EFFECTS OF SOURCE AND LEVEL OF ADDED CHROMIUM ON GROWTH PERFORMANCE OF STARTER PIGS [1,2]

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Summary

A 35-d growth trial was conducted with conventionally weaned nursery pigs to evaluate the efficacy of supplemental chromium (Cr) as either chromium nicotinate (CrNic) or chromium picolinate (CrPic). Neither source nor level of supplemental Cr had any effect on weanling pig growth performance or immune status. Equal levels of CrNic and CrPic produced similar results, except that pigs fed CrPic had higher serum Cr concentrations than pigs fed CrNic. These data suggest no beneficial responses to supplemental CrNic or CrPic in nursery pig diets.

(Key Words: Starter Pigs, Chromium, Chromium Nicotinate, Growth Performance.)

Introduction

Chromium (Cr) is a trace mineral that is actively involved in the metabolism of carbohydrates, lipids, proteins, and nucleic acids. In nursery pigs, Cr supplementation has been reported to increase daily gain and improve feed efficiency. Chromium also is thought to improve immune function in stressed animals (e.g., after weaning). However, these positive results of Cr supplementation have been inconsistent. Several forms of Cr have been evaluated, including yeast cultures and chromium picolinate (CrPic), which has received the most attention in the scientific literature. Recently, a newer form, chromium nicotinate (CrNic), has been developed and is thought to be more biologically available than CrPic. For these reasons, a feeding trial was designed to evaluate the efficacy of CrNic supplementation and to compare the effects of CrNic and CrPic on growth performance.

Procedures

A total of 180 weanling pigs (initially 12.5 lb and 17 to 21 d of age) was used in a 35 d growth trial. Pigs were blocked on the basis of initial weight and randomly allotted to one of six dietary treatments with six pigs per pen and five replications (pens) per treatment. The numbers of barrows and gilts were equalized across pens within each block.

All diets were fed in meal form. A high nutrient dense diet was fed for 14 d postweaning and a less complex diet was fed for the remaining 21 d (Table 1). Chromium was added to the basal diet at 50, 100, 200, or 400 ppb as CrNic or 200 ppb CrPic. The Cr additions were prepared first as a 20 lb premix and then blended with the other dietary ingredients to ensure proper mixing.

Pigs were housed in an environmentally controlled nursery in 5 × 5 ft pens with one self-feeder and nipple waterer to allow ad libitum access to feed and water.

[1]Appreciation is extended to Lonza Inc., Fair Lawn, NJ for financial support and for providing the chromium nicotinate used in this experiment.

[2]The authors would like to thank Colin Bradley of the London Health Sciences Centre, London, Ontario, Canada for conducting the serum chromium assays.

[3]Lonza Inc., Fair Lawn, NJ.

Table 1. Compositions of Basal Diets (As-Fed Basis)[a]

Ingredient, %	Phase I[b]	Phase II[c]
Corn	41.83	50.66
Dried whey	20.00	10.00
Soybean meal, (46.5% CP)	19.63	26.95
Spray-dried animal plasma	5.00	----
Soybean oil	5.00	5.00
Select menhaden fish meal	2.50	----
Spray-dried blood meal	1.75	2.50
Monocalcium phosphate	1.21	1.66
Antibiotic[d]	1.00	1.00
Limestone	.80	.98
Vitamin/trace mineral premix	.40	.40
Zinc oxide	.38	.25
Salt	.20	.35
L-Lysine	.15	.15
DL-Methionine	.15	.10
Total	100.00	100.00

[a]Graded levels of Cr were added to the basal diet to provide concentrations of 50, 100, 200, or 400 ppb.
[b]The phase I diets were formulated to 1.60% lysine, .44% methionine, .90% Ca, and .80% P, and were fed for 14 d postweaning.
[c]The phase II diets were formulated to contain 1.35% lysine, .38% methionine, .85% Ca, and .75% P and were fed from d 14 to 35 postweaning.
[d]Provided 50 g/ton carbadox.

Pigs and feeders were weighed weekly to determine ADG, ADFI, and feed efficiency (F/G). On d 28 postweaning, two randomly selected pigs per pen were bled, and the serum was analyzed to determine Cr and haptoglobin concentrations. Haptoglobin is an acute-phase protein that binds with free hemoglobin and is produced following an immune challenge. The concentration of haptoglobin in our assays is expressed as the amount of methemoglobin bound per milliliter (mgHgb/mL). Thus, lower haptoglobin levels should be indicative of less immune challenge.

