Kansas Agricultural Experiment Station Research Reports

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

Article 982

2003

Effects of corn source and fat level on growth performance of grow-finish pigs reared in a commercial facility

C W. Hastad

C L. Jones

Michael D. Tokach

See next page for additional authors

Recommended Citation

Hastad, C W.; Jones, C L.; Tokach, Michael D.; Nelssen, Jim L.; Goodband, Robert D.; DeRouchey, Joel M.; and Dritz, Steven S. (2003) "Effects of corn source and fat level on growth performance of grow-finish pigs reared in a commercial facility," *Kansas Agricultural Experiment Station Research Reports*: Vol. 0: Iss. 10. https://doi.org/10.4148/2378-5977.6822

EFFECTS OF CORN SOURCE AND FAT LEVEL ON GROWTH PERFORMANCE OF GROW-FINISH PIGS REARED IN A COMMERCIAL FACILITY[1]

C.W. Hastad, M.D. Tokach, J.L. Nelssen, S.S. Dritz[2]
R.D. Goodband, J.M. DeRouchey, and C.L. Jones

Summary

A total of 1,144 gilts (initially 110.4 lb, PIC) was used in a commercial research facility to evaluate the effects of corn source (NutriDense™, BASF, or #2 Yellow Dent) and added fat (averaging 0, 3, and 6%) on pig performance and carcass traits. Energy levels were based such that the higher energy (assuming 5% greater ME than #2 yellow dent) in NutriDense corn (with or without added fat) was calculated to be equal to that provided by yellow dent corn and added fat. In each phase, the first treatment diet contained yellow dent corn and no added fat. In the next dietary treatment, yellow dent corn was replaced with NutriDense corn, and then fat was added (2.7 to 3.2% based on phase) to the yellow dent corn-based diet to equal the energy content of the NutriDense corn diet. This amount of added fat was then added to the NutriDense-based diet. The last yellow dent corn based diet used 5.2 to 6.2% (based on phase) added fat to equal the energy content of the second NutriDense corn diet. This amount of fat was then added to the NutriDense-base diet to complete the treatment structure.

For the overall study, pigs fed NutriDense corn had greater (P<0.04) ADG compared to pigs fed yellow dent corn. There was a corn source by fat level interaction (P<0.01) observed for ADFI and F/G. When fat was added to diets containing NutriDense corn, F/G decreased linearly, whereas when fat was added to yellow dent corn the greatest improvement in feed efficiency was observed with the first 3% added fat. Adding fat to diets also increased (P<0.01) final and carcass weight, and tended (P<0.09) to increase backfat thickness. Using the known energy values of yellow dent corn and fat, we calculated NutriDense corn to have 5.3% more ME than yellow dent corn.

These results are similar to previous research in nursery pigs at Kansas State University showing 5% more ME for NutriDense corn than yellow dent corn. This also supports work done the University of Illinois which determined that NutriDense corn has 6.5% more ME than yellow dent corn. Increasing the dietary energy level above a yellow dent corn-soybean meal-based diet with 6% added fat improved ADG and F/G in grow-finish pigs. Furthermore, pigs fed NutriDense corn had greater ADG than pigs fed yellow dent corn.

(Key Words: Corn, Fat, Energy, Grow-Finish Pigs)

Introduction

NutriDense corn is a nutritionally enhanced product containing a stacked set of traits to provide greater nutrient density than

---

[1]Appreciation is expressed to Exseed Genetics, a BASF company, for partial financial support for this trial.
[2]Food Animal Health and Management Center.

conventional yellow dent corn. Specifically, it contains approximately 30% more lysine, 50% more sulfur-containing amino acids, 18% more threonine, and almost 25% more tryptophan (Table 1). Feeding trials with nursery pigs at Kansas State University indicated that the energy value of NutriDense corn was approximately 5% greater than the energy density of yellow dent corn. In these trials, F/G was improved linearly through the highest level of energy (6% fat added to a diet containing NutriDense corn).

Past research trials conducted in commercial research facilities indicate that ADG and F/G improve linearly when increasing levels of fat are added to grow-finish diets. The purpose of this experiment was to validate the nursery trials and data from the University of Illinois that indicate NutriDense corn contains 5 to 6% more ME than yellow dent corn. The second objective was to determine if grow-finish pig performance continues to be improved linearly when dietary energy density is increased beyond the level achieved with yellow dent corn and added fat.

