Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 10 *Swine Day (1968-2014)*

Article 1036

2004

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Recommended Citation

Groesbeck, C N.; James, B W.; Keegan, T P.; Lawrence, K R.; Goodband, Robert D.; Tokach, Michael D.; Nelssen, Jim L.; DeRouchey, Joel M.; and Dritz, Steven S. (2004) "Interactive effects between pantothenic acid and ractopamine HCl (paylean®) on growth performance and carcass characteristics of growing-finishing pigs," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 10. https://doi.org/10.4148/2378-5977.6876

Interactive effects between pantothenic acid and ractopamine HCl (paylean®) on growth performance and carcass characteristics of growing-finishing pigs

Abstract

Two experiments were conducted to evaluate the interactive effects between added pantothenic acid and ractopamine HCl (PayleanÂ®) on growth performance and carcass traits of growing-finishing pigs. In Exp. 1, 156 pigs (PIC, initial BW = 56.7 Â± 5.8 lb) were used in a 2 Ã— 3 factorial with ractopamine HCl (RAC; 0 or 10 ppm) and added pantothenic acid (PA; 0, 22.5, or 45 ppm). Pigs were fed the assigned PA concentrations from 56.7 to 268.1 lb (d 0 to 98), and were fed RAC for the last 28 d before slaughter. Increasing added PA had no effect (P<0.05) on ADG, ADFI, or feed efficiency (F/G) from d 0 to d 70. A PA Ã— gender interaction (P<0.05) was observed for ADG and F/G from d 71 to 98. Increasing PA increased ADG and F/G in gilts, but not in barrows. Added RAC for the last 28 d before slaughter increased (P<0.001) ADG and F/G for d 71 to 98 and d 0 to 98. Increasing the amount of added PA had no effect (P<0.05) on carcass traits. Adding RAC increased (P<0.001) longissimus muscle area and percentage lean. In Exp. 2, the effects of added PA on N balance of finishing pigs fed RAC were evaluated. A total of 156 barrows (PIC, initial weight = 131.6 lb) were fed added PA (0, 22.5, or 45.0 ppm) for a minimum of eight weeks. A total of 44 pigs were randomly selected from the 156 initial pigs and were moved into individual stainlesssteel metabolism creates. Pigs remained on their respective PA treatments, with or without RAC (10 ppm), for 8 d, were moved out of the collection chambers, and were fed the same diets from d 8 to 28. There were no PA Ã— RAC interactions (P<0.05) observed. Added PA had no effect (P<0.05) on N excretion, N retention, or biological value (BV). Fecal N excretion was greater (P<0.01) for pigs fed RAC, compared with that of the pigs not fed RAC, but urinary N decreased (P<0.01) for the pigs fed RAC, resulting in no difference in total excreted N. Adding RAC increased (P<0.04) BV. No PA (P < 0.05) response was observed for ADG or F/G, and RAC increased (P<0.001) ADG and F/G from d 0 to 28.; Swine Day, 2004, Kansas State University, Manhattan, KS, 2004

Keywords

Swine day, 2004; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 940; Kansas Agricultural Experiment Station contribution ; no. 05-113-S; Growth; Pantothenic acid; Pigs; Ractopamine hcl; Vitamin; Swine

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INTERACTIVE EFFECTS BETWEEN PANTOTHENIC ACID AND RACTOPAMINE HCl (PAYLEAN®) ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF GROWING-FINISHING PIGS[1]

