[Kansas Agricultural Experiment Station Research Reports](https://newprairiepress.org/kaesrr)

Volume 3
Issue 7 *Swine Day*

Article 48

2017

Effect of Chromium Propionate Level and Feeding Regimen on Finishing Pig Growth Performance and Carcass Characteristics

J. T. Gebhardt
Kansas State University, Manhattan, jgebhardt@k-state.edu

J. C. Woodworth
Kansas State University, Manhattan, jwoodworth@k-state.edu

M. D. Tokach
Department of Animal Science and Industry, Kansas State University, mtokach@ksu.edu

See next page for additional authors

Recommended Citation

Gebhardt, J. T.; Woodworth, J. C.; Tokach, M. D.; DeRouchey, J. M.; Goodband, R. D.; Cemin, H. S.; Loughmiller, J. A.; and Dritz, S. S. (2017) "Effect of Chromium Propionate Level and Feeding Regimen on Finishing Pig Growth Performance and Carcass Characteristics," *Kansas Agricultural Experiment Station Research Reports*: Vol. 3: Iss. 7. https://doi.org/10.4148/2378-5977.7501

Cover Page Footnote
Appreciation is expressed to New Horizon Farms (Pipestone, MN) for providing the animals and research facilities and to H. Houselog, M. Heintz, and C. Steck for technical assistance.

Authors
J. T. Gebhardt, J. C. Woodworth, M. D. Tokach, J. M. DeRouchey, R. D. Goodband, H. S. Cemin, J. A. Loughmiller, and S. S. Dritz

Effect of Chromium Propionate Level and Feeding Regimen on Finishing Pig Growth Performance and Carcass Characteristics[1,2]

J.T. Gebhardt, J.C. Woodworth, M.D. Tokach, J.M. DeRouchey, R.D. Goodband, H.S. Cemin, J.A. Loughmiller,[3] and S.S. Dritz[4]

Summary

A total of 1,206 pigs (PIC 359 × 1050; initial BW = 107.9 lb) were used in an 84-d study to evaluate the effects of added dietary chromium (Cr; KemTRACE chromium propionate, Kemin Industries Inc., Des Moines, IA) and feeding regimen on growth performance of finishing pigs housed under commercial conditions. Pigs were placed in mixed-gender pens (27 pigs per pen), blocked by BW, and randomly assigned to 1 of 3 dietary treatments (15 pens per treatment). Diets were corn-soybean meal-based with added dried distillers gains with solubles, and were fed in 4 phases. Treatments were: 1) control, no Cr in grower or finisher formulas; 2) 200 ppb of Cr fed in both grower and finisher; and 3) 200 ppb of Cr fed in grower and 100 ppb fed in finisher. The grower phase was from 108 to 202 lb and the finisher phase was 202 to 273 lb. There was no evidence ($P \geq 0.197$) of treatment differences in the grower period. In the finishing period, added Cr resulted in a marginally significant increase (linear; $P = 0.061$) in ADG (2.03, 2.02, 2.08 ± 0.022 lb/d; 0, 100, 200 ppb added Cr, respectively) with no evidence of an effect ($P \geq 0.148$) on ADFI and F/G. For the overall period, there was marginal significance that at least one treatment differed from another ($P = 0.086$) for ADG. When compared directly, addition of 200 ppb Cr in both grower and finisher increased ($P = 0.037$) ADG, compared to control with pigs fed 200 ppb added Cr fed in grower, followed by 100 ppb fed in finisher intermediate (1.97, 1.98, and 2.01 ± 0.013 lb/d; 0, 200/100, and 200/200 ppb added Cr, respectively). There was no evidence ($P \geq 0.526$) of differences in overall ADFI and F/G. Percentage carcass yield was reduced ($P = 0.018$) in pigs fed 200 ppb added Cr for both the grower and finishing periods compared to other treatments. There was no evidence of differences ($P \geq 0.206$) in HCW, loin depth, backfat, or percentage lean between treatments. In summary, adding 200 ppb of Cr in both grower and finisher formulas increased finishing ADG, led to a marginally significant improvement in overall ADG, but reduced carcass yield.

