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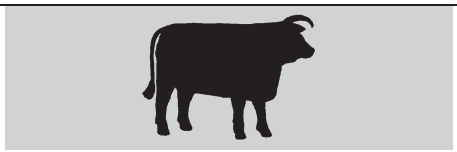

Comparison of methionine hydroxy analogue chelated versus sulfate forms of copper, zinc, and manganese on growth performance and pregnancy rates in yearling beef replacement heifers

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ABSTRACT

Our objectives were to compare growth performance and pregnancy rates of heifers supplemented with Cu, Zn, and Mn as either methionine hydroxy analog chelate (provided as MINTREX) or in the SO_4 form. The experiment used 3 ranches, each having 2 replicate pens per treatment. Performance data were analyzed by ANOVA as a randomized complete block design using pen as the experimental unit. Pregnancy diagnosis data were analyzed using Chi-squared analysis. Heifers (n = 2,480) were fed diets for 181 d (ranch A), 149 d (ranch B), and 151 d (ranch C) before breeding. Heifers were weighed (shrunk) at trial initiation, end of feeding, breeding, and at pregnancy diagnosis. Ranch A heifers were bred by AI followed by natural service (45-d breeding), ranch B heifers were bred by natural service (50-d breeding), and ranch C heifers were bred by AI once at estrus detection only. No ranch × treatment interactions were detected for any measurements, and no differences were detected between treatments for gain, ADG, and G:F. Ranch effects were significant for gain, ADG, G:F, and overall pregnancy rate but not for conception in the first 21 d of breeding. Pregnancies conceived during the first 21 d of breeding did not differ between treatments. Overall pregnancy rate was increased by 2% for heifers supplemented with methionine hydroxy analog chelate versus SO_4 form. Under the conditions of this experiment, methionine hydroxy analog chelate contributed to increased pregnancy rates compared with a readily available inorganic form of trace mineral.

Key words: chelated mineral, fertility, mineral nutrition, methionine hydroxy analog chelate

INTRODUCTION

Heifers must calve by 24 mo to achieve maximum lifetime productivity (Patterson et al., 1992). One suggested cause of pregnancy failure in heifers is mineral deficiency of Cu, Zn, and Mn (NRC, 1996; Paterson and Engle, 2005). Supplementation of both Cu and Zn together increased liver storage of each mineral more than when only one mineral was supplemented (Wellington et al., 1998), and supplementation of both Zn and Mn increased immunity compared

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with supplementation with Zn alone (Chirase et al., 1994). Sulfate, Mo, and Fe are antagonists to Cu absorption (Suttle, 1974, 1991). Bioavailability of organic minerals in beef cattle has been questioned (NRC, 1996), and research has produced inconsistent results (Suttle, 2010). Nockels et al. (1993) reported that copper lysine (CuLys) and zinc methionine (ZnMet) were more bioavailable than $CuSO_4$ and $ZnSO_4$. Kegley and Spears (1994) reported that CuLys and $CuSO_4$ had similar bioavailability. Other research has suggested that feeding elevated levels of methionine hydroxy analog chelate (**CTM**) as MINTREX (Novus International, St. Charles, MO) resulted in reduced mortality and morbidity in the feedlot when a high level of SO_4 was present in water (Vazquez-Anon et al., 2007). Kincaid et al. (1986) and Rabiansky et al. (1999) reported that CuLys was more available than $CuSO_4$ when S and Mo were present. Organic mineral supplementation has resulted in greater pregnancy rates in cows but with inconsistency across age groups, breeding methods, and time (Stanton et al., 2000; Ahola et al., 2004; Arthington and Swenson, 2004). Research has explored CuLys, ZnMet, and manganese methionine (MnMet), but limited research has compared supplementation with the CTM form of Cu, Zn, and Mn to the SO_4 form to satisfy requirements for rate and efficiency of gain or attainment of pregnancy in heifers. The objectives of this study were to compare rate of gain, efficiency of gain, and pregnancy rates in heifers supplemented with either a CTM form or a SO_4 form of Cu, Zn, and Mn. The null hypothesis tested was that no differences would exist in drylot performance or in pregnancy rates between forms of supplemental trace minerals.

