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# Determining the Influence of KemTRACE Cr and/or Micro-Aid on Growth Performance and Carcass Composition of Pigs Housed in a Commercial Environment

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
*Kansas State University, Manhattan*, mtokach@k-state.edu

*See next page for additional authors*



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# Determining the Influence of KemTRACE Cr and/or Micro-Aid on Growth Performance and Carcass Composition of Pigs Housed in a Commercial Environment


## Abstract

A study was conducted to determine the interactive effects of chromium propionate (KemTRACE Cr; Kemin Industries Inc., Des Moines, IA) and Micro-Aid (Y*ucca schidigera*-based product; Distributors Processing Inc., Porterville, CA) on growth performance and carcass composition of finishing pigs housed in a commercial environment. There were a total of 1,188 pigs (PIC 337 × 1050; initial BW = 60.3 lb) with 27 pigs/ pen and 11 pens/treatment. Pigs were split by gender upon arrival at the facility, with 5 blocks of each gender and a final mixed sex gender block. Gender blocks were randomly allotted to groups of 4 pen locations within the barn. Diets were corn-soybean meal-dried distillers grains with solubles-based and were fed in 5 phases. All nutrients were formulated to meet or exceed NRC (2012) requirement estimates. Treatments were arranged as a 2 × 2 factorial with main effects of Cr (0 vs 200 ppb) or Micro-Aid (0 vs 62.5 ppm). There were no Cr × Micro-Aid interactions observed for growth or carcass measurements. Overall, ADG and F/G were not influenced by treatment. Adding Cr alone increased (P = 0.048) ADFI, and inclusion of Micro-Aid resulted in a marginally significant increase (P = 0.076) in ADFI. For carcass characteristics, HCW, loin depth, and percentage carcass yield were not influenced by treatment. Backfat depth tended to increase (P = 0.055) and lean percentage was decreased (P = 0.014) when Cr was added to diets. In summary, no synergistic effects were observed from feeding Cr and Micro-Aid in diets fed to finishing pigs housed in a commercial environment. Only marginal differences were observed from adding Cr or Micro-Aid with increased ADFI observed from feeding either. Finally, diets containing added Cr tended to be associated with carcasses having more backfat and less lean suggesting the increased ADFI was not utilized for increased muscle deposition.



## Keywords

chromium propionate, Micro-Aid, pigs





## 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. Appreciation is expressed to Kemin Industries (Des Moines, IA) for project funding.



## Authors

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

# Determining the Influence of KemTRACE Cr and/or Micro-Aid on Growth Performance and Carcass Composition of Pigs Housed in a Commercial Environment[1,2]

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

## Summary

A study was conducted to determine the interactive effects of chromium propionate (KemTRACE Cr; Kemin Industries Inc., Des Moines, IA) and Micro-Aid (*Yucca schidigera*-based product; Distributors Processing Inc., Porterville, CA) on growth performance and carcass composition of finishing pigs housed in a commercial environment. There were a total of 1,188 pigs (PIC 337 × 1050; initial BW = 60.3 lb) with 27 pigs/pen and 11 pens/treatment. Pigs were split by gender upon arrival at the facility, with 5 blocks of each gender and a final mixed sex gender block. Gender blocks were randomly allotted to groups of 4 pen locations within the barn. Diets were corn-soybean meal-dried distillers grains with solubles-based and were fed in 5 phases. All nutrients were formulated to meet or exceed NRC (2012) requirement estimates. Treatments were arranged as a 2 × 2 factorial with main effects of Cr (0 vs 200 ppb) or Micro-Aid (0 vs 62.5 ppm). There were no Cr × Micro-Aid interactions observed for growth or carcass measurements. Overall, ADG and F/G were not influenced by treatment. Adding Cr alone increased ($P = 0.048$) ADFI, and inclusion of Micro-Aid resulted in a marginally significant increase ($P = 0.076$) in ADFI. For carcass characteristics, HCW, loin depth, and percentage carcass yield were not influenced by treatment. Backfat depth tended to increase ($P = 0.055$) and lean percentage was decreased ($P = 0.014$) when Cr was added to diets. In summary, no synergistic effects were observed from feeding Cr and Micro-Aid in diets fed to finishing pigs housed in a commercial environment. Only marginal differences were observed from adding Cr or Micro-Aid with increased ADFI observed from feeding either. Finally, diets containing added Cr tended to be associated

[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.

with carcasses having more backfat and less lean suggesting the increased ADFI was not utilized for increased muscle deposition.

