Director's Digest

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#313

Evaluation of the Effects of Dietary Fat, Conjugated Linoleic Acid, and Ractopamine on Growth Performance and Carcass Quality in Genetically Lean Gilts

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Introduction:

The pork industry is constantly seeking economical methods which will increase production efficiency and carcass quality. Three nutritional management "tools" at pork producer's disposal that have been demonstrated to improve growth performance and carcass characteristics are: 1) adding rendered animal fats to diets; 2) adding the recently approved feed additive ractopamine to finishing diets; and 3) adding conjugated linoleic acid (CLA) to diets. Adding animal fats to diets has long been known to enhance the feed efficiency of finishing swine. Supplementing swine diets with CLA has been shown to improve feed efficiency and enhance carcass quality by increasing lean percentage and belly firmness. Ractopamine, when added to finishing swine diets, increases growth performance, carcass lean, and carcass yield. However, limited research has been conducted as to the interactions and combined effects of dietary fat, CLA, and ractopamine.

Objective:

The goal of this experiment was to determine the individual and combined effects of dietary fat, CLA, and ractopamine on the growth performance and carcass quality of a genetically lean population of gilts.

Industry Summary:

Gilts (n = 180; Newsham XL sires x Newsham parent females; initial BW = 130 lb) were assigned to a 2 x 2 x 3 factorial arrangement consisting of dietary CLA, ractopamine, and fat treatments. The CLA treatment consisted of a 1% commercially available CLA product containing 60% CLA isomers (.6% CLA) or 1% soybean oil. Ractopamine levels were either 0 or 9 g/ton. Dietary fat treatments consisted of: 1) diets containing 0% added fat; 2) diets containing 5% choice white grease; or 3) diets containing 5% beef tallow. The CLA and dietary fat treatments were initiated at 130 lb BW, 4 weeks prior to the ractopamine treatments. Theractopamine treatments were imposed when the gilts reached an average body weight of 188 lb and lasted for the duration of the final four weeks until carcass data were collected.

For the overall experimental period (wk 0 to 8) gilts fed 9 g/ton ractopamine had greater daily gain (2.20 vs.2.06) and improved feed conversion (2.48 vs.2.78) than gilts fed 0 g/ton ractopamine. Feeding diets containing 0.6% CLA improved (2.52 vs.2.61) feed conversion, but had no effect upon daily gain nor feed intake. Dietary fat increased the average daily gain (2.15 vs.2.09), decreased feed intake (5.39 vs.5.61), and improved feed conversion (2.50 vs.2.69) compared to gilts fed diets containing 0% added fat. Final body weights were increased 8.6 lbs by feeding 9 g/ton ractopamine and 5.32 lbs by adding 5% fat to the diets. Feeding diets containing 9 g/ton ractopamine increased carcass weight 8.6 lbs and dressing percentage by 1.4 units. Adding 5% fat to the diets increased carcass weight 4.9 lbs and dressing percentage by 0.71 units. Predicted lean percentage was increased by 1.6% (57.8 vs.56.2 %) by feeding ractopamine. Gilts fed diets containing 5% fat had slightly increased 10th rib (0.69 vs.0.66), and last rib fat depth (0.72 vs.0.79). Gilts fed diets containing ractopamine (7.15 vs.7.94 in^2) or 5% added fat (7.67 vs.7.30 in^2) had greater loin eye areas than gilts fed diets devoid of ractopamine or fat. Loin eye area was (7.69 vs.7.41 in^2) increased in gilts fed CLA as compared to gilts fed diets containing no added CLA. Gilts fed either CLA or added fat had numerically greater marbling scores than gilts fed diets devoid of CLA or fat.

The results of this research support previous research in which feeding diets containing added fat increases feed conversion efficiency. The enhancement in growth efficiency was not different between beef tallow and choice white grease which demonstrates that the two fat sources are comparable to one another in terms of the improvement in growth performance realized. By feeding 5% added dietary fat for eight weeks to genetically lean gilts increases carcass weight without affecting the predicted percentage lean in the carcass. As expected, feeding gilts diets containing ractopamine increased growth performance and carcass content. The impact of dietary fat to increase growth rate and improve feed efficiency tended to be greater in ractopamine fed pigs. In addition, CLA enhanced feed efficiency and increased the predicted percent lean in the population of lean gilts used in this trial.