[1] Appreciation is expressed to New Horizon Farms (Pipestone, MN) for providing the animals and research facilities and to H. Houselog, M. Heintz, and C. Steck for technical assistance.
[2] Appreciation is expressed to Kemin Industries (Des Moines, IA) for project funding.
[3] Kemin Industries, Des Moines, IA.
[4] Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University.

Introduction

The nutritional impact of dietary chromium (Cr) has been evaluated using meta-analysis[5] as well as more recent investigation in commercial facilities.[6] The meta-analysis indicated that improvements in growth performance (ADG and F/G) and carcass composition (reduced backfat and increased percentage lean) can be achieved with added dietary Cr, and outcome of supplementation is dependent upon feeding dosage and duration. This hypothesis was evaluated by feeding 0, 100, or 200 ppb added Cr during early and/or late finishing. It was observed that an improvement in growth characteristics may be present with 100 ppb added Cr, and this benefit was observed in both early and late finishing.[6] However, research evaluating the impact of 200 ppb added Cr on carcass characteristics in a commercial setting has shown an increase in backfat and subsequent reduction in percentage lean.[7,8] It has been observed that 200 ppb of added Cr yields growth performance benefits early in the finishing period; however, it may increase backfat and reduce percentage lean when fed at a high concentration late in finishing. A reduction in the amount of added Cr may still provide beneficial growth performance outcomes while maintaining beneficial carcass characteristics, including carcass leanness and yield. Therefore, the objective of this experiment was to determine the effects of Cr inclusion (0 and 200 ppb added Cr during early finishing) and feeding regimen (0, 100, 200 ppb added Cr during late finishing) on growth performance and carcass composition of pigs housed in a commercial environment.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at a commercial research-finishing site in southwest Minnesota. The barn was naturally ventilated and double-curtain-sided. Each pen (18 × 10 ft) was equipped with a 4-hole stainless steel feeder and cup waterer for ad libitum access to feed and water and allowed approximately 6.5 ft^2/pig. Feed additions to each individual pen were made and recorded by a robotic feeding system (FeedPro; Feedlogic Corp., Willmar, MN).

A total of 1,206 pigs (PIC 359 × 1050; initial BW = 107.9 lb) were used in an 84-d growth trial. Pigs were placed in mixed-gender pens (27 pigs per pen) with equal number of barrows and gilts on each treatment, pens were blocked by average BW and randomly assigned to 1 of 3 dietary treatments (15 pens per treatment) at initiation of the experiment. Diets were corn-soybean meal-based and fed in meal form, with di-

---

[5] Sales, J., and F. Jancik. 2011. Effects of dietary chromium supplementation on performance, carcass characteristics, and meat quality of growing-finishing swine: A meta-analysis. J. Anim. Sci. 89: 4054-4067.

[6] Gebhardt, J. T., J. C. Woodworth, M. D. Tokach, J. M. DeRouchey, R. D. Goodband, J. A. Loughmiller, and S. S. Dritz. 2016. Influence of Chromium Dose and Feeding Regimen on Growth Performance and Carcass Composition of Pigs Housed in a Commercial Environment. Kansas Agricultural Experiment Station Research Reports: Vol. 2: Iss. 8. http://dx.doi.org/10.4148/2378-5977.1312.

[7] Gebhardt, J. T., J. C. Woodworth, M. D. Tokach, J. M. DeRouchey, R. D. Goodband, J. A. Loughmiller, and S. S Dritz. 2016. Determining the Influence of KemTRACE Cr and/or Micro-Aid on Growth Performance and Carcass Composition of Pigs Housed in a Commercial Environment. Kansas Agricultural Experiment Station Research Reports: Vol. 2: Iss. 8. http://dx.doi.org/10.4148/2378-5977.1313.