MATERIALS AND METHODS

Three ranches were used for this experiment. One ranch was near Dillon, Montana, and held 498 Angus heifers. Dillon, Montana, (45.21N, 112.64W) lies at an elevation of 1,555 m, receives annual precipitation of 25 cm and annual snowfall of 92 cm, and has a mean minimum temperature of −1°C and mean maximum temperature of 13°C. A second ranch was near Terry, Montana, and held 240 fixed composite (50% Red Angus, 25% Charolais, and 25% Terrantaise) heifers. Terry, Montana, (46.79N, 105.31W) lies at an elevation of 686 m, receives annual precipitation of 30 cm and annual snowfall of 36 cm, and has a mean minimum temperature of −1°C and mean maximum temperature of 14°C. The third ranch was near Dayton, Wyoming, and held 1,742 heifers of primarily Angus genetics but were also influenced by Hereford and Charolais. Dayton, Wyoming, (44.87N, 107.26W) lies at an elevation of 1,195 m, receives annual precipitation of 44 cm and annual snowfall of 154 cm, and has a mean minimum temperature of −1°C and a mean maximum temperature of 15°C. All animals were cared for and handled using acceptable practices (FASS, 2010) that followed ranch protocol and BQA (Beef Quality Assurance) standards.

The experimental design was a randomized block (3 ranches) with each ranch having 2 pens per treatment. Treatments were supplemental trace minerals provided in either sulfate form of Cu, Zn, and Mn or a methionine hydroxy analog chelate form of Cu, Zn, and Mn. Treatments were provided as part of a total mixed ration while in the feedlot or in mineral feeders when cattle were on pasture (ranch C). Pen was the experimental unit for drylot performance measures with approximately 125 heifers per pen at ranch A, approximately 60 heifers per pen at ranch B, and 333 to 537 heifers per pen at ranch C. Diets were formulated using NRC (1996) recommendations for CP and NE_g so that heifers would achieve 65% of mature BW by the time of breeding. Diets, water, and supplements were analyzed at a commercial laboratory (Midwest Laboratories, Omaha, NE) for CP, ADF, NDF, and mineral content. Midwest Laboratories performed a 2-step DM determination of wet samples using forced-air drying ovens (Undersander et al., 1993), analyzed CP via animal feed combustion method (AOAC International, 2009), analyzed NDF and ADF via filter bag technique following Ankom (Macedon, NY) procedures using Ankom fiber analyzers, and analyzed minerals via inductively coupled argon plasma (AOAC International, 2009). Net energy and TDN values were calculated based on the results of the wet chemistry analysis. Heifers were fed silage-based diets that contained approximately 13.5% CP and 64% TDN (DM basis) and had minimal concentrations of SO_4, Mo, or Fe in either feed or water. Diets contained an average of 24 mg/kg Cu, 70 mg/kg Zn, and 64 mg/kg Mn (Table 1), consistent with common industry practice in the area. Diets were fed as a TMR once daily during the feedlot phase of the trial and then fed in free-choice mineral feeders when cattle were on pasture in the days between the end of the feeding period and breeding. Prior to breeding, heifers received the treatment supplements for 181, 149, and 151 d at ranch A, B, and C, respectively.

Initial shrunk BW (shrunk BW = BW, kg × 0.95) of heifers was collected on December 11, 2010, at ranch A (BW 257 kg ± 2.0), on December 15, 2010, at ranch B (BW 269 kg ± 2.8), and February 8 to 11 and 14, 2011, at ranch C (BW 295 kg ± 1.5). Body weight (shrunk) was recorded upon completion of the drylot phase of the experiment after 181 d at ranch A (BW 341 kg ± 2.6), after 149 d at ranch B (BW 390 kg ± 3.9), and 77 to 81 d at ranch C (BW 348 kg ± 1.6). Ranch A heifers were bred via AI by a trained technician June 3 to 5, 2011, with bulls introduced on June 15, 2011, for 45 d. Ranch B heifers were bred via natural service for 50 d starting on May 20, 2011, with a bull-to-heifer ratio of 1:20. Ranch C heifers were placed on pasture immediately after drylot phase conclusion but remained segregated by treatment and continued to receive the assigned treatment until breeding commenced, at which time they were