Currently, 9 g ractopamine per ton costs approximately $20.00/ton of feed. The response to ractopamine substantially declines after 4 weeks. Feeding dietary fat increases ADG when ractopamine is fed such that more carcass weight can be gained before the ractopamine response declines. The addition of dietary fat to ractopamine-supplemented diets will maximize carcass weight gain. The combined use of dietary fat and ractopamine will reduce sort losses and allow more rapid close out of finishers utilizing all-in/all-out management.

With 4.9 lbs of carcass weight gain, gross income increased $2.94/head by feeding 5% dietary fat from 130-250 pounds. With the 2.50 versus 2.69 feed conversion for diets without dietary fat, the break-even price for the fat-added diets increases by $28.73/ton ($120.00 vs.$148.73) to result in equal net profit above costs.

FPRF Comments:

This study is highly supportive for the use of animal fat in the diet of grow-finish swine. In particular swine with high lean gain potential genetics and in combination with lean tissue enhancing compounds. Of current interest is the product marketed by Elanco Products as Paylean® (Ractopamine). This product was recently approved by the FDA for use as lean tissue enhancer in finishing swine diets. Its adaptation into the rations of swine is increasing steadily. The use of animal feeding fats should be recommended as a complimentary ingredient for enhancement of benefits to pork quality. Carcass weight gain, feed efficiency and gross income.

Research data is limited concerning the combination feeding of either 5% tallow or 5% choice white grease with Paylean®. Dr. Schinckel has submitted several abstracts, popular press articles and verbal presentations. The work is completed, there will be additional carcass information to follow. The very positive results of increasing the energy concentration of diets containing Paylean® should be conveyed to your pork producers. Additionally the use of animal fats in improving feed efficiency should again be used as reinforcement to keep pork producers informed.

Scientific Abstract:

Gilts (n = 180; Newsham XL sires × Newsham parent females; initial BW = 130 lb) were assigned to a 2 × 2 × 3 factorial arrangement consisting of dietary CLA, ractopamine, and fat treatments. The CLA treatment consisted of a 1% commercially available CLA product containing 60% CLA isomers (0.6% CLA) or 1% soybean oil (Table 4). Ractopamine levels were either 0 or 9 g/ton. Dietary fat treatments consisted of: 1) diets containing 0% added fat; 2) diets containing 5% choice white grease (CWG); or 3) diets containing 5% beef tallow (BT). The CLA and dietary fat treatments were initiated at 130 lb BW, 4 weeks prior to the ractopamine treatments. The ractopamine treatments were imposed when the gilts reached an average body weight of 188 lb and lasted for the duration of the final four weeks until carcass data were collected.

For the overall experimental period (wk 0 to 8) gilts fed 9 g/ton ractopamine had greater ($P < 0.01$) daily gain (2.20 vs. 2.06) and improved feed conversion (2.48 vs. 2.78) than gilts fed 0 g/ton ractopamine (Tables 4 and 5). Feeding diets containing 0.6% CLA improved (2.52 vs. 2.61; $P < 0.01$) feed conversion, but had no effect ($P > 0.20$) upon daily gain nor feed intake. Dietary fat increased the average daily gain (2.15 vs. 2.09; $P < 0.10$), decreased feed intake (5.39 vs. 5.61; $P < 0.02$), and improved feed conversion (2.50 vs. 2.69; $P < 0.01$) compared to gilts fed diets containing 0% added fat. Final body weights were increased 8.6 lbs ($P < 0.01$) by feeding 9 g/ton ractopamine and 5.32 lbs ($P < 0.10$) by adding 5% fat to the diets. Feeding diets containing 9 g/ton ractopamine increased carcass weight 8.6 lbs and dressing percentage by 1.4 units. Adding 5% fat, as either CWG or BT, to the diets increased ($P < 0.01$) carcass weight 4.9 lbs and ($P < 0.06$) dressing percentage by 0.71 units. Predicted lean percentage was increased by 1.6% (57.8 vs. 56.2 %; $P < 0.01$) by feeding ractopamine. Gilts fed diets containing 5% fat had slightly increased ($P = 0.20$) 10^{th} rib (0.69 vs. 0.66), and last rib fat depth (0.72 vs.0.79; $P = 0.01$). Gilts fed diets containing ractopamine (7.15 vs.7.94 in^2) or 5% added fat (7.67 vs.7.30 in^2) had greater ($P = 0.01$) loin eye areas than gilts fed diets devoid of ractopamine or fat. Loin eye area was (7.69 vs.7.41 in^2; $P < 0.06$) increased in gilts fed CLA as compared to gilts fed diets containing no added CLA. Gilts fed either CLA or added fat had numerically greater marbling scores than gilts fed diets devoid of CLA or fat.

