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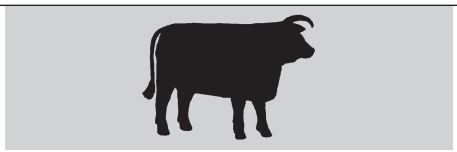

The effects of zinc hydroxychloride and basic copper chloride on growth performance, carcass characteristics, and liver zinc and copper status at slaughter in yearling feedlot steers[1]

J. J. Wagner,*[2] PAS, T. E. Engle,* PAS, E. Caldera,* PAS, K. L. Neuhold,* PAS, D. R. Woerner,* J. W. Spears,† PAS, J. S. Heldt,‡ PAS, and S. B. Laudert‡

*Department of Animal Science, Colorado State University, Fort Collins 80523-1171; †Professor Emeritus, North Carolina State University, Raleigh 27695; and ‡Micronutrients, Indianapolis, IN 46231-3350

ABSTRACT

Several trace mineral sources are available for use in feedlot diets. This study was conducted to provide nutritionists with information supporting the formulation of more cost effective trace mineral supplementation programs. Crossbred yearling steers (n = 288, initial BW = 319 ± 10.2 kg), housed in 32 pens (8 pens per treatment), were used in a randomized complete block design experiment to compare the effects of Zn hydroxychloride and basic Cu chloride, fed at 2 concentrations, to Zn and Cu sulfate or Zn and Cu sulfate plus Zn and Cu amino acid complexes on feedlot performance, carcass merit, and liver mineral status at slaughter. Treatments (100% DM basis) included 90 mg/kg of Zn from Zn sulfate and 15 mg/kg of Cu from Cu sulfate; 67.5 mg/kg of Zn from Zn sulfate plus 22.5 mg/kg of Zn from Zn amino acid complex (Availa Zn; Zinpro Corporation, Eden Prairie, MN) and 11.25 mg/kg of Cu from Cu sulfate plus 3.75 mg/kg of Cu from Cu amino acid complex (Availa Cu; Zinpro Corporation); 90 mg/kg of Zn from Zn hydroxychloride (IntelliBond Z; Micronutrients, Indianapolis, IN) and 15 mg/kg of Cu from basic Cu chloride (IntelliBond C; Micronutrients); and 54 mg/kg of Zn from Zn hydroxychloride and 9 mg/kg of Cu from basic Cu chloride. No significant (P > 0.10) treatment differences were found for initial, d-28, or final BW. Average daily gain, DMI, G:F, NE recovery, carcass characteristics, and liver Cu and Zn concentrations at the time of slaughter did not differ (P > 0.10) among treatments. These results indicate that Zn hydroxychloride and basic Cu chloride were effectively absorbed and used by yearling steers and can be fed at a reduced rate compared with current industry feeding practices without negative effects on feedlot performance, carcass merit, and liver Zn and Cu status.

Key words: feedlot, zinc, copper, organic trace minerals, hydroxy trace minerals

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[2] Corresponding author: john.wagner@colostate.edu

INTRODUCTION

Feed ingredients commonly used in feedlot diets may contain inadequate concentrations of essential trace minerals (**TM**), and basal diets, especially diets containing corn processing coproducts, may contain elevated concentrations of TM antagonists. As a result, TM are typically supplemented in feedlot diets. Zinc and Cu sulfate are inorganic mineral sources in which a single Zn or Cu ion, respectively, is associated with a single sulfate ion through an ionic bond. In contrast, organic TM are molecules where a Zn or Cu ion is covalently bound to a carbon-containing carbohydrate or protein molecule or a single amino acid. Zinc hydroxychloride (IntelliBond Z, Micronutrients, Indianapolis, IN) and basic Cu chloride (IntelliBond C, Micronutrients) are manufactured using a patented process reacting high purity forms (elemental metal, oxides, or chloride salts) of the desired trace metal with water, as the source of hydroxyl groups, and hydrochloric acid, as the source of chloride. During the process, hydroxychloride crystals are formed that contain the trace metal covalently bonded to hydroxyl groups and to chloride (Leisure et al., 2014). These hydroxy TM have lower solubility at neutral pH ranges as compared with the sulfate mineral forms and escape the rumen and undergo dissociation and absorption in the lower pH environment found in the lower digestive tract (Genther and Hansen, 2015). Studies examining TM bioavailability (organic vs. inorganic) and measuring various metabolic, digestibility, and performance parameters (Spears, 1989; Nockels et al., 1993; Rust and Schlegel, 1993; Kegley and Spears, 1994; Du et al., 1996; Ward and Spears, 1997; Engle et al., 2000a; Spears and Kegley, 2002) have reported variable results. Trace mineral sources providing greater bioavailability could help decrease the amount of mineral required in feedlot diets, ultimately decreasing production costs and environmental waste. The objective of this study was to compare the effects of mineral programs based on Zn hydroxychloride and basic Cu chloride, fed at 2 concentrations, to mineral programs based on Zn and Cu sulfate or Zn and Cu sulfate plus Zn and Cu amino acid complexes on performance, carcass characteristics, and liver TM status at slaughter in feedlot steers fed diets based on steam-flaked corn.