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Summary

Two experiments were conducted to evaluate the interactive effects between added pantothenic acid and ractopamine HCl (Paylean®) on growth performance and carcass traits of growing-finishing pigs. In Exp. 1, 156 pigs (PIC, initial BW = 56.7 ± 5.8 lb) were used in a 2 × 3 factorial with ractopamine HCl (RAC; 0 or 10 ppm) and added pantothenic acid (PA; 0, 22.5, or 45 ppm). Pigs were fed the assigned PA concentrations from 56.7 to 268.1 lb (d 0 to 98), and were fed RAC for the last 28 d before slaughter. Increasing added PA had no effect (P<0.05) on ADG, ADFI, or feed efficiency (F/G) from d 0 to d 70. A PA × gender interaction (P<0.05) was observed for ADG and F/G from d 71 to 98. Increasing PA increased ADG and F/G in gilts, but not in barrows. Added RAC for the last 28 d before slaughter increased (P<0.001) ADG and F/G for d 71 to 98 and d 0 to 98. Increasing the amount of added PA had no effect (P<0.05) on carcass traits. Adding RAC increased (P<0.001) longissimus muscle area and percentage lean. In Exp. 2, the effects of added PA on N balance of finishing pigs fed RAC were evaluated. A total of 156 barrows (PIC, initial weight = 131.6 lb) were fed added PA (0, 22.5, or 45.0 ppm) for a minimum of eight weeks. A total of 44 pigs were randomly selected from the 156 initial pigs and were moved into individual stainless-steel metabolism creates. Pigs remained on their respective PA treatments, with or without RAC (10 ppm), for 8 d, were moved out of the collection chambers, and were fed the same diets from d 8 to 28. There were no PA × RAC interactions (P<0.05) observed. Added PA had no effect (P<0.05) on N excretion, N retention, or biological value (BV). Fecal N excretion was greater (P<0.01) for pigs fed RAC, compared with that of the pigs not fed RAC, but urinary N decreased (P<0.01) for the pigs fed RAC, resulting in no difference in total excreted N. Adding RAC increased (P<0.04) BV. No PA (P < 0.05) response was observed for ADG or F/G, and RAC increased (P<0.001) ADG and F/G from d 0 to 28.

(Key Words: Growth, Pantothenic Acid, Pigs, Ractopamine HCl, Vitamin.)

Introduction

Pantothenic acid is one of four major B vitamins (riboflavin, niacin, thiamine) that are responsible for several metabolic and regulatory functions. Pantothenic acid is active in oxidation and acetylation reactions, the citric-acid cycle, fatty-acid synthesis, and cholesterol synthesis in the form of coenzyme A

[1]Appreciation is expressed to DSM (Parsippany, NJ) for providing the vitamin premix used in this experiment.
[2]Food Animal Health and Management Center.

(CoA) and the acyl carrier protein (ACP). These processes are essential to maximize weight gain and efficiency. The National Research Council estimates that growing-finishing pigs have a pantothenic acid requirement of 6.0 to 10.5 ppm, and a typical corn-soybean meal diet will supply between 8.0 and 10.0 ppm pantothenic acid to the pig. Pantothenic acid in corn and soybean meal is approximately 100% bioavailable to the pig. There is evidence that increasing pantothenic acid may improve carcass leanness in pigs. Research conducted at Iowa State University showed that increasing dietary pantothenic acid (0 to 120 ppm added pantothenic acid) reduced subcutaneous fat thickness and increased loin eye area. Carcass lean content was increased by <1% for pigs fed 45 ppm PA. Additional feed-industry studies showed no improvement in loin eye area and only a numerical improvement in tenth-rib fat depth in pigs given supplemental pantothenic acid. The objective of our studies was to further evaluate the effects of increasing pantothenic acid on pig performance and carcass composition and determine the interactive effects of ractopamine HCl (RAC) and pantothenic acid in growing-finishing pigs.

Procedures

The Kansas State University Animal Care and Use Committee approved all experimental protocols used in these experiments.

Experiment 1. A total of 156 PIC pigs (PIC, Franklyn, KY), with initial BW of 56.7 ± 5.8 lb, were used. Pigs were blocked by weight and sex, and randomly allotted to one of six dietary treatments. There were 42 pens of barrows and 36 pens of gilts, with two pigs per pen and 13 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. Pigs were fed, in meal form, the experimental diets based on corn-soybean meal in four phases (Table 1). Dietary treatments consisted of a control diet (no added pantothenic acid), or the control diet with 22.5 or 45.0 ppm added pantothenic acid from d-calcium pantothenate. Ractopamine HCl (RAC; 0 or 10 ppm; Elanco, Indianapolis, IN) was fed the last 28 d before slaughter. Dietary treatments were fed from d 0 to market (56.7 to 268.1 lb). All diets contained 0.15% L-lysine HCl. The vitamin premix contained no pantothenic acid and was formulated to provide approximately 300% of the National Research Council's estimate for niacin, riboflavin, B_{12}, and vitamins A, D, E, and K. A pantothenic acid premix was prepared with d-calcium pantothenate, corn starch, and corn to equal 6 lb. Corn added to the premix was subtracted from the bulk ingredient addition. The pantothenic acid premix was added to the diet during the micro-ingredient addition.