Introduction:

The pork industry is constantly seeking economical methods which will increase production efficiency and carcass quality. Three nutritional management "tools" at pork producer's disposal that have been demonstrated to improve growth performance and carcass characteristics are: 1) adding rendered animal fats to diets; 2) adding the recently approved feed additive ractopamine to finishing diets; and 3) adding conjugated linoleic acid (CLA) to diets. Adding animal fats to diets has long been known to enhance the feed efficiency of finishing swine (Seerly et al., 1978; Stahly et al., 1979). Supplementing swine diets with CLA has been shown to improve feed efficiency and enhance carcass quality by increasing lean percentage and belly firmness (Dugan et al., 1997; Schinckel et al., 2000). Ractopamine, when added to finishing swine diets, increases growth performance, carcass lean, and carcass yield (Herr et al., 2000). However, limited research has been conducted as to the interactions and combined effects of dietary fat, CLA, and ractopamine.

Objective:

The goal of this experiment was to determine the individual and combined effects of dietary fat, CLA, and ractopamine on the growth performance and carcass quality of a genetically lean population of gilts.

Materials and Methods:

Gilts (n = 180; Newsham XL sires × Newsham parent females; initial BW = 130 lb) were assigned to a 2 × 2 × 3 factorial arrangement consisting of dietary CLA, ractopamine, and fat treatments. The CLA treatment consisted of a 1% commercially available CLA product containing 60% CLA isomers (0.6% CLA) or 1% soybean oil (Table 1). Ractopamine levels were either 0 or 9 g/ton. Dietary fat treatments consisted of: 1) diets containing 0% added fat; 2) diets containing 5% choice white grease (CWG); or 3) diets containing 5% beef tallow (BT). The CLA and dietary fat treatments were initiated at 130 lb BW, 4 weeks prior to the ractopamine treatments. The ractopamine treatments were imposed when the gilts reached an average body weight of 188 lb and lasted for the duration of final 4 weeks until carcass data were collected.

The gilts and feeders were weighed every two weeks to monitor growth performance and feed intake. At the completion of the 4 wk trial when the gilts averaged 247 lb body weight, carcass data were collected at the Purdue University abattoir. Carcass data collected included: carcass weight, 45 minute and 24 hour loin pH, last rib midline backfat depth, 10^{th} rib inner and outer layer backfat thickness, and 10^{th} rib loin eye area. Subjective loin color, marbling, and firmness measurements were taken at the interface of the 10^{th} and 11^{th} rib (NPPC, 1999). In addition, objective loin color (L*, a*, and b*) and water holding capacity were determined. At 24 hours postmortem, belly firmness measurements were recorded by placing the bellies skin side down centered horizontally over a metal bar. Firmness was analyzed as the length measured between the anterior and posterior end of the belly when it was suspended over the bar. Therefore, firmer bellies result in greater values of the length measured between the anterior and posterior ends when suspended over a bar. Additionally, subjective firmness scores (range 1 to 5) were assigned to the bellies with a score of 5 being assigned to the firmest and a score of 1 being assigned to the softest bellies.

Results:

The growth performance data for the duration of the ractopamine treatment (wk 4 to 8) are summarized in Tables 2 and 3. Gilts fed diets containing ractopamine had greater ($P < 0.01$) daily gains and converted feed more efficiently ($P < 0.01$) than gilts fed diets devoid of ractopamine. Gilts fed CLA containing diets had greater ($P < 0.03$) ADG and were more ($P < 0.01$) feed efficient during wk 6 to 8 than gilts not fed CLA. For the last 4 wks of the trial, gilts fed CLA demonstrated greater (P < 0.02) feed efficiency than gilts consuming the 1% soybean oil diets. Adding 5% fat to the diet as either CWG or BT decreased (P < 0.02) feed intake during wk 6 to 8 and wk 4 to 8 while concurrently improving (P < 0.01) feed efficiency during the same time periods. For the overall experimental period (wk 0 to 8) gilts fed 9 g/ton ractopamine had greater daily gain (2.20 vs. 2.06; P < 0.01) and improved feed conversion (2.48 vs. 2.78) than gilts fed 0 g/ton ractopamine (Tables 4 and 5). Feeding diets containing 0.6% CLA improved (2.52 vs. 2.61; P < .01) feed conversion, but had no effect (P > 0.20) upon daily gain nor feed intake. Dietary fat, provided as either CWG or BT, increased (2.15 vs. 2.09; P < 0.10) to increase average daily gain, decreased (5.39 vs. 5.66; P < 0.02) feed intake, and improved (2.50 vs. 2.69; P < 0.01) feed conversion compared to gilts fed diets containing 0% added fat. Final body weights were increased 8.61 lbs (P < 0.01) by feeding 9 g/ton ractopamine and increased 5.32 lbs (P < 0.10) by adding 5% fat to the diets. Gilts fed CLA tended (P < 0.07) to have greater ADG during wk 6 to 8 while also being fed ractopamine compared to gilts fed SBO and ractopamine.

