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EFFECT OF CHELATED TRACE MINERALS ON NURSERY PIG GROWTH PERFORMANCE[1]

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Summary

A total of 442 weanling pigs (inital age and wt of 22 d and 14.4 lb, respectively) was used on a commercial farm in northeast Kansas to evaluate growth performance with diets containing a chelated trace mineral premix or an inorganic trace mineral premix. Minerals evaluated in the premixes provided 16.5 ppm Cu, 165 ppm Fe, 40 ppm Mn, and 165 ppm Zn. For the inorganic trace mineral treatment, the mineral sources were copper sulfate, ferrous sulfate, manganous oxide, and zinc oxide. The chelated trace mineral premix had the following fractions of these minerals provided as amino acid chelates: 109.7% of Cu, 75.8% of Fe, 78.1% of Mn, and 47.0% of Zn with the balance coming from the previous inorganic sources to make diets similar in added trace mineral content. All diets also contained copper sulfate, providing an additional 188 ppm Cu. Pigs fed the chelated trace mineral had increased average daily gain (ADG), average daily feed intake (ADFI), and lower feed efficiency (F/G) from d 0 to 7 postweaning. No differences occurred between treatments in ADG or ADFI from d 7 to 14. For this same period, pigs fed the inorganic trace minerals had lower F/G than pigs fed the chelated trace minerals. For the entire Phase I period (d 0 to 14), pigs fed the chelated trace minerals had greater ADFI with no difference in ADG or F/G. No differences occurred in ADG or F/G for the Phase II period (d 14 to 28). However, pigs fed the inorganic trace minerals had increased ADFI ($P > .02$). For the entire nursery period (d 0 to 28), no differences occurred in ADG, ADFI, and F/G between pigs fed either chelated or inorganic trace minerals. Based on the improved performance observed, chelated trace minerals may have been more available, which benefitted the weanling pig during the stressful first week postweaning. However, for the entire nursery period, based on this single study, no significant differences occurred in growth performance for pigs fed either trace mineral source.

(Key Words: Starter, Minerals, Performance.)

Introduction

Chelated minerals previously have been demonstrated to have greater availability compared to traditional inorganic mineral sources for livestock. Additionally, research has linked chelated minerals with enhanced immune function, improved reproduction, changes in the lean to fat ratio. Therefore, this trial was designed to directly compare a standard industry level of inorganic trace minerals (Fe, Cu, Mn, and Zn) with a chelated trace mineral premix in diets for early-weaned starter pigs.

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[2]Albion Laboratories, Inc., Atlantic, IA.

Procedures

A total of 442 weanling pigs averaging 22 d of age with an average initial weight of 14.4 lb was used on a commercial farm in northeast Kansas to evaluate the use of a chelated trace mineral premix or a traditional inorganic trace mineral premix. Crossbred pigs (Pig Improvement Company) were blocked by weight and sex and allotted to one of two dietary treatments. Pigs were housed with 14 or 15 pigs per pen. Each pen was 4 × 8 ft, had woven wire flooring, and contained two nipple waters and a six-hole self-feeder.

Pigs were fed a high nutrient density Phase I diet from d 0 to 14 (Table 1), which was formulated to 1.5% lysine, .42% methionine, .9% Ca, and .8% P. The Phase I diet also contained 7.5% spray-dried porcine plasma, 1.75% spray-dried blood meal, and 25% dried whey. On day 14, all pigs were switched to the Phase II diets (Table 1). The Phase II diets were corn-soybean meal-based and contained 10% dried whey and 2.5% spray-dried blood meal. Phase II diets were formulated to 1.25% lysine, .35% methionine, .9% Ca, and .8% P. All diets were pelleted through a 5/32 inch die.

Minerals evaluated in the premixes provided 16.5 ppm Cu, 165 ppm Fe, 40 ppm Mn, and 165 ppm Zn from copper sulfate, ferrous sulfate, manganous oxide, and zinc oxide for the inorganic trace mineral treatment. The following fractions of these inorganic trace minerals were replaced with an amino acid chelate: 109.7% of Cu, 75.8% of Fe, 78.1% of Mn, and 47.0% of Zn. All diets contained additional copper sulfate providing another 188 ppm Cu.

Pigs and feeders were weighed weekly to determine pen ADG, ADFI, and F/G.

Results and Discussion

Pigs fed chelated trace minerals had increased ADG ($P<.03$), ADFI ($P<.07$), and lower F/G ($P<.11$) for d 0 to 7 (Table 2). The proposed increased availability of the chelated trace minerals may have improved week 1 pig growth performance.

For week 2 of the experiment, no difference occurred in ADG or ADFI ($P>.18$) between pigs fed chelated and inorganic trace mineral premixes. However, for d 7 to 14, pigs fed inorganic trace minerals had lower F/G ($P<.02$) than pigs fed the chelated trace minerals. This response may have been due to the pigs reaching a critical level of gut maturation and improved absorption of inorganic trace minerals, stimulating a partial compensatory efficency response.

