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Feeding KemTRACE® Chromium Propionate during the Early and Late Phase Nursery Period

Introduction

The suggested physiological role of chromium in both human and animal nutrition is by influencing the action of insulin and having an association with the metabolism of nucleic acids, lipids and carbohydrates[1, 2]. In livestock, the responses and effects of feeding supplemental dietary chromium have been investigated and presented in numerous studies. Specifically for swine, studies have examined the response of chromium on growth and or carcass composition with either a positive[3 - 7] or neutral responses[8 – 15]. Studies have also examined the response to insulin[8, 16, 17] and glucose[17] kinetics, immune[9] response and reproductive improvements[5, 18]. KemTRACE® Chromium Propionate is approved as a source of chromium in swine diets by the U.S. Food & Drug Administration and as a supplement for growing and finishing swine intended to improve average daily gain by the Canadian Food Inspection Agency. Published works demonstrate an inconsistent basis as to which phase of production (nursery, grow/finish, gestation and lactation) provides the most consistent response and on a cost return basis[6, 7, 10, 12, 13]. The purpose of this study was to evaluate the effects of feeding KemTRACE Chromium Propionate during the early and/or late nursery period.

Materials and Methods

The trial was conducted as a randomized complete block design with replication. Thirty-six pens of 10 piglets each were randomly assigned within blocks to one of the four experimental treatments in each of two nursery rooms. Blocks were assigned based on sex, initial pen weight and position within the room. Replication was achieved by provision of two nursery rooms, with placement of piglets in each room staggered by one day. A total of nine blocks was created in each of the two rooms, with 4 blocks of each sex assigned on the basis of average pen weight. The ninth block in each room was assigned to barrows (Room 1) and gilts (Room 2). Chromium, from KemTRACE Chromium Propionate, was supplemented in the diets at a rate of 200 ppb. A three-phase dietary program was employed, with dietary Phase I considered to represent 'early nursery phase' and dietary Phases II & III representing 'late nursery phase' (Table 1).

Average Daily Feed Intake (ADFI), Average Daily Gain (ADG) and Feed:Gain (FG), were measured weekly by pen. Additionally, piglets were weighed individually on day of placement and at the conclusion of the trial, allowing for assessment of total gain per piglet. Animals were observed daily for disease, morbidity and mortality.

Table 1. Description of treatments

	Supplementation with Cr (ppb) from chromium propionate					
	Early Nursery Phase		Late Nursery Phase			
	Dietary Phase I		Dietary Phase II		Dietary Phase III	
Treatment	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
A	0	0	0	0	0	0
B	200	200	0	0	0	0
C	0	0	200	200	200	200
D	200	200	200	200	200	200

Results

Statistical analysis of the data for ADFI, ADG and FG is summarized for each phase of the trial and over the entire trial period. When analyzed by phase, treatment did not have a significant impact on ADFI or ADG ($P > 0.05$). In the early phase, chromium supplementation improved FG ($P < 0.01$) for piglets in treatment group D by 3 points of conversion over treatment group A (control) and 5 points of conversion over piglets in treatment group C. In addition, room was significant ($P < 0.05$) for FG in the early phase (Table 2). To examine the data for commercial purposes, an assessment on an individual room basis was also conducted (Tables 3, 4 and 5). The analysis identified overall numerical benefits to chromium supplementation for piglets in Room 1; whereas, no benefit was observed for piglets in Room 2. In Room 1, ADG over the entire 6-week period of the trial was improved by 0.057 lb/head/day for piglets receiving supplementation in the early nursery phase and by 0.04 lb/head/day for piglets receiving chromium supplementation continuously throughout the nursery period. All treatments slightly increased ADFI over control, but advantages ($P < 0.05$) in the early phase for FG (3 points of conversion for piglets receiving early phase supplementation and 4 points of conversion for piglets receiving continuous supplementation) were maintained.

Table 2. Impact of chromium supplementation on Feed:Gain by dietary phase

Factor		Early Phase (Weeks 1& 2)	Late Phase (Weeks 3-6)	Overall (Weeks 1-6)
Room	1	1.037	1.415	1.352
	2	1.062	1.424	1.363
	P value	<0.05	0.44	0.23
Treatment	A	1.058[bc]	1.419	1.358
	B	1.043[ab]	1.416	1.354
	C	1.074[c]	1.428	1.370
	D	1.024[a]	1.415	1.349
	P value	<0.01	0.81	0.38

Table 3: Impact of chromium supplementation on Average Daily Feed Intake (lb) for individual rooms by phase