The carcass characteristics data are presented in Tables 6 and 7. Feeding diets containing 9g/ton ractopamine increased (P < 0.01) carcass weight 8.55 lbs and dressing percentage by 1.4 units. It was also found that adding 5% fat as either CWG or BT to the diets increased (P < 0.01) carcass weight 4.9 lbs and increased (P < 0.06) dressing percentage by 0.71 units. Predicted lean percentage was increased by 1.6% (57.8 vs. 56.2 %; P < 0.01) by feeding ractopamine. An increase (P < 0.03) in predicted lean percentage was also found in gilts fed diets containing 0.6% added CLA versus gilts fed 1% soybean oil. Outer layer 10th rib backfat depth was decreased (P < 0.01) and total 10th rib backfat tended (P < 0.10) to decrease in gilts fed either the 9g/ton ractopamine or 0.6% CLA treatments as compared to gilts fed diets devoid of ractopamine or CLA. Adding 5% fat as either CWG or BT to the diet tended (P < 0.09) to increase the outer layer backfat depth. Within the fat treatments, gilts fed diets containing 5% CWG had slightly increased (P = 0.20) 10th rib inner layer, 10th rib (0.69 vs. 0.66) , and last rib fat depth (0.72 vs. 0.79; P = 0.01) and tended (P < 0.07) to have greater 10th rib outer layer backfat depth versus gilts fed diets containing BT. Both the CLA and fat treatments affected last rib fat depth. Gilts fed diets containing CLA had less (P < .01) and gilts fed diets containing fat as either CWG or BT, had increased (P < .01) last rib fat depth as compared to gilts fed diets without CLA or 5% added fat, respectively. Gilts fed diets containing ractopamine (7.15 vs. 7.94 in^2) or 5% added fat (7.67 vs. 7.30 in^2) had greater (P < .01) loin eye areas than gilts fed diets devoid of ractopamine or fat. Loin eye area was (7.69 vs. 7.41 in^2; P < .06) increased in gilts fed CLA as compared to gilts fed diets containing no added CLA.

The data representing the quality characteristics of *longissimus dorsi* and bellies are presented in Tables 8 and 9. Both the CLA and added fat treatments tended (P < .10) to affect subjective marbling scores as gilts fed either CLA or added fat had numerically greater marbling scores than gilts fed diets devoid of CLA or fat. Gilts fed diets containing ractopamine tended (P < .07) to have lower subjective belly firmness than gilts fed diets containing no ractopamine. However, this difference was not supported by the objective belly firmness measurements as there was no difference (P > .10) between gilts fed ractopamine and gilts fed diets devoid of ractopamine. Both subjective and objective belly firmness measurements were increased (P < .01) in gilts fed diets containing CLA as compared to gilts fed diets containing no CLA. Within the added fat treatment, gilts fed diets containing CWG had higher (P < .04) objective belly firmness scores compared to gilts fed diets containing BT.

Discussion:

The results of this research support previous research in which feeding diets containing added fat increases feed conversion efficiency. There were no differences between the two fat types used in this study (CWG and BT) in the enhancement of growth efficiency which demonstrates that the two fat sources are comparable to one another in terms of the improvement in growth performance realized. By feeding 5% added dietary fat for eight weeks to genetically lean gilts carcass weight increased without affecting the predicted percentage lean in the carcass. As expected, feeding gilts diets containing ractopamine increased growth performance and carcass content. The impact of dietary fat on increased growth rate and improve feed efficiency tended to be greater in pigs fed ractopamine ($P = 0.15$). Feeding diets containing CLA increased belly quality in this trial which supports results from previous research carried out in the Animal Sciences Department. In addition, CLA enhanced feed efficiency and increased the predicted percent lean in the population of lean gilts which were used in this trial.

Implications:

The results of this research demonstrate that feeding diets containing added fat to genetically lean gilts, either in the form of beef tallow or choice white grease, increases production efficiency and increases the pounds of pork produced per pig. Adding ractopamine and CLA to the diets of lean gilts improves growth efficiency and enhances carcass characteristics.

