

# INFLUENCE OF ZINC SOURCE ON FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF STEERS

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## Summary

Yearling steers were fed a control diet containing 60 ppm of supplemental Zn from ZnSO<sub>4</sub> (**basal**), basal + 30 ppm of Zn from ZnSO<sub>4</sub> (**30S**), basal + 30 ppm of Zn from Zinpro 100<sup>®</sup> (**30M**), and basal + 30 ppm of Zn from Availa Zn<sup>®</sup> (**30A**). Steers were reimplanted after 56 days and slaughtered after 152 days. Steer DMI, ADG, and ADG:DMI before reimplanting or over the entire feeding period were not influenced ( $P > 0.10$ ) by additional Zn. Yield grade characteristics, quality grade distribution, and net economic return were not altered ( $P > 0.10$ ) by supplemental Zn. Performance and carcass merit of finishing steers fed diets containing 90 ppm of total Zn was not improved by an additional 30 ppm of Zn from ZnSO<sub>4</sub>, Zinpro 100<sup>®</sup>, or Availa Zn<sup>®</sup>.

## Introduction

A review of 22 feedlot trials (Anonymous, 2001) of cattle fed basal diets containing from 24 to 122 ppm of Zn reported greater ADG (3.2%), greater gain efficiency (4.0%), and a tendency for more carcasses grading at least low Choice when cattle were supplemented with approximately 40 mg of additional Zn/kg of DM from a metal-amino acid complex, Zinpro 100<sup>®</sup>. However, few data are available quantifying growth performance by feedlot cattle supplemented with a more recently developed Zn-amino acid complex, Availa-Zn<sup>®</sup>.

A recent survey (Glavean and Gleghorn, 2001) indicates that practical formulations for Zn for feedlot cattle are commonly between 50 and 80 ppm, and that formulation targets for Zn and other trace minerals often reflect desired supplemental mineral addition rather than total dietary concentration. The objective of the present experiment was to evaluate the influence of Zn source (ZnSO<sub>4</sub>, Zinpro 100<sup>®</sup>, and Availa-Zn<sup>®</sup>) on growth performance and carcass characteristics.

## Experimental Procedures

One hundred eighty six crossbred steers were purchased from an order buyer and were processed on arrival. Processing included individual identification, weighing, vaccination with Titanium 5 and Vision 7, receiving Cydectin, excision of previous implant(s), and administering Ralgro. All animals were fed a basal 55% concentrate diet at a common

percentage of body weight for 8 days before initial weight was determined for the study. Six light steers were excluded from the study.

Treatments were a positive control diet containing 60 ppm of supplemental Zn from ZnSO<sub>4</sub> (**basal**), basal + 30 ppm of Zn from ZnSO<sub>4</sub> (**30S**), basal + 30 ppm of Zn from Zinpro 100<sup>®</sup> (**30M**), and basal + 30 ppm of Zn from Availa Zn<sup>®</sup> (**30A**). Zinc concentration in the positive control diet was selected to be representative of current industry formulations. Steers were reimplanted with Revalor-S after 56 days and fed for an average of 152 days.

Steers were adapted to 92% concentrate diets (Table 1) by feeding 70 and 81% concentrate diets for 6 and 7 days, respectively. Meal-form supplements were manufactured for each treatment using a stationary ribbon mixer that was cleaned between each batch using compressed air. Samples of each Zn source were assayed for Zn before premixes were prepared, and laboratory results were used for formulation. Diets were prepared once daily in a stationary paddle mixer and flushed with whole corn between each batch. Hot carcass weight was determined after slaughter at a commercial facility, and carcasses were evaluated after chilling for approximately 48 hours. Carcass-adjusted final body weight was determined by dividing hot carcass weight by the overall average dressing percentage.

Feedlot performance, yield grade, and marbling score data were analyzed using mixed model procedures (SAS Inst. Inc., Cary, NC). The model included the fixed effect of treatment, the random effect of block, and pen served as the experimental unit. Carcass quality grade and liver abscess incidence data from individual animals were analyzed as repeated measures using nonparametric procedures (GENMOD; SAS Inst. Inc., Cary, NC) for binomial distributions. The model included block and treatment; block x treatment was included as the subject effect and animal was included as the within subject effect to allow pen to serve as the experimental unit.

## Results and Discussion

Steer DMI, ADG, and ADG:DMI before reimplanting on d 56 were not influenced ( $P > 0.10$ ) by additional supplemental Zn from the three sources tested

(Table 2). Overall DMI, adjusted ADG, and adjusted ADG:DMI did not differ among treatments ( $P > 0.10$ ), suggesting that the basal diet contained adequate Zn for the growth potential of the cattle in the present study. Yield grade characteristics, quality grade distribution, liver abscess incidence, and net economic return were not altered ( $P > 0.10$ ; Table 3) by additional Zn.