Pigs and feeders were weighed every 14 d to calculate ADG, ADFI, and F/G. At the conclusion of the growth study, all pigs in each pen were tattooed to maintain individual pig identity and were transported to a commercial packing facility (R. C. Pork, Downs, KS). Hot-carcass weight was measured at the packing facility. Carcasses were chilled for 6 h and then backfat was measured with a ruler at the first and last rib and last lumbar vertebrae. Longissimus muscle area and tenth-rib backfat were traced onto acetate paper and measured on the left side of all carcasses.

Experiment 2. A total of 156 barrows, initially 131.6 lb, were used in the selection process for the 44 pigs used in Exp. 2. The 156 pigs were fed in two groups of 78 pigs, with 13 pigs per pen and 2 pens per dietary treatment. Pigs had ad libitum access to feed and water, and were housed in 6 × 15 ft pens with partly slatted concrete floors. Pigs were fed, in meal form, the experimental acclimation diet based on corn-soybean meal for at least eight weeks (Table 1) The acclimation diet was identical to the phase 4 diet without RAC used in Exp.1, with dietary treatments consisting of a control diet (no added pantothenic acid), or the control diet with 22.5 or

45.0 ppm added pantothenic acid from d-calcium pantothenate. As in Exp. 1, a 6-lb pantothenic acid premix (d-calcium pantothenate, corn starch, and corn) was prepared before manufacturing diets, and was added to the diet during micro-ingredient addition.

Twelve pigs were selected with an average weight of 207.3 lb at the end of eight weeks and were moved to individual, stainless-steel metabolism crates (2 × 5 ft) designed for separate collection of feces and urine. Each pig was immediately fed the original corresponding pantothenic acid concentration, with or without ractopamine HCl (RAC; 0 or 10 ppm) on d 0, resulting in two pigs per dietary treatment. Each pig was allowed three d (d 0 to 3) to adapt to the dietary treatments, then total fecal and urine were collected (d 3 to 6). Ferric oxide (1% of the diet) was used as an indigestible marker to identify the beginning and end of the fecal collection period. It was added to the first meal of the collection period (d 3), and the fecal collection began with the appearance of marked feces. The marker was also added to the seventh meal, and fecal collection stopped with the appearance of marked feces. Feces were collected twice daily, the weight was recorded, and the feces were pooled for each pig, and stored at -20°C for later analysis. Feces were dried at 55°C and ground through a Wily mill. After grinding, a subsample was collected for analysis of DM and N. Urine was collected into plastic bottles containing 25 mL of 6 *N* HCl. Urine volume was recorded, and 10% of the daily collection was stored at -20°C, for later analysis for DM and N. Feces and urine were analyzed for GE by using adiabatic bomb calorimetery. Data was used to calculate GE, DE, ME, N intake, fecal and urinary N, N retention, percentage of N retention, and biological value. Pigs were initially fed 3% of body weight, increasing the percentage fed to maximize feed intake until the start of the collection period, at which time feed intake was held constant. Feed was divided into two equal meals and fed at 5:30 a.m. and 5:30 p.m. each day; pigs were allowed ad libitum access to water. Pigs were removed from the metabolism chambers on d 8 and were fed the same treatment diets for an additional 20 d, for a total of 28 d on treatment diets. A second set of twelve pigs were removed from the original group of 78 pigs and moved to the metabolism chambers according to the same protocol. Because of the rapid changes in protein deposition in pigs fed RAC, we performed the replication with four sets of new pigs, for a total of 44 pigs. On d 28 of the treatment diets, pigs were weighed, tattooed to maintain pig identity, and transported to the KSU Meats Lab. Hot-carcass weight and leaf fat were collected at time of harvest. Cold-carcass weight and backfat were measured 24 hours after harvest. Longissimus muscle area and tenth-rib backfat were traced from the left side of all carcasses. Color, marbling, and firmness were visually scored according to NPPC specifications. A one-inch core sample was removed from each carcass loin for drip-loss analysis.