Key words: chromium propionate, Micro-Aid, pigs

## Introduction

Chromium plays a role in carbohydrate, lipid, protein, and nucleic acid metabolism.[5,6] In addition, Cr is associated with insulin sensitivity in the form of a cofactor for glucose tolerance factor.[7] Corn-soybean meal-based diets contain a significant amount of Cr ranging from 1,000 to 3,000 ppb, but much of that is thought to be unavailable to the animal.[8] Recently, a meta-analysis was conducted including 31 different research studies that evaluated Cr supplementation in finishing pig diets. They observed that improvements in growth performance (ADG and F/G) and carcass composition (reduced backfat and increased percentage lean) can be expected with Cr supplementation.[9]

Additionally, *Yucca schidigera* is believed to have a positive impact on gastrointestinal microflora through its saponin characteristics thereby reducing gaseous emissions and potentially improving growth performance; however, limited research exists.[10] Research evaluating the effects of *Yucca schidigera* supplementation in poultry is available, and would suggest an improvement in F/G.[11] Additionally, research in mice with artificially induced diabetes mellitus indicates a potential reduction of circulating glucose levels when supplemented with *Yucca schidigera* extract through a potential insulin releasing mechanism from pancreatic β-cells.[12] Research related to the impact of *Yucca schidigera* on blood metabolites in swine is currently very limited, and there are no data available to determine the interactive effects of Cr and *Yucca schidigera* when fed to finishing pigs. Therefore, the objective of this experiment was to determine the effects of Cr supplementation with and without Micro-Aid 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 feet) 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. Hourly ambient barn temperatures were recorded throughout the ex-

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

[6] Trace Elements in Human and Animal Nutrition. 1977. 4th ed. Academic Press Inc., New York, NY.

[7] Swine Nutrition. 2001. 2nd ed. CRC Press LLC, Boca Raton, FL.

[8] Lindemann, M. D., 2007. Use of chromium as an animal feed supplement. In: J. B. Vincent, editor, The Nutritional Biochemistry of Chromium (III). Elsevier, Amsterdam. p. 85–118.

[9] 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.

[10] Colina, J.J., A.J. Lewis, P.S. Miller, and R.L. Fischer. 2001. Dietary manipulation to reduce aerial ammonia concentrations in nursery pig facilities. J. Anim. Sci. 79: 3096-3103.

[11] Sahoo S.P., D. Kaur, A.P. Sethi, A. Sharma, and M. Chandra. 2015. Evaluation of Yucca schidigera extract as feed additive on performance of broiler chicks in winter season. Veterinary World 8(4): 556-560.

[12] Oztasan, N. 2013. The effects of Yucca schidigera on blood glucose and lipid levels in diabetic rats. African Journal of Biochemistry Research. 7(9): 179-183.

periment (EasyLog Data Loggers; Lascar Electronics, Erie, PA). Feed additions to each individual pen were made and recorded by a robotic feeding system (FeedPro; Feedlogic Corp., Wilmar, MN).