MATERIALS AND METHODS

Cattle Processing and Allotment Procedures

Prior to the initiation of the aforementioned study, care, handling, and sampling of the animals defined in this proposal were approved by the Colorado State University Animal Care and Use Committee.

Newly arrived, English × Continental cross-bred yearling steers (n = 288, initial BW = 319 ± 10.2 kg), selected from an initial group of 301 steers, sourced from multiple auctions, were used in this experiment. Upon arrival at the Southeast Colorado Research Center located near Lamar, Colorado, steers were individually identified with an electronic ear tag and weighed, vaccinated for the prevention of respiratory disease (Presponse and Pyramid 2 plus Type II BVD; Boehringer Ingelheim Vetmedica Inc., St. Joseph, MO), treated with an ivermectin injection (Promectin; Vedco Inc., St. Joseph, MO) and oxfendazole oral drench (Synanthic; Boehringer Ingelheim Vetmedica Inc.) for the control of external and internal parasites, and implanted with 40 mg of estradiol and 200 mg of trenbolone acetate (Revalor-XS; Merck Animal Health, Summit, NJ) administered in the right ear. Steers were not reimplanted before slaughter.

Steers were ranked by BW, and individuals that were beyond ±2 SD from the mean BW and individuals showing health problems upon feedlot arrival were excluded from further consideration for the experiment. Remaining steers were assigned a random number from 1 to 1,000 using the RAND function of Microsoft Excel 2003 (Microsoft Inc., Seattle, WA). A sufficient number of steers with the lowest random numbers were removed from further consideration for the study to reach the 288 steers required for the experiment. Steers were ranked by BW and divided into 8 weight blocks, each consisting of 36 steers. Within each weight block, each successive group of 4 ranked steers were assigned to treatments 1 through 4 using the lowest to highest random number assigned to the grouped steers, respectively. This was repeated until all steers were assigned to treatment, resulting in 8 weight block pen replicates, each containing 9 steers, for each of the 4 treatments in the study. Following their initial processing, steers had ad libitum access to long-stem grass hay and water overnight. The following morning steers were returned through the squeeze chute and weighed, and visual tags identifying trial, treatment (1 to 4), replicate (1 to 8), and individual steer (1 to 9) within trial, treatment, and replicate were applied. Steers were then sorted into their respective treatment pens, and the experiment was initiated.

Treatments

Treatments, expressed on a 100% DM basis, included 90 mg/kg of Zn from Zn sulfate and 15 mg/kg of Cu from Cu sulfate (**CON**); 67.5 mg/kg of Zn from Zn sulfate plus 22.5 mg/kg of Zn from Zn amino acid complex (Availa Zn; Zinpro Corporation, Eden Prairie, MN) and 11.25 mg/kg of Cu from Cu sulfate plus 3.75 mg/kg of Cu from Cu amino acid complex (Availa Cu; Zinpro Corporation; **ORG**); 90 mg/kg of Zn from Zn hydroxychloride (IntelliBond Z; Micronutrients) and 15 mg/kg of Cu from basic Cu chloride (IntelliBond C; Micronutrients; **IB100**); and 54 mg/kg of Zn from Zn hydroxychloride and 9 mg/kg of Cu from basic Cu chloride (a 40% reduction of Zn and Cu supplementation, **IB60**). Supplemental TM concentrations used in the CON, ORG, and IB100 treatments were similar to the average supplemental TM concentrations