Currently, 9 g ractopamine per ton costs approximately $20.00/ton of feed. The response to ractopamine substantially declines after 4 weeks. Feeding dietary fat increases ADG when ractopamine is fed such that more carcass weight can be gained before the ractopamine response declines. The addition of dietary fat to ractopamine-supplemented diets will maximize carcass weight gain. The combined use of dietary fat and ractopamine will reduce sort losses and allow more rapid close out of finishers utilizing all-in/all-out management.

With 4.9 lbs of carcass weight gain, gross income increased $2.94/head by feeding 5% dietary fat from 130-250 pounds. With the 2.50 versus 2.69 feed conversion for diets without dietary fat, the break-even price for the fat-added diets increases by $28.73/ton ($120.00 vs.$148.73) to result in equal net profit above costs.

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Table 1. Composition of experimental diets (as-fed basis)

Item, %	Phase 1 (130 to 189 lb) Control	Phase 1 (130 to 189 lb) Added fat	Phase 2 (189 to 247 lb) Control	Phase 2 (189 to 247 lb) Added fat
Corn	75.80	68.22	68.76	60.03
Soybean meal (46.5% CP)	20.01	22.66	27.25	31.04
Dicalcium phosphate	1.35	1.37	1.19	1.18
Added fat[a]	--	5.00	--	5.00
Soybean oil[b]	1.00	1.00	1.00	1.00
Limestone	0.91	0.88	0.94	0.92
Salt	0.30	0.30	0.25	0.25
Vitamin premix[c]	0.15	0.15	0.15	0.15
Trace mineral premix[de]	0.10	0.10	0.09	0.09
Lysine•HCl	0.13	0.13	0.13	0.10
Ethoxyquin	0.05	0.05	0.05	0.05
Micro-aid	0.10	0.10	0.10	0.10
Selenium premix[f]	0.05	0.05	0.05	0.05
Antibiotic[g]	0.05	0.05	--	--
Ractopamine•HCl[h]	--	--	0.05	0.05
Calculated analysis				
Crude protein, %	15.80	16.42	18.64	19.72
Lysine, %	0.90	0.96	1.10	1.17
ME, Mcal/lb	1.52	1.62	1.52	1.63
Lysine, g/Mcal	2.69	2.68	3.28	3.26
Ca, %	0.70	0.70	0.70	0.70
P, %	0.60	0.60	0.60	0.60

[a]The added fat diets contained 5% choice white grease or 5% beef tallow

[b]In diets containing conjugated linoleic acid (CLA) 1% of a product consisting of 60% CLA isomers replaced soybean oil

[c]Provided per lb of complete diet: vitamin A, 1,650 IU; vitamin D_3, 165 IU; vitamin E, 12.0 IU; Menadione, 0.55 mg; vitamin B_{12}, 0.01 mg; riboflavin, 1.92 mg; pantothenic acid, 6.0 mg; and niacin, 8.64 mg

[d]Provided per lb of complete diet in phase 1: Fe, 43.99 mg; Zn, 43.99 mg; Mn, 5.45 mg; Cu, 4.08 mg; and I, 0.15 mg

[e]Provided per lb of complete diet in phase 2: Fe, 38.49 mg; Zn, 38.49 mg; Mn, 4.76 mg; Cu, 3.57 mg; and I, 0.13 mg

[f]Provided 0.14 mg Se per lb of complete diet

[g]Provided 20.0 mg tylosin per lb of complete die

[h]In diets containing ractopamine•HCl the premix, which was added at the expense of corn provided 9 g ractopamine•HCl per ton of complete diet

Table 2. Growth performance (wk 4 to 8) of lean gilts fed diets containing conjugated linoleic acid (CLA) or soybean oil (SBO) with 5% choice white grease (CWG), 5% beef tallow (BT), or 0% added fat with or without ractopamine•HCl (RAC)

