Performance of Growing Calves Supplemented with Bioplex® Copper Pre- or Post-Shipping to a Feedlot[1]

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Story in Brief

A growing, transporting, and feedlot receiving trial was conducted to determine the benefits of Bioplex® copper supplementation on the performance and health of cattle grazing winter annual pasture before and after shipping to a high-plains feedlot. Cattle were supplemented with 1.5 g of Bioplex copper (10% copper) 30 days before shipping while grazing wheat/rye/ryegrass pasture in South Arkansas. Then after arriving at the feedlot, one-half of the control (no copper) and and one-half the supplemented cattle received 1.5 g of Bioplex copper daily (2 x 2 factorial) for a 42-day receiving period. It seems that supplementation of copper deficient diets with Bioplex copper before shipping to a feedlot increased BW gain, and the BW advantage was maintained through the receiving period at the feedlot. No benefit relative to performance was recorded when Bioplex copper was fed at the feedlot. There were no signs of clinical disease at the feedlot; thus, no conclusions could be drawn considering the immune response or disease resistance of the cattle used in this trial.

Introduction

Copper is an essential trace mineral for cattle grazing on Coastal Plains soils in the southern United States. These soil include millions of acres, following the coastline from Virginia to Texas (Brady, 1974). With stocker cattle undergoing stress, copper requirements range from 10 to 15 ppm depending on animal factors (NRC, 1996) and content of interfering substances such as molybdenum or iron (Gengelbach et al., 1997). Deficiency of copper results in decreased growth rate, anemia, and changes in hair color (McDonald et al., 1988). Copper also affects immune function in cattle (Gengelbach and Spears, 1998).

Winter annual grasses grown on Coastal Plain soils are shallowly rooted because of frequent rainfalls. The topsoils associated with these soil types are noted for their low organic matter, base saturation, and poor cation-exchange capacity (CEC). Hydrogen ions are released from plant root hairs as they grow, these hydrogen ions force cations, like copper, to be released into soil water and then assimilated with the absorptive surfaces of the roots. However, when soils have a low CEC and base saturation, cations are not as easily released from the soil's exchange complex resulting in plant tissue low in the minerals in question (Brady, 1974). Thus, this study was designed to determine the effect of supplementation with Alltech Bioplex® copper, a source of copper in the proteinate form, on calves backgrounded on winter annual pasture, either before shipment to a feedlot or after arrival.

Materials and Methods

Eighty-four Angus- and Brangus-sired steers were used to determine the effects of feeding Bioplex copper (Alltech, Inc.) before shipping or during the feedlot receiving period. Steers were weaned from the Southwest Research and Extension Center cow herd in October of 1997. At weaning, the calves were processed, including treatment for internal and external parasites (Ivomec®, Merck & Co., Inc., Whitehouse Station, New Jersey), vaccinated with a 7-way Clostridial antigen (Vision 7®, Bayer Corp., Shawnee, Kansas) and IBR-PI_3-BVD-BRSV (Bovishield 4®, SmithKline Beecham Animal Health, Exton, Pennsylvania). Calves were then fed hay and 2 lb/animal/day of a high-protein supplement (30% CP). On February 19, 1998, the calves were weighed after a 16-hour shrink (cattle were held in a corral with no feed or water), implanted with Component-S® (Ivy Laboratories, Inc., Overland Park, Kansas) separated by treatment, and placed on 12 two-acre bermudagrass pastures interseeded with wheat, rye, and ryegrass. From February 19 to April 16, the cattle were fed 2 lb/animal/day of corn, containing a commercial mineral premix (Vigortone 46S, PM Ag Products, Inc., Cedar Rapid, Iowa), three times per week. On April 16, the cattle were weighed after a 16-hour shrink

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and copper supplementation began.