A total of 1,188 pigs (PIC 337 × 1050; initial BW = 60.3 lb) with 27 pigs/pen and 11 pens/treatment were used in a 117-d study. Pens were blocked by BW and were randomly assigned to diets with 27 pigs per pen and 7 pens per treatment. Pigs were split by gender upon arrival at the facility, with 5 blocks of each gender and a final mixed sex gender block. Gender blocks were randomly allotted to groups of 4 pen locations within the barn. Diets were corn-soybean meal-dried distillers grains with solubles-based and were fed in 5 phases. All nutrients were formulated to meet or exceed NRC (2012) requirement estimates (Table 1). Treatments were arranged in a 2 × 2 factorial with main effects of Cr (0 vs. 200 ppb; KemTRACE Cr; Kemin Industries Inc., Des Moines, IA) or Micro-Aid (0 vs. 62.5 ppm; Micro-Aid (a *Yucca schidigera*-based product); Distributors Processing Inc., Porterville, CA) and were fed for the full duration of the experiment. Ractopamine HCl (Paylean 9 g/ton; Elanco Animal Health, Greenfield, IN) was included in phase 5 diets and was fed for 27 d. The 4 experimental diets were manufactured at a commercial feedmill (New Horizon Feeds, Pipestone, MN).

Samples of the complete feed were taken from the feeder at the beginning and end of each phase and diet samples were subsampled using a riffle-splitter, then submitted for proximate (Ward Laboratories, Inc., Kearney, NE) and chromium analysis (University of Guelph Agriculture & Food Laboratory; Guelph, ON). Pens of pigs were weighed and feeder measurements were recorded at the time of dietary phase changes, first marketing, and conclusion of the trial (d 0, 21, 39, 59, 90, 97, and 117) to determine ADG, ADFI, and F/G. The 3 largest pigs/pen were selected and marketed at an average barn weight of 245 lb on d 97 and marketed following the routine farm protocol with no carcass data collected on these animals. At the conclusion of the trial (d 117), remaining animals were given a tattoo corresponding to pen 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 live pen weight, HCW, backfat, percentage carcass lean, and loin depth. Additionally, percentage yield was calculated by dividing HCW by average live animal plant weight for the corresponding pen.

Data were analyzed as a randomized complete block design using the GLIMMIX procedure of SAS (SAS Institute, Inc., Cary, NC) with pen as the experimental unit. Block was included in the model as a random effect and accounted for gender, location within barn, and initial BW at the time of allotment. 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

As expected, chemical analysis of complete diets revealed no notable differences among treatments (Tables 2 to 4). The only discrepancy was in Phase 3 when both Cr and Micro-Aid were included and the dietary level of Cr was lower than expected.

There were no Cr × Micro-Aid interactions observed for the entire study (Table 5). For the grower period, added Cr increased ($P < 0.028$) ADG and ADFI. Added Micro-Aid in the grower period tended to worsen ($P = 0.051$) F/G. During the finishing period, added Cr tended to increase ($P = 0.080$) ADFI but worsen F/G. Added Micro-Aid in the finishing period tended to increase ($P = 0.088$) ADFI. Overall, ADG and F/G were not influenced by treatment. Adding Micro-Aid tended to increase ($P = 0.076$) and adding Cr increased ($P = 0.048$) ADFI. For carcass characteristics, HCW, loin depth, and carcass yield were not influenced by treatment. Backfat depth tended to increase ($P = 0.055$) and lean percentage decreased ($P = 0.014$) when Cr was added into the diets.

Meta-analysis conducted by Sales and Jancik (2011) suggests a reduction ($P < 0.05$) in 10th-rib backfat thickness and increase in percentage lean (Hedge's *g* standardized effect size = -0.416 and 0.491, respectively) when finishing pigs are supplemented with dietary Cr. Results from the current study did not support this conclusion, and an increase in backfat thickness leading to a reduction in percentage lean was observed. Colina et al. (2001) did not observe any differences ($P \geq 0.41$) in ADG, ADFI, or G/F when *Yucca schidigera* was included in nursery pig diets at a level of 125 ppm. Additionally, the advantages observed with *Yucca schidigera* supplementation in broiler production by Sahoo et al. (2015) do not appear to be transferable to nursery or finishing pig production, with little research currently available.

In summary, no synergistic effects were observed from feeding Cr and Micro-Aid in diets fed to finishing pigs housed in a commercial environment. Only marginal differences were observed from adding either Cr or Micro-Aid with increased ADFI observed from feeding either Cr or Micro-Aid. Finally, diets containing added Cr tended to be associated with carcasses having more backfat and less lean. This suggests the increased ADFI observed from pigs fed added Cr was not utilized to support lean deposition, but rather was converted to backfat.