Statistical Analyses. Analysis was performed by using MIXED procedure in SAS v. 8.1. Pigs were blocked by weight and gender in Exp. 1 and by weight in Exp. 2. Data in Exp. 1 and 2 were analyzed as a 2 × 3 factorial. The model statements included contrasts for linear and quadratic effects of increasing pantothenic acid.

Results

Experiment 1. From d 0 to 70, increasing added pantothenic acid had no effect ($P<0.05$) on ADG, ADFI, or F/G (Table 2). As expected, barrows had a greater ADG ($P<0.001$) and ADFI ($P<0.01$) than gilts had. When RAC was fed (d 71 to 98), there was no pantothenic acid × RAC × gender or pantothenic acid × RAC interactions ($P<0.05$) observed. But a pantothenic acid × gender interaction ($P>0.05$) was observed for ADG and F/G. Increasing the amount of added pantothenic acid increased ADG and F/G in gilts, but not in barrows. The response observed d 71 to 98 re-

sulted in a similar response for the overall feeding period (d 0 to 98). Average daily gain and F/G increased with pantothenic acid addition in gilts, but no differences were observed for ADG and F/G in barrows (Table 3). Adding RAC increased (P<0.001) ADG and improved (P<0.001) F/G from d 71 to 98 and for the overall feeding period (Table 2). Pigs fed the RAC treatments had a greater (P<0.01) final weight than pigs fed diets containing no RAC.

There were no pantothenic acid × RAC or RAC × gender interactions observed for carcass traits. Increasing the amount of added pantothenic acid had no effect (P<0.05) on carcass traits (Table 4). Adding RAC increased (P<0.001) longissimus area and percentage lean and decreased (P<0.02) tenth-rib and last-lumbar fat depth (Table 4). Gilts had a greater (P<0.01) dressing percentage and percentage lean than barrows had. Gilts also had less (P<0.01) average backfat and a tendency toward having a smaller (P<0.06) loin eye area than barrows did.

Experiment 2. There were no pantothenic acid × RAC interactions (P<0.05) observed. There was no pantothenic acid (P<0.05) response of ADG or F/G. (Table 5). Ractopamine HCl improved (P<0.001) ADG and F/G from d 0 to 8, 8 to 28, and for the overall feeding period, and pigs in RAC treatments also had a greater (P<0.001) final weight than did pigs fed dietary treatments containing no RAC. In Exp. 1, there was a 16% improvement in ADG, with approximately a 6.5-lb increase in final weight, compared with the weight of pigs fed the non-RAC dietary treatment. An 11% improvement in F/G was also observed in pigs fed the RAC dietary treatments, compared with the F/G of pigs fed the non-RAC dietary treatments in Exp. 1. In Exp. 2, there was approximately an 11-lb improvement in final weight, compared with the weight of pigs fed the non-RAC dietary treatments. With the increase in growth performance for pigs fed RAC, N retention and BV are expected to increase.

In Exp. 2, added pantothenic acid had no effect (P<0.05) on N excretion, N retention, or BV%, but fecal N excretion was greater (P<0.01) for the pigs fed RAC, compared with that of pigs fed the diets containing no RAC, and urinary N decreased (P<0.01) for the pigs fed RAC, resulting in no significant difference in total excreted N. But the pigs fed the RAC dietary treatments did have a numerically lower value for total N excreted. Adding RAC increased (P<0.04) BV and numerically increased (P<0.07) N retained as a percentage of N intake.

There were no pantothenic acid × RAC interactions (P<0.05) observed for carcass traits. Increasing pantothenic acid had no effect (P<0.05) on carcass traits (Table 6), but there was a linear effect (P<0.04) observed for hot-carcass weight and cold-carcass weight as the amount of added pantothenic acid increased. Adding RAC increased (P<0.001) hot-carcass weight and cold-carcass weight. Leaf fat decreased (P<0.04) with the addition of RAC, and RAC also had a tendency (P<0.06) to increase drip loss, compared with that of pigs not fed RAC.

Our data suggest that adding increasing amounts of pantothenic acid to diets during the growing-finishing phase does not provide any consistent advantage in growth performance or carcass composition of finishing pigs. Adding RAC improves ADG, F/G, and percentage lean.