Data from Zn-depleted lambs fed a semi-purified diet supplemented with 15 ppm of Zn suggest that a small proportion (approximately 35%) of dietary Zn is absorbed; non-depleted lambs fed an 80% forage diet absorbed approximately 18% of Zn consumed (Spears, 1989). Although Zn absorption has been similar between Zn methionine and inorganic sources, evidence exists that Zn provided by Zn methionine is retained in the body more effectively than inorganic Zn (Spears, 1989). In addition, Zn plays an important role in animal growth by promoting cellular delivery of IGF from IGFBP 3 and 5 (McCusker, 1998).

In the present study, supplemental Zn above the basal treatment of 90 ppm of total Zn (i.e., 60 ppm supplemental), regardless of source, did not improve growth performance or carcass merit. Data suggest that current dietary Zn formulations by practitioners likely supply adequate Zn for optimum feedlot performance by yearling steers fed whole corn. Consistent with these findings, Malcolm-Callis et al. (2000) reported that growth performance was similar among steers fed basal diets (containing approximately 50 ppm of supplemental Zn) supplemented with 30 ppm of Zn from either  $ZnSO_4$  or Availa Zn. However, carcasses of steers supplemented with Availa Zn had more external fat but less internal fat. However, implanted steers supplemented with 200 ppm of Zn from  $ZnSO_4$  in addition to Zn in the basal diet (80 ppm of Zn) gained more rapidly than steers receiving the basal diet only or supplemental Zn methionine (200 ppm), but

carcasses from steers fed Zn methionine had more internal fat (Huerta et al., 2002).

### Implications

Growth performance and carcass merit of finishing yearling steers fed diets based on whole corn and containing 90 ppm of total Zn were not improved by providing an additional 30 ppm of Zn from  $ZnSO_4$ , Zinpro 100<sup>®</sup>, or Availa Zn<sup>®</sup>.

### Literature Cited

- Anonymous. 2001. Summary of 22 beef feedlot trials shows significant Zinpro performance advantages. Technical Bulletin TB-B-9202-C. Zinpro Inc., Eden Prairie, MN.
- Galyean, M. L., and J. F. Gleghorn. 2001. Summary of the 2000 Texas Tech consulting nutritionist survey. Available at: [http://www.asft.ttu.edu/burnett\\_center/progress\\_reports/bc12.pdf](http://www.asft.ttu.edu/burnett_center/progress_reports/bc12.pdf). Accessed 29 July 2001.
- Huerta, M., R. L. Kincaid, J. D. Cronrath, J. Bushboom, A. B. Johnson, and C. K. Swenson. 2002. Interaction of dietary zinc and growth implants on weight gain, carcass traits and zinc in tissues of growing beef steers and heifers. *Anim. Sci. Feed. Tech.* 95:15-32.
- Malcolm-Callis, K. J., G. C. Duff, S. A. Gunter, E. B. Kegley, and D. A. Vermeire. 2000. Effects of supplemental zinc concentration and source on performance, carcass characteristics, and serum values in finishing beef steers. *J. Anim. Sci.* 78:2801-2808.
- McCusker, R. H. 1998. Controlling insulin-like growth factor activity and the modulation of insulin-like growth factor binding protein and receptor binding. *J. Dairy Sci.* 81:1790-1800.
- Spears, J. W. 1989. Zinc methionine for ruminants: Relative bioavailability of zinc in lambs and effects on growth and performance of growing heifers. *J. Anim. Sci.* 67:835-843.

**Table 1.** Ingredient and chemical composition of experimental diets (DM basis)

Item	Treatment <sup>a</sup>			
	Basal	30S	30M	30A
Ingredient composition, % of DM				
Corn, whole shelled	79.25	79.25	79.25	79.25
Cottonseed meal, solvent, 41%	2.25	2.25	2.25	2.25
Supplement <sup>b</sup>	3.0	3.0	3.0	3.0
Cane molasses	5.0	5.0	5.0	5.0
Choice white grease	2.5	2.5	2.5	2.5
Alfalfa hay	8.0	8.0	8.0	8.0
Chemical composition <sup>c</sup>				
CP, % of DM	13.2	13.2	12.8	13.1
EE, % of DM	5.94	5.91	5.75	6.29
ADF, % of DM	6.70	7.90	7.35	7.40
Ash, % of DM	5.38	5.57	5.43	5.90
K, % of DM	0.84	0.94	0.97	0.91
Ca, % of DM	0.65	0.72	0.70	0.71
P, % of DM	0.30	0.30	0.31	0.31
Mg, % of DM	0.28	0.27	0.32	0.27
S, % of DM	0.28	0.28	0.33	0.28
Na, % of DM	0.15	0.13	0.22	0.23
Fe, mg/kg	158	179	164	152
Zn, mg/kg	89	124	129	128
Mn, mg/kg	54	70	58	66
Cu, mg/kg	18	24	20	21

<sup>a</sup>Basal = 60 mg of Zn from ZnSO<sub>4</sub>/kg of diet, 30S = basal + 30 mg of Zn from ZnSO<sub>4</sub>/kg of diet, 30M = basal + 30 mg of Zn from Zinpro 100/kg of diet, 30A = basal + 30 mg of Zn from Availa Zn/kg of diet.