**Table 1. Diet composition (as-fed basis)[1]**

| | Dietary phase | | | | |
|---|---|---|---|---|---|
| Item | 1 | 2 | 3 | 4 | 5 |
| Ingredient, % | | | | | |
| Corn | 56.05 | 61.25 | 65.80 | 69.25 | 67.25 |
| Soybean meal, 46.5% CP | 21.60 | 16.50 | 11.95 | 8.55 | 20.65 |
| DDGS[2] | 20.00 | 20.00 | 20.00 | 20.00 | 10.00 |
| Calcium carbonate | 1.25 | 1.28 | 1.23 | 1.20 | 1.03 |
| Monocalcium phosphate, 21% P | 0.15 | --- | --- | --- | 0.10 |
| Salt | 0.35 | 0.35 | 0.35 | 0.35 | 0.35 |
| L-Lys HCl | 0.36 | 0.37 | 0.39 | 0.39 | 0.28 |
| DL-Met | 0.01 | --- | --- | --- | 0.04 |
| L-Thr | 0.05 | 0.04 | 0.05 | 0.06 | 0.07 |
| L-Trp | --- | 0.01 | 0.02 | 0.02 | --- |
| Ractopamine HCL[3] | --- | --- | --- | --- | 0.03 |
| Phytase[4] | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Trace mineral premix | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Vitamin premix | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| KemTRACE Cr[5] | +/- | +/- | +/- | +/- | +/- |
| Micro-Aid[6] | +/- | +/- | +/- | +/- | +/- |
| Total | 100 | 100 | 100 | 100 | 100 |

*continued*

**Table 1. Diet composition (as-fed basis)[1]**

| | Dietary phase | | | | |
|---|---|---|---|---|---|
| Item | 1 | 2 | 3 | 4 | 5 |
| Calculated analysis[4] | | | | | |
| Standardized ileal digestible (SID) amino acids, % | | | | | |
| Lys | 1.02 | 0.91 | 0.82 | 0.74 | 0.90 |
| Ile:Lys | 63 | 62 | 60 | 59 | 64 |
| Leu:Lys | 152 | 159 | 164 | 171 | 150 |
| Met:Lys | 29 | 29 | 30 | 31 | 32 |
| Met and Cys:Lys | 55 | 56 | 57 | 59 | 59 |
| Thr:Lys | 61 | 61 | 61 | 63 | 65 |
| Trp:Lys | 18.4 | 18.4 | 18.4 | 18.4 | 19.0 |
| Val:Lys | 70 | 70 | 70 | 70 | 71 |
| Total Lys, % | 1.18 | 1.06 | 0.96 | 0.87 | 1.04 |
| ME, kcal/lb | 1,502 | 1,506 | 1,509 | 1,511 | 1,506 |
| NE, kcal/lb | 1,103 | 1,118 | 1,130 | 1,140 | 1,123 |
| SID Lys:ME, g/Mcal | 3.08 | 2.74 | 2.46 | 2.22 | 2.71 |
| SID Lys:NE, g/Mcal | 4.20 | 3.69 | 3.29 | 2.94 | 3.64 |
| CP, % | 20.0 | 18.1 | 16.4 | 15.0 | 17.6 |
| Ca, % | 0.61 | 0.57 | 0.54 | 0.52 | 0.50 |
| P, % | 0.45 | 0.40 | 0.38 | 0.36 | 0.40 |
| Available P, % | 0.29 | 0.26 | 0.25 | 0.25 | 0.24 |

[1]Treatment diets were fed for the full duration of the trial and were formulated for 60 to 100, 100 to 135, 135 to 170, 170 to 230, and 230 to 280 lb BW ranges.
[2] DDGS = dried distillers grains with solubles.
[3] Paylean 9 g/lb (Elanco, Greenfield, IN).
[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 1.0 lb/ton (200 ppb Cr) at the expense of corn in the appropriate treatment diets.
[6] Micro-Aid (*Yucca schidigera*-based product; Distributors Processing Inc., Porterville, CA) was added at 2.0 lb ton (62.5 ppm active ingredient) at the expense of corn in the appropriate treatment diets.
[7] NRC. 2012. Nutrient Requirements of Swine, 11th ed. Natl. Acad. Press, Washington, D.C.