Item	RAC, g/ton	CLA 0%	CLA 5% CWG	CLA 5% BT	SBO 0%	SBO 5% CWG	SBO 5% BT	SEM
ADG, lb								
wk 4 to 6	0.0	1.97	2.04	2.00	2.14	2.03	2.14	0.11
	9.0	2.68	2.39	2.60	2.51	2.49	2.68	0.11
wk 6 to 8	0.0	1.79	1.80	1.85	1.78	1.73	1.84	0.18
	9.0	2.07	2.38	2.19	1.91	1.87	1.96	0.18
wk 4 to 8	0.0	1.88	1.92	1.93	1.88	1.88	1.99	0.11
	9.0	2.38	2.38	2.39	2.21	2.18	2.32	0.11
ADFI, lb								
wk 4 to 6	0.0	5.71	5.32	5.26	5.52	5.52	5.63	0.20
	9.0	5.70	5.45	5.47	5.65	5.22	5.56	0.20
wk 6 to 8	0.0	5.61	5.10	4.95	5.75	5.26	5.41	0.31
	9.0	5.60	5.70	5.62	5.85	5.16	5.30	0.31
wk 4 to 8	0.0	5.66	5.21	5.10	5.64	5.39	5.52	0.22
	9.0	5.65	5.57	5.55	5.75	5.19	5.43	0.22
Feed:Gain								
wk 4 to 6	0.0	2.90	2.60	2.62	2.84	2.71	2.62	0.02
	9.0	2.14	2.29	2.10	2.25	2.09	2.07	0.02
wk 6 to 8	0.0	3.13	2.86	2.65	3.26	2.99	2.96	0.02
	9.0	2.71	2.38	2.56	3.10	2.75	2.74	0.02
wk 4 to 8	0.0	3.00	2.72	2.64	3.03	2.84	2.79	0.01
	9.0	2.39	2.34	2.31	2.61	2.38	2.36	0.01
Initial BW, lb	0.0	187.26	189.93	192.61	190.06	190.74	188.28	2.4
	9.0	180.73	190.65	190.85	184.21	188.87	187.40	2.4
Final BW, lb	0.0	239.93	243.72	246.47	242.62	242.46	244.00	3.7
	9.0	247.26	255.27	257.86	246.00	252.12	252.25	3.7

Table 3. Contrast P-values for growth performance wk 4 to 8

Item	Contrast						
	1. Rac vs No Rac	2. CLA vs No CLA	3. Fat vs No Fat	4. CWG vs BT	5. 1 x 2[a]	6. 1 x 3[b]	7. 2 x 3[c]
ADG							
wk 4 to 6	0.01	0.46	0.63	0.25	0.46	0.89	0.76
wk 6 to 8	0.01	0.03	0.41	0.87	0.07	0.57	0.46
wk 4 to 8	0.01	0.22	0.51	0.36	0.17	0.84	0.83
ADFI							
wk 4 to 6	0.91	0.80	0.13	0.54	0.48	0.84	0.42
wk 6 to 8	0.21	0.86	0.02	0.93	0.14	0.51	0.44
wk 4 to 8	0.37	0.80	0.02	0.68	0.17	0.75	0.96
G:F							
wk 4 to 6	0.01	0.82	0.12	0.38	0.66	0.50	0.51
wk 6 to 8	0.01	0.01	0.01	0.97	0.33	0.93	0.81
wk 4 to 8	0.01	0.02	0.01	0.38	0.73	0.56	0.64
Initial BW	0.40	0.90	0.20	0.95	0.95	0.43	0.43
Final BW	0.01	0.54	0.10	0.63	0.62	0.45	0.55

[a]Represents the contrast for the interaction between ractopamine (Rac) and CLA treatments
[b]Represents the contrast for the interaction between Rac and added fat treatments
[c]Represents the contrast for the interaction between CLA and added fat treatments

Table 4. Growth performance of genetically lean gilts fed diets containing conjugated linoleic acid (CLA) or soybean oil with 5% choice white grease (CWG), 5% beef tallow (BT), or 0% added fat with or without ractopamine •HCl (RAC)

Item	RAC, g/ton	CLA			SBO			SEM
		0%	5% CWG	5% BT	0%	5% CWG	5% BT	
ADG, lb	0.0	2.05	2.05	2.09	2.05	2.04	2.05	0.07
	9.0	2.16	2.27	2.31	2.09	2.15	2.23	0.07
ADFI, lb	0.0	5.56	5.29	5.19	5.67	5.51	5.41	0.18
	9.0	5.51	5.50	5.50	5.70	5.23	5.45	0.18
Feed/Gain	0.0	2.70	2.57	2.48	2.77	2.70	2.63	0.01
	9.0	2.55	2.42	2.38	2.72	2.38	2.44	0.01
Initial BW, lb	0.0	128.85	130.42	130.86	130.72	129.25	130.75	1.1
	9.0	128.85	129.54	129.67	130.35	130.77	130.28	1.1
Final BW, lb	0.0	239.93	243.72	246.47	242.62	242.46	244.00	3.7
	9.0	247.26	255.27	257.86	246.00	252.12	252.25	3.7

