. At or soon after weaning, calves are often sold through local auction markets during which time they are exposed to a variety of stressors, including food and water deprivation and potentially dramatic dietary changes from forage- to concentrate-based diets. Additionally, calves from multiple sources are typically commingled after purchase and thus potentially exposed to foreign pathogens. Stress experienced by calves during transportation and weaning increases their susceptibility to infection (Breazile, 1988). In addition to medical costs due to morbidity, morbid cattle in general grow slower during the feedlot phase, are less efficient at converting feed to gain, and have both lighter BW and lower-quality carcasses after slaughter (McNeill, 1995; Gardner et al., 1999). Several factors can affect immune function, one of those being trace-mineral status (Wan et al., 1989; Erickson et al., 2000; Spears, 2000). However, different sources of trace

[1] Corresponding author: ekegley@uark.edu

minerals may vary in price and have been shown to differ in bioavailability (Wedekind et al., 1992; Kegley and Spears, 1994; Spears et al., 2004). In addition, Kegley and coworkers (2012) reported an increase in growth performance in calves supplemented with amino acid complexed trace minerals compared with inorganic sulfate trace minerals. However, results have varied; Garcia et al. (2014) reported recently that varying level and source of trace minerals did not affect growth performance or morbidity in newly received cattle. Trace minerals from hydroxy sources have not been evaluated as a trace-mineral supplement in shipping-stressed cattle. Zinc hydroxychloride, Mn hydroxychloride, and basic Cu chloride are crystalline inorganic mineral sources formed by covalent bonds between the trace mineral and a hydroxy group. These forms of trace minerals lack solubility at neutral pH and dissolution occurs at lower pH. Recently, Genther and Hansen (2015) confirmed that Mn and Cu from these hydroxy sources were relatively insoluble in the rumen but had similar solubilities to sulfate sources in the abomasum. Therefore, our objective was to evaluate the effect of trace-mineral supplementation from sulfate, organic amino acid complex or hydroxy sources on growth performance, morbidity, and immune response to vaccination for bovine viral diarrhea (**BVD**) virus in newly received stocker cattle.

MATERIALS AND METHODS

Prior to initiation of this study, care, handling, and sampling of the animals were approved by the University of Arkansas Animal Care and Use Committee. A total of 350 crossbred beef calves (89 heifers, 129 steers, and 132 bulls; average BW of 240 ± 1 kg) were obtained from regional livestock auction markets in Arkansas and Oklahoma and shipped to the University of Arkansas Beef Cattle Facility at Savoy. Calves arrived in 4 shipment sets (block) with arrival dates of February 8 (n = 87, 63 bulls and 24 steers), March 1 (n = 88, 60 bulls and 28 steers), May 10 (n = 89, heifers), and September 26, 2013 (n = 86, 9 bulls and 77 steers). Upon arrival, calves were tagged in the left ear with a unique identification number, weighed, ear notched, and housed overnight in a holding pen with access to hay and water. Ear notches were sent for persistent infection with BVD virus testing (Cattle Stats LLC, Oklahoma City, OK), and no calves tested positive for the virus. The following morning, calves were administered respiratory (Pyramid 5, Boehringer Ingelheim Vetmedica, Ridgefield, CT) and clostridial (Covexin 8, Intervet Inc., Omaha, NE) vaccinations and were dewormed (Ivomec Plus, Merial Limited, Duluth, GA), and bulls were castrated by banding (California Bander, Inosol Co. LLC, El Centro, CA). All animals were branded with a hot iron on the right hip and weighed.

Within each block, cattle were stratified by BW and, if necessary, arrival sex (bulls or steers) and assigned randomly to 1 of 8 pens (10 to 12 calves per pen). Pens were assigned randomly to treatment. Calves were housed on 0.42-ha grass paddocks. Calves were fed corn and dried distillers grain–based supplements (Tables 1 and 2) that served as carriers of mineral treatments. Treatments consisted of supplemental Zn (360 mg/d), Mn (200 mg/d), and Cu (125 mg/d) from sulfate (n = 2 pens per block), organic amino acid complex (Availa-4, Zinpro Corp., Eden Prairie, MN; n = 3 pens per block), and hydroxy (IntelliBond Z, M, and C, Micronutrients Inc., Indianapolis, IN; n = 3 pens per block) trace-mineral sources. This resulted in 8 pens of cattle supplemented with sulfate sources of trace minerals and 12 pens of cattle supplemented with trace minerals as organic amino acid complex or hydroxy sources. Calves were offered a supplement formulated for feeding at 0.9 kg/d (as-fed basis) on d 0. When the majority of the calves in each pen were consuming the supplements, the pen was switched to supplements with the appropriate mineral treatment formulated for feeding at the 1.4 kg/d (as-fed basis) rate, and then to supplements formulated for feeding at the 1.8 kg/d (as-fed basis) rate, with calves receiving this supplement for the remainder of the 42- (block 4) to 45-d (block 1, 2, and 3) trial. During block 1, intakes of the 0.9 and 1.4 kg/d supplements for all treatments were deemed inadequate, and thus the supplement composition was changed before block 2. Changes in the supplement were formulated so that the new supplement was approximately equal in nutrients to the original diet but the percentage of dried distillers grain plus solubles was reduced. Calves had ad libitum access to bermudagrass hay (89.92% DM, 12.85% CP, 70% NDF, 38% ADF, 134 mg of Mn/kg, 52 mg of Zn/kg, 9 mg of Cu/kg, and 0.25% S; DM basis). Grab samples of supplement were taken daily and composited by diet within block. Grab samples of hay were taken from each bale offered and were composited within block. Samples were frozen at −20°C until analysis. Any supplement refusals were collected and weighed, and a subsample was frozen at −20°C until DM analysis. Calves received booster vaccinations on d 14 (block 4) or d 16 (block 1, 2, and 3).

Cattle were observed daily by trained personnel for signs of bovine respiratory disease (**BRD**) beginning the day after processing. Signs of BRD included depression, nasal or ocular discharge, cough, poor appetite, and respiratory distress. Cattle were given a clinical illness score of 1 to 5 (1 = normal to 5 = moribund). Calves with a score >1 were brought to the working facility and a rectal temperature was taken. If the rectal temperature was ≥40°C, the calf was treated according to a preplanned antibiotic protocol with therapy 1 (Micotil, Elanco Animal Health, Greenfield, IN) administered at 3 mL/45.45 kg of BW. Treated calves were returned to their home pen for convalescence and were re-evaluated in 72 h. If rectal temperature was ≥40°C during re-evaluation, the calf received therapy 2 (Nuflor, Intervet Inc.) at a rate of 6 mL/45.45 kg of BW. Calves receiving therapy 2 were returned to their home pen for

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