INFLUENCE OF CHROMIUM SOURCE ON PLASMA NON-ESTERIFIED FATTY ACID CONCENTRATIONS IN GROWING-FINISHING PIGS[1]

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Summary

A total of 150 pigs (PIC, initial body weight 178.9 ± 14.7 lb) were used in a 35-d study to evaluate the effect of chromium propionate and chromium tripicolinate on plasma non-esterifed fatty acids (NEFA) in growing-finishing pigs. Our objective was to determine if differences between sources and rate of source being fed can be detected in fasted growing-finishing pigs by measuring plasma NEFA. Pigs were randomly allotted to one of the five dietary treatments arranged as a 2 × 2 factorial plus negative control (no chromium). Main effects were source of chromium (chromium propionate and chromium tripicolinate) and chromium concentration (100 or 200 ppb). On d 34, feeders were removed from pens 16 h before collecting blood on d 35 for analysis of plasma NEFA. There were no interactions (P>0.10) observed for chromium source, rate, or gender. There was no effect observed (P>0.10) of chromium source or rate on ADG, ADFI, or F/G. There was no chromium-source effect (P>0.73) observed for NEFA, but there was a tendency (quadratic, P>0.08) for plasma NEFA to decrease in pigs fed 100 ppb chromium tripicolinate and to increase in the pigs fed 200 ppb tripicolinate.

(Key Words: Chromium Propionate, Chromium Tripicolinate, NEFA, Pigs.)

Introduction

Chromium picolinate is currently used at 200 ppb in many sow diets to improve insulin sensitivity, glucose metabolism, and reproductive performance. Chromium propionate has recently been introduced to the market, and the U.S. Documentation for the approval of these sources was based on their ability to reduce non-esterified fatty acid (NEFA) concentrations in a fasted pig. It is generally accepted that the source of chromium affects bioavailability, with organic chromium potentially having a greater bioavailability than inorganic sources. Measuring NEFA concentration in fasted growing-finishing pigs may be the lowest-cost and quickest method to determine the relative response to various chromium sources being compared with each other to determine source bioavailability. In the experiment done by Kemin Industries for chromium propionate approval, NEFA concentration decreased quadratically, with the optimal inclusion rate of 200 ppb. Additional Cr sources have also been approved on the basis of demonstrating changes in NEFA concentration. Therefore, our objective was to determine if differences

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between Cr sources and rate fed can be detected in fasted growing-finishing pigs by measuring NEFA.

Procedures

A total of 150 pigs (PIC, Franklyn, KY), with initial body weight 178.9 ± 14.7 lb, were used in a 35-d study to evaluate the effect of chromium propionate and chromium tripicolinate on plasma NEFA in growing-finishing pigs. Pigs were blocked by weight and gender and were randomly allotted to one of five dietary treatments. There were 40 pens of gilts and 35 pens of barrows, with two pigs per pen and 15 pens per treatment. Pigs had ad libitum access to feed and water. Pigs were housed on totally slatted concrete floors in 4 × 4 ft pens. The dietary treatments were arranged as a 2 × 2 factorial plus a negative control (no chromium); main effects were chromium source (chromium propionate or chromium tripicolinate) and concentration (100 or 200 ppb, Table 1). Pigs were weighed and feed intake was determined on d 0, 17 and 35. These data were used to calculate ADG, ADFI, and feed efficiency (F/G). On d 34, feeders were removed from pens 16 h before collection of plasma on d 35. After plasma samples were obtained from all pigs, pigs were weighed to determine final weight. Plasma was analyzed for NEFA concentration by using a NEFA C test kit (Wako Diagnostics, VA). Statistical analysis was performed by using the MIXED procedure in SAS v. 8.1.

Results and Discussion

There were no interactions (P>0.10) observed for chromium source or rate or gender. There was no effect (P>0.10) of chromium source or rate on ADG, ADFI, or F/G (Table 2). There also was no chromium-source effect (P>0.73) observed for NEFA. There was a tendency (quadratic, P>0.08) for NEFA to decrease, then increase, in pigs fed chromium tripicolinate.

Previous research conducted at Louisiana State University used NEFA to evaluate chromium sources. Similar to our study, that study found no differences in growth performance, but plasma NEFA concentrations were decreased (P>0.02) in pigs fed the diets containing chromium tripicolinate; no effect (P>0.12) on plasma NEFA was observed in pigs fed chromium propionate, compared with that of control pigs. But follow-up study also demonstrated a linear (P > 0.09) decrease in plasma NEFA concentration for early finishing pigs fed increasing rates of supplemental chromium propionate.

Table 1. Ingredient and Chemical Composition of Diets (As-fed Basis)[a]

Ingredient	Percentage
Corn	80.10
Soybean meal (46.5% CP)	17.35
Monocalcium phosphate (21% P)	0.80
Limestone	0.90
Salt	0.35
Vitamin premix	0.15
Trace mineral premix	0.15
Sand[b]	0.05
L-Lysine HCl	0.15
Total	100.00

[a]Dietary treatments were formulated to contain 0.85% lysine, 0.57% Ca, and 0.51% P.
[b]Sand was replaced with chromium propionate or chromium tripicolinate at .5 or 1 lb/ton to provide 100 or 200 ppb for each chromium source.

Plasma NEFA concentrations are expected to decrease with the addition of chromium to the diets, but this has not been demonstrated in every experiment. In addition, researchers from Louisiana State University also reported no change in plasma NEFA with chromium tripicolinate, chromium chloride, or chromium nicotinate.

The decrease in plasma NEFA concentration indicated in previous research is an indication that chromium may have an influence on lipid metabolism in swine and, therefore, may be the most cost-effective method of measuring the effects of supplemental chromium. In our study, however, the tendency toward a quadratic response in plasma NEFA concentration indicated that NEFA concentrations were not consistently reduced by added chromium from either source. Therefore, further research investigating the effects of chromium use in finishing pigs needs to be conducted.

Table 2. Effects of Chromium Source on Growth Performance and Non-esterified Fatty Acid (NEFA) Plasma Concentration[a]

							Probabilities, P<					
		Chromium Tripicolinate		Chromium Propionate					Chromium Tripicolinate		Chromium Propionate	
Item	Control	100 ppb	200 ppb	100 ppb	200 ppb	SE	Cr	Source	Linear	Quadratic	Linear	Quadratic
Day 0 to 36												
Initial wt, lb	179.22	178.99	179.50	178.96	179.09	3.80	0.49	0.37	0.40	0.19	0.71	0.51
ADG, lb	1.89	1.84	1.82	1.89	1.86	0.06	0.85	0.41	0.36	0.78	0.67	0.81
ADFI, lb	6.27	6.00	6.15	6.20	6.23	0.18	0.69	0.34	0.55	0.22	0.86	0.78
F/G	3.33	3.27	3.38	3.32	3.36	0.08	0.80	0.90	0.60	0.28	0.82	0.75
Final Wt, lb	245.22	243.26	243.26	245.01	244.10	4.65	0.89	0.48	0.43	0.64	0.66	0.88
NEFA, mmol/L	0.44	0.39	0.54	0.42	0.47	0.05	0.21	0.73	0.14	0.08	0.61	0.54

[a]A total of 150 pigs (PIC, initial BW = 178.9 ± 14.7 lb) were used in the experiment. The values represent two pigs per pen and 15 pens per treatment.