Table 5. Contrast P-values for overall growth performance

Item	Contrast						
	1. Rac vs No Rac	2. CLA vs No CLA	3. Fat vs No Fat	4. CWG vs BT	5. 1 x 2[a]	6. 1 x 3[b]	7. 2 x 3[c]
ADG	0.01	0.21	0.10	0.51	0.45	0.15	0.80
ADFI	0.63	0.45	0.02	0.95	0.21	0.67	0.52
G:F	0.01	0.01	0.01	0.49	0.48	0.17	0.68
Initial BW	0.90	0.73	0.81	0.87	0.81	0.98	0.70
Final BW	0.01	0.54	0.10	0.63	0.62	0.45	0.55

[a]Represents the contrast for the interaction between ractopamine (Rac) and CLA treatments
[b]Represents the contrast for the interaction between Rac and added fat treatments
[c]Represents the contrast for the interaction between CLA and added fat treatments

Table 6. Carcass characteristics of genetically lean gilts fed diets containing conjugated linoleic acid (CLA) or soybean oil (SBO) with 5% choice white grease (CWG), 5% beef tallow (BT), or 0% added fat with or without ractopamine•HCl (RAC)

Item	RAC,	CLA			SBO			SEM
	g/ton	0%	5% CWG	5% BT	0%	5% CWG	5% BT	
Carcass weight, lb	0.0	170.3	174.4	174.77	172.6	177.2	172.7	2.9
	9.0	178.4	182.8	187.5	177.5	184.1	183.0	2.9
Dressing percentage	0.0	70.74	70.67	71.39	70.72	71.48	71.01	0.6
	9.0	70.89	72.51	72.76	72.59	73.15	72.59	0.6
Lean percentage[a]	0.0	56.31	56.50	57.21	55.39	55.68	56.37	0.8
	9.0	59.72	57.57	57.88	56.25	57.19	58.10	0.8
Backfat, in.								
10th rib inner layer	0.0	0.36	0.40	0.33	0.36	0.43	0.34	0.04
	9.0	0.30	0.36	0.36	0.38	0.38	0.33	0.04
10th rib outer layer	0.0	0.31	0.33	0.31	0.34	0.36	0.35	0.02
	9.0	0.27	0.31	0.30	0.33	0.35	0.31	0.02
10th rib	0.0	0.67	0.73	0.64	0.70	0.79	0.69	0.04
	9.0	0.57	0.67	0.66	0.71	0.73	0.64	0.04
Last rib	0.0	0.69	0.78	0.74	0.74	0.93	0.76	0.04
	9.0	0.65	0.75	0.75	0.78	0.82	0.79	0.04
Longissimus muscle								
Area, $in.^2$	0.0	6.93	7.45	7.33	6.71	7.36	7.12	0.25
	9.0	8.24	7.95	8.21	7.32	7.98	7.96	0.25
PH at 45 min	0.0	6.45	6.53	6.52	6.41	6.46	6.49	0.05
	9.0	6.45	6.46	6.45	6.52	6.54	6.53	0.05
PH at 24 h	0.0	5.65	5.59	5.66	5.64	5.61	5.59	0.03
	9.0	5.60	5.60	5.63	5.61	5.65	5.66	0.03

[a]Carcass lean was calculated using the equation for ribbed carcasses (NPPC, 1991)

Table 7. Contrast P-values for carcass characteristics

Item	Contrast						
	1. Rac vs No Rac	2. CLA vs No CLA	3. Fat vs No Fat	4. CWG vs BT	5. 1 x 2[a]	6. 1 x 3[b]	7. 2 x 3[c]
Carcass weight	0.01	0.92	0.01	0.95	0.47	0.38	0.68
Dressing percentage	0.01	0.22	0.06	0.96	0.41	0.42	0.40
Lean percentage	0.01	0.03	0.77	0.25	0.71	0.37	0.08
Backfat							
10th rib inner layer	0.35	0.39	0.50	0.04	0.90	0.94	0.42
10th rib outer layer	0.01	0.01	0.09	0.07	0.72	0.73	0.45
10th rib	0.10	0.06	0.20	0.02	0.85	0.82	0.31
Last rib	0.50	0.01	0.01	0.05	0.88	0.67	0.73
Longissimus muscle							
Area	0.01	0.06	0.01	0.80	0.50	0.43	0.14
pH at 45 min	0.59	0.71	0.19	0.99	0.05	0.33	0.96
pH at 24 h	0.88	0.74	0.97	0.27	0.12	0.10	0.75