[8] Santos, A., M. D. Tokach, S. S. Dritz, J. C. Woodworth, R. D. Goodband, and J. M. DeRouchey. 2016. Effects of Added Chromium and Space Allocation on Finishing Pig Performance. Kansas Agricultural Experiment Station Research Reports: Vol. 2: Iss. 8. http://dx.doi.org/10.4148/2378-5977.1314.

etary phases formulated for 100 to 150, 150 to 200, 200 to 240, and 240 to 280 lb BW ranges. All nutrients were formulated to meet or exceed the NRC[9] requirement estimates within phase.

Dietary treatments were: 1) control, no Cr in grower or finisher; 2) 200 ppb of Cr (KemTRACE Cr; Kemin Industries Inc., Des Moines, IA) fed in both grower and finisher formulas; and 3) 200 ppb of Cr fed in grower and 100 ppb fed in finisher. The grower phase was from approximately 108 to 202 lb and the finisher phase was approximately 202 to 273 lb. All diets were manufactured at a commercial feed mill (New Horizon Feeds, Pipestone, MN; Table 1) and were fed in meal form.

Samples of the complete feed were taken from the feeder at the beginning and end of each phase. Subsamples of each diet were then submitted for proximate analysis (Ward Laboratories, Inc., Kearney, NE) and Cr analysis (University of Guelph Agriculture & Food Laboratory; Guelph, ON). Pens of pigs were weighed and feeder measurements were recorded a minimum of every 14 d, and such events included dietary phase changes, first marketing, and conclusion of the trial to determine ADG, ADFI, and F/G. The 3 largest pigs/pen were selected and marketed at an average barn weight of 242 lb on d 68 following the routine farm protocol with no carcass data collected on these animals. At the conclusion of the trial (d 84), the remaining animals were given a tattoo corresponding to pen number and were transported to a commercial packing facility (JBS Swift and Company; Worthington, MN) for processing and carcass data collection. Carcass measurements taken at the plant included HCW, backfat, percentage carcass lean, and loin depth. Additionally, percentage carcass yield was calculated by dividing HCW by mean animal live weight collected at the research facilities prior to transport to harvest facility for the corresponding pen.

Data were analyzed as a randomized complete block design using the GLIMMIX procedure of SAS version 9.4 (SAS Institute, Inc., Cary, NC) with pen as the experimental unit using a randomized complete block design. Weight block was included in the model as a random effect. Growth performance during the grower period was analyzed to compare 0 vs. 200 ppb added Cr. During the finishing period, growth performance characteristics were analyzed using linear and quadratic contrast statements comparing the effect of increasing dietary Cr supplementation (0, 100, and 200 ppb Cr). Overall growth performance and carcass characteristics were analyzed using an *F*-test to determine if differences were present and using LSMEANS procedure with the DIFF and LINES options to separate significant differences among treatments (0/0, 200/100, and 200/200 ppb added Cr, corresponding to grower/finisher Cr, respectively). Backfat, loin depth, and percentage lean were adjusted to a common carcass weight for analysis using HCW as a covariate. Results were considered significant at $P \leq 0.05$ and marginally significant between $P > 0.05$ and $P \leq 0.10$.

Results and Discussion

Feed proximate analysis did not significantly differ from formulated values (Tables 2 to 3). Although variable, analysis of Cr generally resulted in greater values in diets supplemented with Cr propionate as expected. Unexpectedly, the diet supplemented with 200

[9] NRC. 2012. Nutrient Requirements of Swine, 11th ed. Natl. Acad. Press, Washington D.C.

ppb added Cr in dietary phase 4 resulted in a lower level of analyzed Cr than the 0 or 100 ppb added Cr diets. Therefore, all three diets in dietary phase 4 were reanalyzed and a similar pattern was found. It is unknown why this sample resulted in the lowest level of Cr.

