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PROGRESS REPORT

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Effects of Zinc Levels on Performance and Carcass Characteristics of Finishing Beef Steers[1]

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Trace minerals for feedlot diets are often formulated in excess of amounts suggested by the NRC (1996). In particular, zinc concentrations may be supplemented in excess of requirements. Galyean (1995) surveyed consultants that service feedlots in Nebraska, Kansas, Texas, Arizona, and California and reported that added zinc levels (as zinc sulfate) ranged from a low of 24 to 30 parts per million (**ppm**) to a high of 300 ppm. Consultants using higher levels of added zinc suggested that these levels may improve carcass characteristics. Our objective in the present study was to evaluate the effects of zinc levels on performance and carcass characteristics of finishing beef steers.

One hundred eight medium-framed beef steers (British x Continental) were selected from a group of 370 steers based on uniformity of body weight (**BW**). The steers had previously grazed improved pastures or were fed a 90% concentrate diet at restricted intake during a growing program at the Clayton Livestock Research Center. Steers were adapted to a 90% concentrate diet. Approximately 2 weeks before the start of the experiment, steers were weighed, implanted with Synovex-S and vaccinated with a Clostridial antigen. One week before the start of the experiment, the 108 steers used were treated for internal and external parasites with Ivomec pour on, sorted into six pens with 18 steers per pen and fed a 90% concentrate diet in amount sufficient to provide ad libitum consumption. Steer BW were obtained and steers were sorted into their respective pens on d 0. Steer BW were stratified such that each pen had equal average BW. Treatments were assigned randomly to 12 pens, resulting in four pens of 9 steers per treatment diet. Treatments included 20 ppm of added zinc (as zinc sulfate), 100 ppm of added zinc (as zinc sulfate), and 200 ppm of added zinc (as zinc sulfate). Treatment diets were 90% concentrate diets with steam-flaked corn as the grain source (Table 1). Flake weight for the steam-flaked corn was determined at 2 h intervals starting at 0830 and averaged 28 lb/bushel. Added zinc was included in the diet via an intermediate premix. Three trace mineral packages were formulated (Table 1) and included at 6% (dry matter [**DM**] basis) of the intermediate premix. The three intermediate premixes were included at approximately 2% of the DM (Table 1). Steers were weighed individually at 28-d intervals throughout the experiment. At each 28 d weigh period, feed bunks were swept, and any feed remaining in the bunk was weighed and its DM content determined. At the 56-d weigh period, steers were re-implanted with Synovex-S. Feed bunks were evaluated visually daily at 0730 to determine the amount of feed to offer each pen. The bunk management approach was designed to allow for 0 to .5 kg of unconsumed feed per pen. Computer records for each pen was used to help with bunk management, and records for the previous 7 d were available. Feed was mixed in the order of 20 ppm, 100 ppm, and 200 ppm treatments. Samples of dietary ingredients were taken every 2 weeks during the experiment to determine DM content.

Daily DM intake, daily gain, feed gain ratio, and carcass data were analyzed as a completely random design with pen as the experimental unit. Orthogonal contrasts were used to test linear and quadratic effects of zinc level.

Performance and carcass data for the overall experiment are shown in Table 2. No differences ($P > .10$) were noted between treatments for daily gain. However, cattle fed 20 ppm of added zinc had numerically greater daily gain than cattle fed 100 ppm and 200 ppm which resulted in approximately 10 lb heavier final BW. There was a linear ($P < .10$) decrease in daily DM intake with increasing zinc concentrations suggesting that higher concentrations of zinc sulfate may have a negative influence on palatability. No differences were noted ($P > .10$) among treatments in the feed:gain ratio.

Table 1. Composition (% of DM) of finishing diets

	Treatment		
Ingredient	20 ppm	100 ppm	200 ppm
Sudangrass hay	10.34	10.34	10.34
Whole corn	9.11	9.11	9.11
Steam-flaked corn	63.66	63.65	63.65
Soybean meal	3.52	3.52	3.52
Molasses	5.34	5.34	5.34
Fat (yellow grease)	3.15	3.15	3.15
Limestone	.76	.76	.76
Dicalcium phosphate	.50	.50	.50
Salt	.30	.30	.30
Urea	1.02	1.02	1.02
Ammonium sulfate	.25	.25	.25
Premix[a]	2.05	2.06	2.06
Trace mineral package			
Zinc sulfate	4.584	22.919	45.838
Copper sulfate	1.637	1.637	1.637
Iron sulfate	13.355	13.355	13.355
Manganous oxide	2.690	2.690	2.690
Magnesium oxide	14.880	14.880	14.880
Cobalt carbonate	.181	.181	.181
Calcium iodate	.134	.134	.134
Wheat midds	58.589	40.254	17.335
Mineral oil	3.950	3.950	3.950

[a]Premix contained (DM basis): wheat midds (92.0843%), Vitamin A - 30,000 IU/g (.375%), Vitamin E - 500 IU/g (.134%), Rumensin-80 (.8437%), Tylan-40 (.563%), and trace mineral package (6%).

Increasing added zinc levels up to 200 ppm did not have a great affect on carcass characteristics measured in the present study. No differences ($P > .10$) were noted in hot carcass weight, dressing percentage, ribeye area, percent kidney, pelvic, and heart fat, or marbling score (Table 2). There were, however, quadratic effects of added zinc on fat thickness ($P < .05$) and yield grade ($P < .01$; Table 2). However, the biological significance of these differences are doubtful.

Results from the present study suggest no benefit on carcass characteristics from increasing added zinc in the form of zinc sulfate above NRC (1996) recommendations. Moreover, there may be detrimental effects of increased zinc sulfate concentrations above levels suggested by NRC (1996) on DM intake. Results may differ, however, with other sources of added zinc.

Literature Cited

Galyean, M. L. 1995 Disparity between requirements for zinc and current fortification levels in beef cattle finishing diets. In: Proceedings of the Southwest Nurtition and Management Conference. pp 27-32. University of Arizona, Tucson.

NRC. 1996. Nutrient Requirements of Beef Cattle (7th Ed.). National Academy Press, Washington, DC.

[1]We thank Elanco Anim. Health for supplying Rumensin and Tylan, Fort Dodge Anim. Health for supplying Synovex-S, Roche Anim. Health for supplying vitamin E, and Merck AgVet for supplying Ivomec pour on

Table 2. Effects of zinc levels on performance and carcass characteristics of beef steers

Item	Treatment			SE[a]	Contrast[b]
	20 ppm	100 ppm	200 ppm		
Initial BW, lb	814.2	816.2	814.7	3.55	NS
Final BW, lb	1247.2	1237.7	1233.3	11.49	NS
Daily gain, lb	3.87	3.76	3.74	.10	NS
Daily DM intake, lb/steer	22.15	21.64	21.05	.368	L (.10)
Feed:gain	5.74	5.76	5.64	.117	NS
Hot carcass wt, lb	771.4	766.2	756.0	7.33	NS
Dressing percent	61.9	61.9	61.3	.35	NS
Ribeye area, sq. in.	12.76	12.21	12.71	.26	NS
KPH, %	2.18	2.25	2.13	.04	NS
Fat thicknes, in.	.39	.47	.39	.02	Q (.05)
Marbling score[c]	4.1	3.9	4.1	.15	NS
Yield grade	2.8	3.1	2.7	.09	Q (.01)

[a]Pooled standard error of treatment means, n = four pens per treatment.

[b]Observed significance level (in parentheses) for linear (L) and quadratic (Q) contrasts. NS = non-significant (P > .10).

[c]3.0 = Slight^0; 4.0 = Small^0: 5.0 = Modest^0.

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