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

| | Phase 1 | | | | Phase 2 | | | |
|---|---|---|---|---|---|---|---|---|
| Added Cr, ppb[3]: | 0 | 200 | 0 | 200 | 0 | 200 | 0 | 200 |
| Micro-Aid, ppm[4]: | 0 | 0 | 62.5 | 62.5 | 0 | 0 | 62.5 | 62.5 |
| DM, % | 88.01 | 87.11 | 88.67 | 88.32 | 88.05 | 88.77 | 88.18 | 87.44 |
| CP, % | 19.9 | 17.8 | 20.0 | 18.5 | 16.8 | 18.2 | 21.4 | 19.2 |
| Ether extract, % | 3.7 | 3.2 | 3.6 | 3.5 | 4.3 | 3.6 | 3.7 | 3.3 |
| Crude fiber, % | 3.6 | 3.6 | 3.0 | 2.8 | 3.4 | 3.5 | 3.5 | 4.6 |
| Cr, ppb | 570 | 710 | 700 | 910 | 560 | 730 | 610 | 800 |

[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 60 to 100 lb and Phase 2 fed from approximately 100 to 135 lb.
[3] KemTRACE Cr (chromium propionate; Kemin Industries Inc., Des Moines, IA).
[4] Micro-Aid (*Yucca schidigera*-based product; Distributors Processing, Inc., Porterville, CA).

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

| | Phase 3 | | | | Phase 4 | | | |
|---|---|---|---|---|---|---|---|---|
| Added Cr, ppb[3]: | 0 | 200 | 0 | 200 | 0 | 200 | 0 | 200 |
| Micro-Aid, ppm[4]: | 0 | 0 | 62.5 | 62.5 | 0 | 0 | 62.5 | 62.5 |
| DM, % | 88.86 | 88.74 | 88.51 | 89.25 | 88.27 | 88.27 | 88.57 | 88.72 |
| CP, % | 16.7 | 16.2 | 16.9 | 15.5 | 15.1 | 15.2 | 15.4 | 14.9 |
| Ether extract, % | 3.8 | 3.8 | 3.8 | 3.7 | 3.7 | 3.6 | 3.8 | 3.6 |
| Crude fiber, % | 3.2 | 3.0 | 3.3 | 3.1 | 3.1 | 3.2 | 3.1 | 2.9 |
| Cr, ppb | 700 | 510 | 770 | 460 | 450 | 560 | 440 | 640 |

[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 135 to 170 lb and Phase 4 fed from approximately 170 to 235 lb.
[3] KemTRACE Cr (chromium propionate; Kemin Industries Inc., Des Moines, IA).
[4] Micro-Aid (*Yucca schidigera*-based product; Distributors Processing, Inc., Porterville, CA).

**Table 4. Chemical analysis of diets, Phase 5 (as-fed basis)[1,2]**

| | Phase 5 | | | |
|---|---|---|---|---|
| Added Cr, ppb[3]: | 0 | 200 | 0 | 200 |
| Micro-Aid, ppm[4]: | 0 | 0 | 62.5 | 62.5 |
| DM, % | 87.56 | 88.87 | 88.73 | 88.25 |
| CP, % | 17.6 | 17.8 | 17.5 | 19.5 |
| Ether extract, % | 3.0 | 3.2 | 3.1 | 3.0 |
| Crude fiber, % | 2.6 | 2.9 | 2.8 | 2.8 |
| Cr, ppb | 550 | 660 | 450 | 580 |

[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 5 was fed from approximately 230 to 280 lb.
[3] KemTRACE Cr (chromium propionate; Kemin Industries Inc., Des Moines, IA).
[4] Micro-Aid (*Yucca schidigera*-based product; Distributors Processing, Inc., Porterville, CA).