There was no evidence ($P \geq 0.197$) of Cr supplementation effect in the grower period (~108 to 202 lb BW). In the finishing period (~202 to 273 lb BW), the addition of Cr resulted in a marginally significant increase (linear; $P = 0.061$) in ADG with added Cr, with no evidence of an impact ($P \geq 0.148$) on ADFI and F/G. For the overall period, there was marginal significance that at least one treatment differed from another ($P = 0.086$) for ADG. When compared directly, the addition of 200 ppb Cr in both grower and finisher increased ($P = 0.037$) ADG compared to control, with pigs fed 200 ppb added Cr fed in grower followed by 100 ppb fed in finisher intermediate. There was no evidence ($P \geq 0.526$) for differences on overall ADFI and F/G.

For carcass characteristics, percentage carcass yield was decreased ($P = 0.018$) when 200 ppb Cr was added in both the grower and finishing periods compared to other treatments. There was no evidence of differences ($P \geq 0.206$) in HCW, loin depth, backfat, or percentage lean among treatments.

In summary, adding Cr from 108 to 202 lb BW did not affect performance. However, adding 200 ppb of Cr in both grower and finisher diets increased ADG in the finishing period and led to a marginally significant improvement in overall ADG. Unexpectedly, supplementation of 200 ppb for the full duration of the study reduced percentage yield; however, no additional differences among treatments were observed.

Table 1. Diet composition (as-fed basis)

	Dietary phase[1]			
Item	1	2	3	4
Ingredient, %				
Corn	62.76	67.86	70.89	79.71
Soybean meal, 46.5% CP	14.99	9.91	6.90	8.22
DDGS[2]	20.00	20.00	20.00	10.00
Calcium carbonate	1.28	1.23	1.20	1.03
Monocalcium phosphate, 21% P	---	---	---	0.10
Salt	0.35	0.35	0.35	0.35
L-Lys HCl	0.39	0.40	0.40	0.33
L-Thr	0.04	0.05	0.06	0.07
L-Trp	0.01	0.02	0.02	0.01
Phytase[4]	0.01	0.01	0.01	0.01
Trace mineral premix	0.10	0.10	0.10	0.10
Vitamin premix	0.08	0.08	0.08	0.08
Cr premix[5]	+/-	+/-	+/-	+/-
Total	100	100	100	100
Calculated analysis[6]				
Standardized ileal digestible (SID) amino acids, %				
Lys	0.89	0.78	0.71	0.65
Ile:Lys	60	59	58	58
Leu:Lys	158	166	173	166
Met:Lys	29	30	31	30
Met and Cys:Lys	56	58	60	59
Thr:Lys	60	61	63	65
Trp:Lys	18.0	18.0	18.0	18.0
Val:Lys	69	69	70	69
Total Lys, %	1.04	0.92	0.84	0.76
ME, kcal/lb	1,507	1,510	1,512	1,512
NE, kcal/lb	1,122	1,136	1,144	1,156
SID Lys:ME, g/Mcal	2.68	2.34	2.13	1.95
SID Lys:NE, g/Mcal	3.60	3.11	2.81	2.55
CP, %	17.5	15.6	14.4	12.9
Ca, %	0.57	0.53	0.52	0.46
P, %	0.39	0.37	0.35	0.35
Available P, %	0.25	0.25	0.24	0.22

[1] Diets were fed in a 4-phase feeding program formulated to 100 to 150, 150 to 200, 200 to 240, and 240 to 280 lb BW ranges.

[2] DDGS = dried distillers grains with solubles.

[4] Optiphos 2000 (Huvepharma, Sofia, Bulgaria) provided an estimated release of 0.11% available P.

[5] KemTRACE Cr (chromium propionate; Kemin Industries Inc., Des Moines, IA) was added at 0 or 1.0 lb/ton (200 ppb added Cr) during dietary phases 1 and 2, and 0, 0.5 (100 ppb added Cr) or 1.0 lb/ton (200 ppb added Cr) during dietary phases 3 and 4 at the expense of corn.

[6] NRC. 2012. Nutrient Requirements of Swine, 11th ed. Natl. Acad. Press, Washington D.C.