Table 1. Ingredient and Chemical Composition of Diets (Exp. 1, and 2; As-fed Basis)[a]

Item	Phase 1	Phase 2	Phase 3	Phase 4[b]
Ingredient, %				
Corn	67.41	72.74	78.12	74.49
Soybean meal (46.5% CP)	30.03	24.60	19.17	22.80
Monocalcium phosphate (21% P)	0.75	0.85	0.90	0.85
Limestone	1.00	1.00	1.00	1.00
Salt	0.35	0.35	0.35	0.35
Vitamin premix[c]	0.15	0.15	0.15	0.15
Trace mineral premix[d]	0.15	0.15	0.15	0.15
Corn starch[e]	0.01	0.01	0.01	0.06
L-Lysine HCl	0.15	0.15	0.15	0.15
	100.00	100.00	100.00	100.00
Calculated Analysis				
Total lysine, %	1.20	1.05	0.90	1.00
ME, kcal/lb	1,509	1,509	1,509	1,508
CP, %	19.7	17.6	15.6	16.9
Ca, %	0.64	0.64	0.64	0.64
P, %	0.55	0.55	0.54	0.54
Available P, %	0.23	0.25	0.25	0.24
Lysine:calorie ratio, g/Mcal	0.31	0.32	0.33	0.32

[a]Exp. 1, dietary treatments were fed in four phases, d 0 to 28, 29 to 56, 57 to 70, and 71 to 98, with analyzed pantothenic acid concentrations of 12.5, 10.1, 8.75, and 8.12 ppm, respectively, in the basal diets.

[b]Exp. 2, dietary treatments were fed for an eight-week acclimation period, and then RAC was added at 0 or 10 ppm for 28 d, with analyzed pantothenic acid concentrations of 8.63 and 8.02 ppm, respectively.

[c]Provided (per lb of diet): 3,000 IU of vitamin A; 450 IU of vitamin D_3; 12 IU of vitamin E; 1.20 mg of vitamin K (as menadione sodium bisulfate); 15 mg niacin; 2.7 mg of riboflavin; and 0.011 mg of B_{12}.

[d]Provided (per lb of the diet): 18 mg of Mn (oxide), 78 mg of Fe (sulfate), 75 mg of Zn (oxide), 8 mg of Cu (sulfate), 0.14 mg of I (as Ca iodate), and 0.14 mg of Se (as Na selenite).

[e]Corn starch was replaced with d-calcium pantothenate, resulting in three dietary treatments (0.0, 22.5, and 45.0 added pantothenic acid). RAC replaced corn starch in phase 4 to provide 10 ppm.

Table 2. Effects of Increasing Dietary Pantothenic Acid (PA) on Growth Performance of Finishing Pigs Fed Ractopamine HCl (RAC), Exp. 1 (As-fed Basis)[a]

	RAC, ppm													
	0.0			10.0										
	Added Pantothenic Acid, ppm							Probability, P <						
Item	0.0	22.5	45.0	0.0	22.5	45.0	SE	PA	Linear	Quadratic	RAC	Gender	RAC X PA	PA X Gender
Day 0 to 70														
Initial wt, lb	55.63	55.59	55.60	---	---	---	1.68	0.69	0.57	0.52	---	0.57	---	0.18
ADG, lb	2.12	2.12	2.09	---	---	---	0.02	0.43	0.25	0.54	---	0.0001	---	0.79
ADFI, lb	5.16	5.12	5.04	---	---	---	0.08	0.41	0.19	0.80	---	0.01	---	0.45
F/G	2.44	2.42	2.42	---	---	---	0.03	0.79	0.51	0.84	---	0.68	---	0.22
Day 71 to 98														
Day 70 wt, lb	208.44	205.30	204.10	203.40	204.44	201.37	3.03	0.29	0.12	0.76	0.09	0.01	0.59	0.85
ADG, lb	2.04	2.05	2.08	2.44	2.44	2.49	0.07	0.74	0.51	0.68	0.001	0.25	0.99	0.01
ADFI, lb	6.54	6.44	6.28	6.45	6.18	6.52	0.16	0.50	0.53	0.32	0.82	0.01	0.22	0.24
F/G	3.22	3.03	2.95	2.69	2.64	2.70	0.08	0.20	0.09	0.51	0.001	0.14	0.16	0.03
Day 0 to 98														
Final wt, lb	264.85	262.68	262.35	271.79	272.63	270.97	3.93	0.84	0.56	0.95	0.01	0.01	0.87	0.14
ADG, lb	2.13	2.10	2.10	2.17	2.20	2.19	0.03	0.93	0.81	0.76	0.001	0.001	0.59	0.21
ADFI, lb	5.63	5.53	5.44	5.44	5.39	5.42	0.08	0.49	0.25	0.80	0.13	0.01	0.63	0.72
F/G	2.65	2.63	2.59	2.50	2.45	2.48	0.04	0.26	0.13	0.55	0.001	0.66	0.58	0.02