Data were analyzed as a randomized complete block. The pen was the experimental unit for all calculations. Because of the unequal spacing of CrNic concentrations, a regression model within the REG procedure of SAS was used to determine the linear and quadratic effects of added CrNic. The GLM procedure of SAS was used for the single degree of freedom contrasts between pigs fed 200 ppb CrNic and 200 ppb CrPic and between pigs fed the control diet and 200 ppb CrPic.

Results and Discussion

Increasing levels of Cr as CrNic had no effect (P>.20) on ADG, ADFI, or F/G from d 0 to 14, 14 to 35, or 0 to 35 postweaning (Table 2). Similarly, no differences (P>.10) were observed in any of the growth performance parameters for any of the time periods between pigs fed 200 ppb of CrNic and CrPic. Immune status, as measured by haptoglobin concentration, was not affected (P>.50) by source or level of supplemental Cr (Table 3). Serum Cr levels were not affected (P>.80) by increasing levels of CrNic; however, pigs fed 200 ppb *CrPic* tended to have higher (P=.09) serum Cr levels than pigs fed 200 ppb CrNic.

Previous research reports from other universities have observed sporadic effects of supplemental Cr on either growth performance or immune status.

The different serum Cr levels withe the two sources of Cr may indicate the metabolic bioavailabilities of the two sources. Chromium nicotinate is thought to be more metabolically available to the pig than CrPic. Chromium is cleared rapidly from the blood into the tissues. Any Cr not used or stored by the tissues is excreted back to the blood for excretion from the body via the urine. Thus, higher serum Cr levels (CrPic) may indicate a lower metabolic availability as compared to CrNic. Another possibility is that CrNic may be less digestible than CrPic, leading to lower serum Cr levels. Tissue biopsies would be needed to confirm or disprove this hypothesis.

In conclusion, these data suggest no beneficial responses in nursery pig performance to either supplemental CrNic or CrPic.

Table 2. Growth Performance and Serum Chemistry of Pigs Fed Increasing Chromium[a]

	CrNic, ppb					CrPic, ppb		Probability		
Item	0	50	100	200	400	200	CV	Lin.[b]	Quad.[b]	Cont.[c,d]
d 0 to 14										
ADG, lb	.60	.56	.63	.62	.61	.62	16.77	.64	.70	.92
ADFI, lb	.81	.82	.85	.81	.81	.83	11.99	.86	.78	.93
F/G	1.36	1.47	1.34	1.32	1.33	1.33	10.28	.53	.70	.90
d 14 to 35										
ADG, lb	1.37	1.42	1.36	1.33	1.42	1.43	6.98	.34	.26	.14
ADFI, lb	2.04	2.02	2.01	1.99	2.05	2.06	7.55	.58	.54	.55
F/G	1.49	1.42	1.47	1.49	1.45	1.44	4.83	.71	.63	.35
d 0 to 35										
ADG, lb	1.06	1.08	1.07	1.05	1.09	1.11	7.58	.64	.55	.34
ADFI, lb	1.55	1.54	1.54	1.52	1.55	1.57	7.78	.71	.69	.66
F/G	1.46	1.43	1.44	1.45	1.42	1.42	3.96	.98	.88	.45
Serum paramters:[e]										
Hapto.[f]	22.76	17.98	22.86	18.82	23.68	20.04	45.88	.62	.54	.37
Cr[g]	62.16	56.70	73.64	56.12	60.24	68.42	21.07	.98	.88	.09

[a]Growth performance values are means for 180 pigs, initially weighing 12.5 lb (six pigs/pen and five replications/treatment).
[b]Contrasts refer to the linear and quadratic comparisons of increasing CrNic.
[c]Contrast refers to the comparison of 200 ppb CrNic and 200 ppb CrPic.
[d]The contrast between pig. fed the control diet and 200 ppb CrPic was nonsignificant (P>.30) for all comparisons.
[e]Values are pooled means for two pigs/pen and five replications/treatment.
[f]Haptoglobin concentrations are expressed as mgHgb/mL.
[g]Chromium concentrations are expressed as nmol/L.