Table 2. Chemical analysis of diets, Phase 1 and 2 (as-fed basis)[1,2]

	Phase 1		Phase 2	
Item Added Cr, ppb:	0	200	0	200
DM, %	90.7	90.9	90.8	90.6
CP, %	18.1	18.7	15.9	16.1
Ether extract, %	3.5	3.4	3.7	3.7
Crude fiber, %	1.5	3.8	3.7	3.8
Cr, ppb	330	440	280	310

[1] A composite sample was collected from feeders within treatment and phase, subsampled, and submitted to Ward Laboratories (Kearney, NE) for proximate analysis and to University of Guelph Agriculture & Food Laboratory (Guelph, ON) for Cr analysis.

[2] Phase 1 was fed from approximately 100 to 150 lb, and phase 2 fed from approximately 150 to 200 lb.

Table 3. Chemical analysis of diets, Phase 3 and 4 (as-fed basis)[1,2]

	Phase 3			Phase 4		
Item Added Cr, ppb:	0	100	200	0	100	200
DM, %	90.9	90.8	90.8	90.7	91.0	90.9
CP, %	15.2	15.5	14.9	13.6	14.9	16.5
Ether extract, %	3.6	3.6	3.5	3.0	3.3	3.5
Crude fiber, %	90.9	90.8	90.8	90.7	91.0	90.9
Cr, ppb	290	390	510	640	680	480

[1] A composite sample was collected from feeders within treatment and phase, subsampled, and submitted to Ward Laboratories (Kearney, NE) for proximate analysis and to University of Guelph Agriculture & Food Laboratory (Guelph, ON) for Cr analysis.

[2] Phase 3 was fed from approximately 200 to 240 lb, and phase 4 fed from approximately 240 to 280 lb.

Table 4. Effects of added Cr and feeding duration on finishing pig growth performance and carcass characteristics[1,2]

					Probability, $P <$			
						Grower	Finisher	
Added Cr (grower), ppb:[3]	0	200	200					
Added Cr (finisher), ppb:[4]	0	100	200	SEM	Overall	0 vs. 200	Linear	Quadratic
BW, lb								
d 0	107.9	107.9	108.0	1.12	0.840	---	---	---
d 48	201.1	201.8	202.3	1.20	---	0.275	---	---
d 84	272.4	272.4	274.8	1.40	0.304	---	---	---
Grower (d 0 to 48)								
ADG, lb	1.93	1.95	1.96	0.014	---	0.197	---	---
ADFI, lb	5.28	5.37	5.34	0.048	---	0.239	---	---
F/G	2.73	2.75	2.73	0.021	---	0.873	---	---
Finisher (d 48 to 84)								
ADG, lb	2.03	2.02	2.08	0.022	---	---	0.061	0.165
ADFI, lb	6.53	6.48	6.60	0.056	---	---	0.399	0.201
F/G	3.23	3.21	3.17	0.034	---	---	0.148	0.716
Overall (d 0 to 84)								
ADG, lb	1.97[b]	1.98[a,b]	2.01[a]	0.013	0.086	---	---	---
ADFI, lb	5.80	5.83	5.86	0.046	0.650	---	---	---
F/G	2.94	2.94	2.92	0.022	0.526	---	---	---
Carcass characteristics[5]								
HCW, lb	210.2	210.0	211.0	1.15	0.741	---	---	---
Loin depth, in	2.46	2.49	2.47	0.020	0.590	---	---	---
Backfat, in	0.726	0.710	0.734	0.0108	0.229	---	---	---
Lean, %	55.1	55.4	55.0	0.17	0.206	---	---	---
Carcass yield, %	77.1[a]	77.1[a]	76.8[b]	0.10	0.018	---	---	---

[1] A total of 1,206 finisher pigs (PIC 359 × 1050; initial BW = 107.9 lb) were used in a four-phase finisher study with 27 pigs per pen and 15 replications per treatment.

[2] KemTRACE Cr (chromium propionate; Kemin Industries Inc., Des Moines, IA).

[3] Grower period = 108 to 202 lb BW.

[4] Finisher period = 202 to 273 lb BW.

[5] Carcass characteristics other than HCW and yield adjusted to a common HCW.

[abc] Means lacking common superscripts differ ($P < 0.05$).