[a]A total of 156 pigs (PIC, initial BW = 56.7 ± 5.8 lb) were used in the experiment. The values represent two pigs per pen and 13 pens per treatment.

Table 3. Effects of Increasing Dietary Pantothenic Acid (PA) on Growth Performance of Barrows and Gilts Fed Ractopamine HCl (RAC), Exp. 1 (As-fed Basis)[a]

	Gender							
	Barrow				Gilt			
	Added Pantothenic Acid, ppm							
Item	0.0	22.5	45.0	SE	0.0	22.5	45.0	SE
Day 71 to 98								
ADG, lb[b]	2.41	2.25	2.26	0.07	0.94	1.01	1.04	0.04
ADFI, lb	6.89	6.44	6.69	0.18	2.77	2.80	2.76	0.08
F/G[b]	2.93	2.90	2.98	0.8	0.34	0.36	0.38	0.01
Day 0 to 98								
ADG, lb	2.25	2.23	2.20	0.03	0.93	0.94	0.95	0.02
ADFI, lb	5.73	5.66	5.69	0.11	2.42	2.39	2.34	0.06
F/G[b]	2.54	2.54	2.59	0.04	0.38	0.40	0.41	0.01

[a]A total of 156 pigs (PIC, initial BW = 56.7 ± 5.8 lb) were used in the experiment. The values represent two pigs per pen and 13 pens per treatment.
[b]Added pantothenic acid × gender interactions $P<0.05$.

Table 4. Effects of Increasing Dietary Pantothenic Acid (PA) on Carcass Characteristics of Finishing Pigs Fed Ractopamine HCL (RAC), Exp. 1[ab]

	RAC, ppm							Probability, P <						
	0.0			10.0										
	Added Pantothenic Acid, ppm													
Item	0.0	22.5	45.0	0.0	22.5	45.0	SE	PA	Linear	Quadratic	RAC	Gender	RAC PA	PA X Gender
Dressing percentage	74.86	75.93	76.13	74.11	73.06	74.35	1.50	0.79	0.56	0.74	0.09	0.01	0.71	0.09
Hot-carcass wt, lb	194.71	193.25	193.33	203.02	203.16	202.86	2.93	0.75	0.55	0.66	0.53	0.66	0.76	0.53
Backfat measurement, in														
First rib[c]	1.65	1.64	1.63	1.62	1.65	1.67	0.06	0.93	0.73	0.86	0.17	0.03	0.76	0.29
Last rib[c]	0.93	0.99	0.94	0.91	0.92	0.87	0.03	0.51	0.68	0.28	0.59	0.001	0.63	0.08
Last lumbar[c]	0.71	0.69	0.66	0.61	0.60	0.59	0.03	0.38	0.17	0.79	0.02	0.01	0.86	0.96
Avg backfat[c]	1.09	1.10	1.08	1.05	1.06	1.05	0.03	0.90	0.69	0.85	0.92	0.01	0.93	0.23
Tenth rib[c]	0.67	0.63	0.65	0.53	0.58	0.59	0.03	0.79	0.54	0.77	0.02	0.01	0.13	0.17
Percentage lean[c]	56.96	57.49	57.67	60.05	59.33	59.27	0.50	0.98	0.95	0.89	0.001	0.001	0.28	0.26
Longissimus muscle area, in[c]	8.19	8.23	8.48	9.00	8.89	8.86	0.18	0.93	0.82	0.77	0.001	0.06	0.59	0.68

[a]A total of 156 pigs (PIC, initial BW = 57.8± 5.8 lb) were used in the experiment. The values represent two pigs per pen and 13 pens per treatment.
[b]There were no PA × RAC × Gender, PA × Gender, or RAC × PA interactions observed P<0.05.
[c]Covariate with hot-carcass weight.