**Table 5. Impact of KemTRACE® Cr and Micro-Aid® on finishing pig growth performance and carcass characteristics[1]**

| | | | | | | Probability, $P <$ | | |
|---|---|---|---|---|---|---|---|---|
| Added Cr, ppb:[2] | 0 | 200 | 0 | 200 | | | | MicroAid |
| Micro-Aid, ppm:[3] | 0 | 0 | 62.5 | 62.5 | SEM | MicroAid | Cr | × Cr |
| BW, kg | | | | | | | | |
| d 0 | 60.3 | 60.2 | 60.2 | 60.4 | 1.06 | 0.726 | 0.907 | 0.653 |
| d 39 | 133.4 | 134.4 | 133.2 | 134.4 | 1.74 | 0.916 | 0.099 | 0.906 |
| d 117 | 284.8 | 286.0 | 285.6 | 287.4 | 2.87 | 0.609 | 0.472 | 0.893 |
| Grower (d 0 to 39) | | | | | | | | |
| ADG, lb | 1.87 | 1.90 | 1.87 | 1.90 | 0.023 | 0.713 | 0.026 | 0.989 |
| ADFI, lb | 3.82 | 3.89 | 3.86 | 3.94 | 0.073 | 0.224 | 0.028 | 0.980 |
| F/G | 2.04 | 2.05 | 2.07 | 2.07 | 0.019 | 0.051 | 0.774 | 0.997 |
| Finisher (d 39 to 117) | | | | | | | | |
| ADG, lb | 1.93 | 1.94 | 1.96 | 1.95 | 0.023 | 0.334 | 0.954 | 0.761 |
| ADFI, lb | 5.45 | 5.56 | 5.56 | 5.65 | 0.124 | 0.088 | 0.080 | 0.907 |
| F/G | 2.82 | 2.87 | 2.84 | 2.89 | 0.052 | 0.365 | 0.053 | 0.883 |
| Overall (d 0 to 117) | | | | | | | | |
| ADG, lb | 1.91 | 1.93 | 1.93 | 1.93 | 0.019 | 0.490 | 0.446 | 0.810 |
| ADFI, lb | 4.90 | 4.99 | 4.98 | 5.07 | 0.104 | 0.076 | 0.048 | 0.955 |
| F/G | 2.56 | 2.59 | 2.59 | 2.62 | 0.038 | 0.159 | 0.103 | 0.887 |
| Carcass characteristics[4] | | | | | | | | |
| HCW, lb | 212.1 | 215.1 | 215.0 | 216.8 | 2.41 | 0.160 | 0.139 | 0.715 |
| Backfat, in | 0.668 | 0.696 | 0.679 | 0.690 | 0.0252 | 0.787 | 0.055 | 0.371 |
| Lean, % | 56.9 | 55.9 | 56.8 | 56.5 | 0.41 | 0.261 | 0.014 | 0.158 |
| Loin depth, in | 2.76 | 2.73 | 2.79 | 2.74 | 0.025 | 0.419 | 0.128 | 0.621 |
| Yield, % | 74.51 | 75.23 | 75.27 | 75.44 | 0.456 | 0.254 | 0.302 | 0.511 |

[1] A total of 1,188 finisher pigs (PIC 337 × 1050; initial BW = 60.3 lb) were used in a 117-d, five phase finisher study with 27 pigs per pen and 11 replications per treatment. Pigs were fed in split gender pens, with 5 replicates per gender, and 1 mixed sex replicate. Gender, weight, and location served as blocking factors in allotment to treatment. Treatment diets were fed for the full duration of the trial and were formulated to 60 to 100, 100 to 135, 135 to 170, 170 to 230, and 230 to 280 lb BW ranges.
[2] KemTRACE Cr (chromium propionate; Kemin Industries Inc., Des Moines, IA).
[3] Micro-Aid (*Yucca schidigera*-based product; Distributors Processing, Inc., Porterville, CA).
[4] Backfat, percentage lean, and loin depth were analyzed by adjusting for a common HCW.