Composition of supplements is shown in Table 1. Corn supplements fed three times per week (pro-rated to equal 2 lb/animal/day on a as-fed basis) contained a commercial mineral mix (Vigortone 46S), supplied 200 mg of monensin (Rumensin®; Elanco Animal Health) and either had no additional copper or .165% Bioplex copper (Alltech, Inc.; 10% copper). Nineteen ppm supplemental copper (copper sulfate) was supplied by the mineral premix to the control calves for a total of 21 ppm copper, and 165 ppm additional was fed to Bioplex copper calves for a total of 186 ppm copper. On May 15, the calves were weighed after a 16-hour shrink, shipped to a local receiving yard (F & F Cattle Company, Hope), co-mingled with calves purchased from a local auction, and held on hay and water until May 17. The steers were then shipped from southwest Arkansas to the Clayton Livestock Research Center in Clayton, New Mexico (630 miles, 14-hour transit). Steers arrived at 0730 and were processed, including: branding, treatment for internal and external parasites (Ivomec Pour-On; Merial Animal Health, Iselin, New Jersey), vaccinated with a 7-way clostridial antigen (Fortress 7®; Ft Dodge Animal Health, Overland Park, Kansas), and IBR-PI3-BVD-BRSV (Bovishield 4), implanted with Ralgro® (Schering-Plough Animal Health Corp., Union, New Jersey), rectal temperature was determined, and steers were sorted into treatment pens. Treatment pen assignments were the same as pasture assignments with half of each pre-shipping treatment groups receiving Bioplex copper. All cattle were fed a 70% concentrate diet (Table 2) throughout the 42-day receiving period and observed daily for bovine respiratory disease. After the initial weight at the feedlot, weights were taken unshrunk on d 14, 28, and 42 of the feedlot-receiving period before the morning feeding.

Treatments were applied as a completely randomized design using a 2 x 2 factorial arrangement of treatments. Factors included receiving the Bioplex copper during the grazing period and receiving the Bioplex copper during the feedlot-receiving period. Pen was considered the experimental unit for all calculations. Least-square means and predicted differences were used to separate the effect of copper treatments. Cattle weights were heavier for Bioplex copper calves on April 16, so BW was used as a co-variate in all subsequent statistical analysis.

Results and Discussion

The effects of pre-shipping supplementation with Bioplex copper on pasture on BW variables, ADG, and feed DMI and efficiency did not interact ($P > .10$) with Bioplex copper supplementation at the feedlot. Beginning BW of the grazing calves on April 12 was 630 lb (Table 3). Calves receiving Bioplex copper on pasture tended to be 1.2% heavier (688 vs. 680, respectively; $P < .11$) by the end of the grazing period and had a 17.6% higher ADG (2.0 vs 1.7, respectively; $P < .11$) compared to control calves. At the end of the feedlot receiving period, calves fed Bioplex copper on pasture were 14 lb heavier than control calves (926 vs. 912, respectively, $P < .05$), but ADG was only numerically higher (5.7 vs 5.6, respectively, $P = .34$). Feedlot feed efficiency and DMI was not affected by Bioplex copper supplementation on pasture (Table 3).

Average daily gain of calves that were supplemented with Bioplex copper while grazing was not affected by Bioplex copper supplementation during the feedlot-receiving phase (Table 3), initial feedlot BW averaged 678 lb for Bioplex copper calves and 686 lb for control calves ($P = .22$). Body weight and ADG at the end of the feedlot receiving phase was not affected by feedlot Bioplex copper supplementation compared to control calves (914 vs 923 lb, $P = .15$; and 5.6 vs 5.7 lb, respectively, $P = .76$). Also, feed efficiency and DMI at feedlot did not differ as a result of feedlot Bioplex copper supplementation.

Table 4 shows the effects of copper supplementation when fed on pasture and(or) during the feedlot receiving period. Body weight at the end of the pasture phase and pasture ADG tended to be higher ($P < .11$) for steers on the Bioplex copper/control treatment than for steers on the control/Bioplex copper and control/control treatments. Body weights of steers on the Bioplex copper/control treatment at the end of the feedlot-receiving phase were higher ($P < .05$) than for steers on the control/Bioplex copper or control/control treatments. Feedlot ADG was not affected by the supplementation of Bioplex copper either before or after shipment to the feedlot. No differences were found in rectal temperature, or morbidity during the 42-day feedlot receiving period. No cattle were diagnosed with bovine respiratory disease complex during the receiving period.