Table 5. Effects of Increasing Dietary Pantothenic Acid (PA) on Growth of Finishing Pigs Fed Ractopamine HCl (RAC), Exp. 2[a]

	RAC, ppm							Probability, P <				
	0.0			10.0								
	Added Pantothenic Acid, ppm											
Item	0.0	22.5	45.0	0.0	22.5	45.0	SE	PA	Linear	Quadratic	RAC	RAC X PA
Pre-feeding period (131.6 to 209.3 lb)[b]												
ADG, lb	2.20	2.18	2.20	---	---	---	0.02	0.60	0.87	0.36	---	---
ADFI, lb	6.39	6.32	6.20	---	---	---	0.09	0.49	0.23	0.74	---	---
F/G	2.90	2.90	2.82	---	---	---	0.02	0.24	0.16	0.32	---	---
Metabolism (d 0 to 8)[c]												
Initial wt, lb	209.3	212.4	209.9	205.9	208.7	210.31	12.06	0.07	0.07	0.16		
ADG, lb	2.60	2.33	2.57	3.12	3.05	3.26	0.20	0.47	0.77	0.23	0.002	0.85
ADFI, lb	6.32	6.36	6.34	6.21	6.34	6.35	0.18	0.14	0.10	0.25	0.32	0.45
F/G	2.47	3.05	2.49	2.03	2.14	2.02	0.21	0.36	0.10	0.16	0.001	0.90
Post-feeding (d 8 to 28)[d]												
Initial wt, lb	231.37	233.50	232.87	234.00	236.50	239.89	13.97	0.27	0.12	0.82	0.03	0.58
ADG, lb	1.98	2.37	2.30	2.72	2.86	2.62	0.37	0.246	0.48	0.14	0.001	0.39
ADFI, lb	6.68	7.64	6.79	6.18	7.61	6.79	0.79	0.01	0.34	0.004	0.56	0.74
F/G	3.55	3.60	3.08	2.40	2.69	2.65	0.28	0.49	0.79	0.26	0.001	0.26
Entire RAC period (d 0 to 28)												
ADG, lb	2.20	2.39	2.38	2.86	2.95	2.85	0.23	0.46	0.46	0.33	0.001	0.70
ADFI, lb	6.60	7.22	6.64	6.22	7.20	6.67	0.51	0.01	0.32	0.01	0.54	0.65
F/G	3.06	3.17	2.87	2.18	2.46	2.33	0.16	0.37	0.93	0.16	0.001	0.42
Final wt, lb	266.83	277.00	273.74	282.45	287.32	286.49	10.29	0.07	0.10	0.10	0.001	0.72

[a]A total of 156 barrows with initial weight of 131.6 lb.

[b] Pre-feeding period was a minimum of an eight-week acclimation period.

[c]A total of 48 pigs were selected from the original 156 pigs for the metabolism portion of the trial.

[d]A total of 44 pigs were fed in the post-feeding period of the trial; four pigs were removed from treatment during the metabolism portion of the trial.

Table 6. Effects of Increasing Dietary Pantothenic Acid (PA) on Carcass Characteristics of Finishing Pigs Feed Ractopamine HCL (RAC), Exp. 2[a]