<sup>b</sup>Provided the following nutrients beyond basal ingredients: 0.2 mg of Co, 10 mg of Cu, 10 mg of Fe, 0.5 mg of I, 40 mg of Mn, 0.05 mg of Se, 2,300 IU of vitamin A, 15 IU of vitamin E, 30.9 g of monensin, and 11 mg of tylosin/kg of diet DM; and 0.4% Ca, 0.06% K, 0.09% Mg, 0.06% S, 2.32% CP from urea, 0.25% NaCl, and 0.0075% mineral oil in the final diet.

<sup>c</sup>Determined analytically from weekly samples composited over the course of the study.

**Table 2.** Effect of zinc source on feedlot steer performance

Item	Treatment <sup>a</sup>				SE
	basal	30S	30M	30A	
Pens	5	5	5	5	-
Animals	45	45	44	45	-
Initial unshrunk weight, lb	716	716	716	716	27
Days fed	152	152	152	152	-
Carcass-adjusted final BW, lb	1277	1267	1273	1292	19.9
Day 1 to 56					
DMI, lb/d	19.6	19.7	19.8	20.0	0.25
ADG, lb/d	4.18	4.11	4.10	4.24	0.13
DMI:ADG	4.71	4.81	4.86	4.74	0.15
Day 1 to 152					
DMI, lb/d	21.9	21.6	21.4	21.9	0.5
Adjusted ADG, lb/d	3.69	3.63	3.67	3.80	.10
Adjusted DMI:ADG	5.94	5.96	5.84	5.79	.12

<sup>a</sup>Basal = 60 mg of Zn from ZnSO<sub>4</sub>/kg of diet, 30S = basal + 30 mg of Zn from ZnSO<sub>4</sub>/kg of diet, 30M = basal + 30 mg of Zn from Zinpro 100/kg of diet, 30A = basal + 30 mg of Zn from Availa Zn/kg of diet.

**Table 3.** Effect of zinc source on carcass characteristics of feedlot steers

Item	Treatment <sup>a</sup>				SE
	basal	30S	30M	30A	
Pens	5	5	5	5	-
Animals	45	45	44	45	-
Hot carcass weight, lb	786	780	784	795	12
12 <sup>th</sup> rib fat, in	0.44	0.44	0.40	0.47	0.032
Longissimus area, in <sup>2</sup>	12.9	13.0	12.9	13.1	0.4
Internal fat, %	2.0	2.0	2.1	2.0	0.06
Yield grade	2.86	2.80	2.77	2.91	0.16
Marbling score <sup>b</sup>	413	399	414	397	15.3
Quality grade					
Prime, %	4.4	0.0	2.3	0.0	-
≥ Choice <sup>0</sup> , %	13.3	8.9	11.4	0.0	-
Choice, %	46.7	46.7	54.5	53.3	-
Prime + Choice, %	51.1	46.7	56.8	53.3	-
Select, %	48.9	53.3	43.2	46.7	-
Standard, %	0	0	0	0	-
A-, A, or A+ liver abscess, %	2.2	4.4	2.3	6.7	-
Net economic return, \$ <sup>c, d</sup>	22.94	24.88	37.28	35.36	13.43

<sup>a</sup>Basal = 60 mg of Zn from ZnSO<sub>4</sub>/kg of diet, 30S = basal + 30 mg of Zn from ZnSO<sub>4</sub>/kg of diet, 30M = basal + 30 mg of Zn from Zinpro 100/kg of diet, 30A = basal + 30 mg of Zn from Availa Zn/kg of diet.

<sup>b</sup>Slight = 300 to 399, Small = 400 to 499, etc.

<sup>c</sup>Carcass revenue was calculated from a base grid price (\$107.50/45.4 kg) and actual carcass data using the annual average premiums and discounts from 1999 through 2002 obtained from the USDA Agricultural Marketing Service annual 'National Carlot Meat Trade Review' (available at <http://www.ams.usda.gov/lsmnpu/mnsearch.htm>).

Values do not include data from carcasses that were dark, light (< 249 kg), heavy (> 454 kg), or bloodshot, and carcass maturity was excluded in assigning quality grade.

<sup>d</sup>Basal diet cost assumed as \$120/ton of DM.