It seems that supplementation of copper deficient diets with Bioplex copper before shipping to a feedlot increases BW gain, and the BW advantage is maintained through the receiving period at the feedlot. There were no observed signs of disease at the feedlot, so no conclusions can be drawn considering the immune response or disease resistance of the cattle used in this trial. Table 2 shows the composition of the feedlot diet. When the feedlot diet was analyzed with the NRC computer simulator (NRC, 1996), it indicated a daily copper requirement of 99 mg/day was oversupplied by 136 mg/day (total intake, 235 mg/day). This may explain the differences in effect found when the cattle were on pasture compared to at the feedlot. The premix supplied to the grazing cattle was considered a complete mineral premix and considered well fortified with copper; yet because of the characteristics of the soil, copper levels were still marginal in meeting the requirements of cattle winter annual pasture grown on the Coastal Plain.

Implications

It seems that supplementation of copper deficient diets with Bioplex copper before shipping to a feedlot increases BW gain, and the BW advantage is maintained through the receiving period at the feedlot when cattle are grazing winter annual grasses grown on Coastal Plain soils.

Literature Cited

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Table 1. Composition (as-fed basis) of supplement offered to grazing steers.

Item	% As-fed	
	Bioplex® copper	Control
Supplement composition		
Ground corn	89.375	89.541
Premix	10.334	10.334
Rumensin 80	.125	.125
Alltech Bioplex® copper	.165	.000
Chemical composition		
Crude protein, %	5.8	5.8
Total digestible nutrients, %	76.0	76.1
Monensin, mg/lb	100	100
Copper, ppm	186	21

Table 2. Composition (DM basis) of the basal 70% concentrate feedlot receiving diet.

Item	% of DM
Diet composition	9.9
Sudangrass hay	19.8
Alfalfa hay	9.5
Whole shelled corn	46.7
Steam-flaked corn	3.8
Soybean meal	4.9
Molasses	4.9
Fat (yellow grease)	1.9
Limestone	.7
Dicalcium phosphate	.5
Salt	.3
Urea	.8
Ammonium sulfate	.2
Premix	1.0
Chemical composition	
Dry matter	84.9
Ash	6.6
Crude protein	12.1
Acid detergent fiber	14.7
Copper, ppm	24

Table 3. Main effects of Bioplex® copper fed to grazing steers during final 29 days pre-shipping to a feedlot and during the feedlot receiving-phase on BW, performance, DMI, and feed efficiency[a].

Effects/item	Bioplex® Copper	Control	SE	*P*-value
Grazing effects				
Initial pasture BW, lb	630	630	—-	—-
Final pasture BW, lb	688	680	2.9	.11
Pasture ADG, lb	2.0	1.7	.1	.11
Initial feedlot BW[b], lb	686	678	4.2	.18
Final feedlot BW, lb	926	912	6.9	.04
Feedlot ADG, lb	5.7	5.6	.1	.34
Feed DMI, lb/d	21.6	21.3	.1	.77
Feed efficiency, feed/gain	3.8	3.8	.1	.22
Feedlot effects				
Initial pasture BW, lb	630	630	—-	—-
Final pasture BW, lb	682	686	2.9	.46
Pasture ADG, lb	1.8	1.9	.1	.46
Initial feedlot BW[b], lb	678	686	4.3	.22
Final feedlot BW, lb	914	923	6.9	.15
Feedlot ADG, lb	5.6	5.7	.1	.76
Feed DMI, lb/d	21.3	21.6	.1	.76
Feed efficiency, feed/gain	3.8	3.8	.1	.89

[a]Least-square means using initial pasture BW as a co-variable.
[b]Off truck weight.

Table 4. Effect of Alltech Bioplex® Copper fed to steers while grazing or during feedlot receiving phase[a].

	Treatment				
	BioCu[b]/BioCu	BioCu/CON	CON/BioCu	CON/CON	SE
Initial pasture BW, lb	630	630	630	630	—-
Final pasture BW, lb	684[de]	692[d]	681[e]	679[e]	4.2
Pasture ADG, lb	1.9[de]	2.1[d]	1.8[e]	1.7[e]	.1
Initial feedlot BW[c], lb	683	690	674	682	4.3
Final feedlot BW, lb	921[fg]	930[f]	907[g]	917[g]	6.9
Feedlot ADG, lb	5.7	5.7	5.5	5.6	.1
Body temperature, °F	102.6	102.5	102.5	102.4	.02

[a] Least-square means using initial pasture BW as a co-variable.
[b] BioCu = Bioplex® copper, CON = control.
[c] Off truck weight.
[d,e]Means in rows with differing superscripts differ ($P < .11$).
[f,g]Means in rows with differing superscripts differ ($P < .05$).