	RAC, ppm											
	0.0			10.0								
	Added Pantothenic Acid, ppm							Probability, P <				
Item	0.0	22.5	45.0	0.0	22.5	45.0	SE	PA	Linear	Quadratic	RAC	RAC X PA
Dressing percentage	70.94	70.30	71.21	71.40	71.40	72.19	0.76	0.38	0.37	0.27	0.09	0.84
Hot-carcass wt, lb	189.40	194.54	194.95	201.72	205.15	206.86	8.24	0.10	0.04	0.48	0.001	0.94
Cold-carcass wt, lb	184.41	188.95	189.54	196.41	199.24	201.43	8.50	0.12	0.05	0.61	0.001	0.93
Backfat measurement, in												
First rib[b]	1.21	1.28	1.26	1.19	1.44	1.28	0.09	0.24	0.47	0.13	0.53	0.61
Last rib[b]	0.84	0.88	0.85	0.83	0.80	0.86	0.05	0.91	0.70	0.87	0.51	0.69
Last lumbar[b]	0.80	0.82	0.78	0.77	0.83	0.89	0.06	0.58	0.33	0.72	0.55	0.26
Average backfat[b]	0.96	1.00	0.97	0.93	1.02	1.00	0.05	0.41	0.42	0.30	0.89	0.81
Tenth rib[b]	0.85	0.93	0.85	0.79	0.73	0.85	0.07	0.87	0.61	0.92	0.20	0.27
Percentage lean[b]	53.72	51.55	54.63	55.19	55.32	54.26	1.46	0.61	0.99	0.32	0.18	0.22
Longissimus muscle area, in[b]	7.36	6.68	7.83	7.92	7.66	7.74	0.45	0.22	0.69	0.09	0.19	0.34
Leaf fat, lb	3.26	3.37	2.76	2.43	2.51	2.66	0.32	0.14	0.67	0.55	0.04	0.40
Color [c]	2.38	2.26	2.11	1.94	2.40	2.05	0.24	0.48	0.71	0.25	0.47	0.71
Marbling [d]	1.44	1.21	1.21	1.25	1.21	1.29	0.13	0.60	0.48	0.48	0.72	0.48
Firmness[e]	1.88	1.90	1.61	1.69	1.90	1.51	0.33	0.12	0.17	0.11	0.46	0.17
Drip loss, %	6.39	6.87	8.06	9.74	7.26	9.61	1.17	0.32	0.49	0.17	0.06	0.41

[a]A total of 44 barrows with initial weight of 131.6 lb were fed pantothenic acid dietary treatments for eight weeks and fed RAC diets for 28 d.
[b]Covariate with hot-carcass weight.
[c]Scoring system of 1 to 5: 2=grayish pink; 3=reddish pink; 4=purplish red.
[d]Scoring system of 1 to 5: 2=traces to slight; 3=small to modest; 4=moderate to slightly abundant.
[e]Scoring system of 1 to 5: 2=soft and exudative; 3=slightly firm and moist; 4=firm and dry.

Table 7. Effects of Increasing Dietary Pantothenic Acid on Nitrogen Balance of Finishing Pigs Feed Ractopamine HCl (RAC)[a]

	RAC, ppm											
	0.0			10.0								
	Added Pantothenic Acid, ppm							Probability, P <				
Item	0.0	22.5	45.0	0.0	22.5	45.0	SE	PA	Linear	Quadratic	RAC	RAC X PA
DM digestibility, %	71.38	72.10	73.14	71.86	72.05	69.63	1.87	0.86	0.85	0.60	0.32	0.24
N digestibility, %	72.23	72.92	70.06	66.57	66.10	69.76	0.05	0.98	0.87	0.96	0.13	0.60
DE, kcal/g	3265	3398	3350	3351	3345	3200	83.60	0.35	0.63	0.17	0.48	0.22
ME, kcal/g	3129	3263	3225	3234	3227	3082	89.40	0.36	0.67	0.17	0.65	0.18
N intake, g/d	86.55	88.95	88.24	87.37	88.76	89.24	3.77	0.22	0.15	0.34	0.59	0.86
Fecal N, g/d	25.65	26.12	26.10	29.42	27.59	32.89	1.78	0.32	0.28	0.29	0.01	0.35
Urinary N, g/d	36.30	38.90	35.83	28.51	30.61	28.42	3.00	0.57	0.92	0.30	0.01	0.99
Total N, g/d	61.94	65.02	61.93	57.93	58.20	61.28	3.45	0.85	0.62	0.77	0.17	0.66
N retained, g/d	24.61	23.93	26.31	29.44	30.55	26.93	5.31	0.99	0.97	0.95	0.07	0.68
BV, %	39.29	38.07	41.91	50.16	48.68	46.88	0.06	0.94	0.94	0.75	0.01	0.75
N retained as % N intake	27.77	27.08	29.93	33.43	33.90	30.24	4.99	0.98	0.88	0.96	0.13	0.60

[a]A total of 44 barrows with initial weight of 131.6 lb were fed pantothenic acid dietary treatments for eight weeks and fed RAC diets for 28 d.