[a]Represents the contrast for the interaction between ractopamine (Rac) and CLA treatments
[b]Represents the contrast for the interaction between Rac and added fat treatments
[c]Represents the contrast for the interaction between CLA and added fat treatments

Table 8. Quality characteristics of *longissimus dorsi* muscle and bellies of genetically lean gilts fed diets containing conjugated linoleic acid (CLA) or soybean oil (SBO) with 5% choice white grease (CWG), 5% beef tallow (BT), or 0% added fat with or without ractopamine•HCl (RAC)

		CLA			SBO			
Item	RAC, g/ton	0%	5% CWG	5% BT	0%	5% CWG	5% BT	SEM
Visual evaluation								
Color[a]	0.0	2.73	2.67	2.80	2.79	2.86	2.69	0.1
	9.0	2.87	2.75	2.87	2.67	2.79	2.53	0.1
Marbling[b]	0.0	1.00	1.07	1.07	1.00	1.00	1.06	0.05
	9.0	1.00	1.06	1.13	1.00	1.00	1.00	0.05
Firmness[c]	0.0	2.60	2.73	2.67	2.64	2.64	2.63	0.1
	9.0	2.80	2.50	2.93	2.80	2.79	2.60	0.1
Lean Color								
L*	0.0	44.69	44.70	45.19	47.17	43.71	44.43	0.6
	9.0	45.28	46.21	45.63	44.81	44.31	45.84	0.6
a*	0.0	10.77	10.58	10.48	9.66	11.09	10.94	0.3
	9.0	10.11	9.83	10.15	10.19	9.69	9.89	0.3
b*	0.0	9.01	8.71	8.72	9.01	8.77	8.95	0.2
	9.0	8.78	8.78	8.62	8.51	8.05	8.69	0.2
Drip loss 24 h, %	0.0	3.21	2.64	2.36	2.89	2.87	3.09	0.4
	9.0	2.27	3.07	2.72	2.67	2.54	3.38	0.4
Belly firmness								
Subjective[d]	0.0	3.47	3.13	3.00	2.79	3.21	2.63	0.3
	9.0	2.60	3.31	3.14	3.00	2.21	2.20	0.3
Length, in.[e]	0.0	3.66	3.70	3.00	3.17	3.38	2.89	0.3
	9.0	2.94	3.87	3.51	3.39	2.61	2.34	0.3

[a]Subjective scores were used to evaluate color (1 = pale, pinkish gray; 6 = dark, purplish red; NPPC, 1999)
[b]Subjective scores were used to evaluate marbling (1 = devoid to practically devoid; 6 = moderately abundant or greater; NPPC, 1999)
[c]Carcass firmness was evaluated using subjective scores (1 = very soft; 5 = very firm; NPPC, 1991)
[d]Subjective belly firmness scores were assigned by centrally placing the bellies over a horizontal bar (1 = soft; 5 = firm)
[e]Objective scores were assigned to the bellies by measuring the distance between the anterior and posterior ends of the belly when suspended over a horizontal bar

Table 9. Contrast P-values for *longissimus dorsi* and belly quality characteristics

Item	Contrast						
	1. Rac vs No Rac	2. CLA vs No CLA	3. Fat vs No Fat	4. CWG vs BT	5. 1 x 2[a]	6. 1 x 3[b]	7. 2 x 3[c]
Visual evaluation							
Color	0.88	0.37	0.78	0.60	0.12	0.86	0.90
Marbling	0.99	0.10	0.09	0.32	0.44	0.99	0.25
Firmness	0.22	0.74	0.74	0.63	0.92	0.34	0.65
Lean color							
L*	0.30	0.51	0.30	0.22	0.18	0.01	0.02
a*	0.01	0.63	0.37	0.73	0.87	0.02	0.05
b*	0.01	0.28	0.12	0.17	0.05	0.59	0.84
Drip loss 24 h	0.75	0.38	0.77	0.69	0.92	0.10	0.62
Belly firmness							
Subjective	0.07	0.01	0.52	0.24	0.48	0.88	0.19
Length	0.30	0.01	0.50	0.04	0.33	0.83	0.07

[a]Represents the contrast for the interaction between ractopamine (Rac) and CLA treatments
[b]Represents the contrast for the interaction between Rac and added fat treatments
[c]Represents the contrast for the interaction between CLA and added fat treatments