Factor		Room 1			Room 2		
		Early Phase (Weeks 1&2)	Late Phase (Weeks 3-6)	Overall (Weeks 1-6)	Early Phase (Weeks 1&2)	Late Phase (Weeks 3-6)	Overall (Weeks 1-6)
Treatment	**A**	0.496	1.718	1.311	0.504	1.694	1.298
	B	0.517	1.809	1.378	0.503	1.688	1.293
	C	0.529	1.774	1.359	0.499	1.688	1.291
	D	0.505	1.782	1.356	0.510	1.688	1.296
	P value	0.28	0.23	0.23	0.97	0.99	0.99

Table 4: Impact of chromium supplementation on Average Daily Gain (lb) for individual rooms by phase

Factor		Room 1			Room 2		
		Early Phase (Weeks 1&2)	Late Phase (Weeks 3-6)	Overall (Weeks 1-6)	Early Phase (Weeks 1&2)	Late Phase (Weeks 3-6)	Overall (Weeks 1-6)
Treatment	**A**	0.474	1.218	0.970	0.475	1.189	0.951
	B	0.507	1.286	1.027	0.472	1.184	0.946
	C	0.496	1.235	0.989	0.461	1.189	0.946
	D	0.498	1.268	1.011	0.493	1.186	0.955
	P value	0.31	0.35	0.25	0.53	0.99	0.96

Table 5: Impact of chromium supplementation on Feed:Gain for individual rooms by phase

Factor		Room 1			Room 2		
		Early Phase (Weeks 1&2)	Late Phase (Weeks 3-6)	Overall (Weeks 1-6)	Early Phase (Weeks 1&2)	Late Phase (Weeks 3-6)	Overall (Weeks 1-6)
Treatment	**A**	1.052[ab]	1.413	1.353	1.063	1.425	1.364
	B	1.021[a]	1.406	1.342	1.066	1.426	1.366
	C	1.067[b]	1.437	1.374	1.081	1.419	1.365
	D	1.014[a]	1.406	1.341	1.033	1.424	1.357
	P value	<0.05	0.58	0.36	0.10	0.99	0.92

When evaluated via covariate analysis on an individual Room basis (Table 6), treatment with chromium had a significant impact on final weight for piglets in Room 1 ($P = 0.05$). Chromium supplementation in the early phase (treatment group B) provided a 2.4 lb weight advantage over control piglets (treatment group A) and a 1.6 lb advantage over piglets supplemented in the late nursery phase (treatment group C). Piglets receiving chromium supplementation throughout the nursery period (treatment group D) were, on a numerical basis, 1.8 lb heavier than control piglets.

Table 6: Impact of chromium supplementation on final weight of piglets evaluated

		Room 1		Room 2	
Factor		**n**	**Final Weight (lb)**	**n**	**Final Weight (lb)**
Treatment	A	90	53.8a	90	51.9
	B	90	56.2b	88	51.6
	C	90	54.6a	89	51.7
	D	90	55.6ab	90	52.0
	P value		0.05		0.95
Covariate (initial weight)	P value		<0.001		<0.001

Discussion

The results of this trial are similar to those reported previously for both nursery[19, 20, 21] and grow-finish studies[3 – 15] in swine. The response to chromium did show for chromium treatments, with those supplemented 'early' and 'continuously' showing the greatest improvement. In two of the studies[20, 21] reported previously, a relatively small experimental unit may have reduced the likelihood of a significant response. As shown in the results, analysis of the data pointed out a clear, but unexpected, 'Room effect' on the performance criteria measured in this study which reduced the statistical power of the trial. The difference in initial pen weights along with the occurrence of greasy pig syndrome (identified to be more prevalent and an adverse event in Room 2, personal communication site coordinator), may have contributed to the differences between the two nursery rooms. Greasy Pig Syndrome or Exudative Epidermitis (describing the oozing of fluid from the skin) is caused by the bacterium Staphylococcus hyicus which invades abraded skin causing infection[22]. The Staphylococcus produces toxins which are absorbed into the system and damage the liver and kidneys and can be a major problem in new gilt herds and weaned pigs. Affected pigs also show depression, reduced feed intake, growth depression and dehydration.

Conclusions

Piglets supplemented in the early phase (treatment group D) of the nursery period with 200 ppb of chromium, from chromium propionate, had a 3 point (treatment group A) to 5 point (treatment group C) improvement in FG versus pigs that did not receive supplementation. In addition, chromium supplementation in the early phase (treatment group B) provided a 1.6 lb (treatment group C) to 2.4 lb (treatment group A) final weight advantage over piglets that did not receive chromium supplementation.

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