For the entire Phase I period (d 0 to 14), no differences occurred in ADG ($P>.39$) or F/G ($P>.97$) between the treatments. However, pigs fed the chelated trace minerals had greater ADFI ($P<.07$).

For the Phase II period (d 14 to 28), no differences occurred in ADG ($P<.22$) or F/G ($P>.87$) between the trace mineral treatments. In contrast to Phase I, pigs fed the inorganic trace minerals had greater ADFI ($P<.02$) for the Phase II period. The possible reasons for this have been discussed above.

Average daily gain, ADFI, and F/G for the entire experiment (d 0 to 28) were not different ($P>.18$) between the pigs fed the diets containing chelated or inorganic trace minerals. Final average weights were similar ($P>.60$) for pigs receiving the diets with chelated and inorganic trace minerals (29.8 vs 30.0 lb, respectively).

In conclusion, chelated trace minerals may have provided increased trace mineral absorption and tissue levels that benefitted the weanling pig during the first week post-weaning. However, based on this particular experiment, for the entire nursery trial, feeding the chelated trace mineral premix to nursery pigs provided no sustained benefit.

Table 1. Experimental Diet Composition

	Phase I diets[a]		Phase II diets[b]	
Item, %	Inorganic	Chelate	Inorganic	Chelate
Corn	40.90	40.90	57.73	57.73
SBM, (48% CP)	15.58	15.58	22.21	22.21
Dried whey	25.00	25.00	10.00	10.00
Soybean oil	5.00	5.00	3.00	3.00
Spray-dried porcine plasma	7.50	7.50	—	—
Spray-dried blood meal	1.75	1.75	2.50	2.50
Monocalcium phosphate	1.81	1.81	1.96	1.96
Limestone	.64	.64	.83	.83
Vitamin premix	.25	.25	.25	.25
Inorganic trace mineral premix[c]	.15	—	.15	—
Chelated trace mineral premix[d]	—	.25	—	.25
Lysine	.10	.10	.15	.15
Methionine	.15	.15	.05	.05
Copper sulfate	.075	.075	.075	.075
Soy isolate	.072	—	.072	—
Cornstarch	.028	—	.028	—
Medication[e]	1.00	1.00	1.00	1.00
Totals	100.0	100.0	100.0	100.0

[a]Phase I diets were formulated to contain; 1.5% lysine, .42% methionine, .9% Ca, .8% P.
[b]Phase II diets were formulated to contain; 1.25% lysine, .35% methionine, .9% Ca, .8% P.
[c]Inorganic trace mineral premix: each lb provided 12 g Mn; 50 g Fe; 50 g Zn; 5 g Cu; 90 mg I; 90 mg Se from manganous oxide, ferrous sulfate, zinc oxide, copper sulfate, calcium iodate, and sodium selenite.
[d]Chelated trace mineral premix: each lb provided 7.2 g Mn; 30 g Fe; 30 g Zn; 3 g Cu; 54 mg I; 54 mg Se from a blend of manganese amino acid chelate, iron amino acid chelate, zinc amino acid chelate, copper amino acid chelate, manganous oxide, ferrous sulfate, zinc oxide, copper sulfate, calcium iodate, and sodium selenite.
[e]Medication provided 150 g/ton apramycin during Phase I and 50 g/ton carbadox during Phase II.

Table 2. Effect of Trace Mineral Source on Growth Performance of Weanling Pigs[a]

Item	Chelated mineral	Inorganic mineral	CV	P value
d 0 to 7				
ADG, lb	.337	.272	24.56	.031
ADFI, lb	.399	.373	9.25	.071
F/G	1.24	1.43	18.22	.110
d 7 to 14				
ADG, lb	.563	.592	10.11	.196
ADFI, lb	.665	.644	6.29	.187
F/G	1.19	1.10	8.47	.019
d 0 to 14				
ADG, lb	.450	.432	12.99	.394
ADFI, lb	.532	.509	6.12	.066
F/G	1.19	1.19	9.58	.972
d 14 to 28				
ADG, lb	.648	.682	10.84	.224
ADFI, lb	1.042	1.106	6.20	.020
F/G	1.62	1.62	6.98	.873
d 0 to 28				
ADG, lb	.549	.557	7.55	.629
ADFI, lb	.787	.807	5.10	.189
F/G	1.44	1.45	4.15	.453

[a]A total of 442 pigs were used with 14 or 15 pigs per pen and 15 pens per treatment. Average intitial weight of pigs was 14.4 lb. Average final weights by treatment were 29.8 lb for pigs fed chelated trace minerals and 30.0 lb for pigs fed inorganic trace minerals.