Procedures

This experiment was conducted in a commercial research facility. The barn was curtain sided, with total concrete slats over a deep pit. The barn operates on natural ventilation during the summer and mechanically assisted ventilation during the winter. This trial was started in January and ended in April 2003. Forty-two pens of gilts (PIC C22 X L337) were blocked by weight (initially 110.4 lb) and allotted to one of six dietary treatments. There were initially 27 or 28 pigs per pen and seven pens per treatment. Each pen was 10 × 18 ft, and contained one 4-hole dry feeder and one cup waterer. The experimental diets used were formulated with either Yellow Dent (YD) or NutriDense (ND) corn with increasing levels of choice white grease (Tables 2 to 4). The first treatment diet contained yellow dent corn and no added fat. In the next dietary treatment, yellow dent corn was replaced with NutriDense corn and then fat was added (2.7 to 3.2%, based on phase) to the yellow dent corn-based diet to equal the energy content of the NutriDense corn diet. This amount of added fat was then added to the NutriDense-based diet. The last yellow dent corn based diet used 5.2 to 6.2% (based on phase) added fat to equal the energy content of the second NutriDense corn diet. This amount of fat was then added to the NutriDense-base diet to complete the treatment structure.

All diets were formulated to maintain an equal lysine:calorie ratio and Ca:tP ratio within each phase. Corn dry matter values were 87.3 and 85.2% for ND and YD corn, respectively.

Pig weights and feed disappearance were measured every 14 d to calculate ADG, ADFI, and F/G. Diet phase changes occurred on d 14 and 42. At the end of the experiment, pigs in each pen were individually tattooed and transported to a commercial meat packing facility where carcass traits were obtained.

Analysis of variance was conducted on all data using the PROC MIXED procedure of SAS. Pen was used as the experimental unit of analysis for all treatment effects. The statistical model included treatment as a fixed effect and block as random effect.

Results and Discussion

For phase 1 (d 0 to 14), there were no ($P>0.21$) corn source by added fat interactions (Table 5). Corn source had no effect ($P>0.27$) on ADG or ADFI; however, pigs fed NutriDense corn had improved ($P<0.05$) F/G compared to pigs fed yellow dent corn. Increasing dietary fat increased (linear, $P<0.01$) ADG, reduced (quadratic, $P<0.01$) ADFI and improved (quadratic, $P<0.01$) F/G.

In phase 2 (d 14 to 42), pigs fed NutriDense had greater ($P<0.04$) ADG than pigs

fed yellow dent corn. Increasing added fat had no effect (P>0.51) on ADG. There was a corn source by added fat interaction for ADFI and F/G. For ADFI, the interaction appears to be the result of a greater rate of decrease in feed intake as fat increased in diets containing yellow dent corn, compared with the relatively smaller change in feed intake with added fat in diets containing NutriDense corn. The interaction in F/G appears to be the result of a linear improvement in F/G as fat increased in diets containing NutriDense corn, whereas the response to added fat in yellow dent corn was quadratic and maximized at 3%.

In phase 3 (d 42 to 78), corn source had no effect (P>0.37) on ADG; however increasing fat improved (linear, P<0.05) ADG. As in phase 2, there was a tendency (P<0.06) for a corn source by added fat interaction. Again the interaction appears to be the result of a greater rate of decrease in feed intake as fat was added in diets containing yellow dent corn compared to diets containing NutriDense corn. Feed efficiency was improved (linear, P<0.05) as added fat increased and tended (P<0.08) to be improved for pigs fed NutriDense corn compared to pigs fed yellow dent corn.

For the overall experiment period, pigs fed NutriDense corn had greater (P<0.04) ADG compared to pigs fed yellow dent corn. Increasing dietary fat increased (quadratic, P<0.08) ADG, with the greatest improvement observed as fat increased from 0 to 3%. Similar to the response in phase 2, there was a corn source by added fat interaction for ADFI and F/G. For ADFI, the interaction appears to be the result of a greater rate of decrease in feed intake as fat increased in diets containing yellow dent corn, compared with the relatively smaller change in feed intake with added fat in diets containing NutriDense corn. The interaction in F/G appears to be the result of a linear improvement in F/G as fat increased in diets containing NutriDense corn, whereas the response to added fat in yellow dent corn was quadratic, with the greatest response to the first 3% added fat.

To determine the energy concentration in NutriDense corn, we looked at the energetic efficiency of gain. Pigs fed diets with NutriDense corn (assumed to contain 5% more ME) had similar energetic efficiency to pigs fed yellow dent corn diets with similar dietary ME. By comparing the energetic efficiency between corn sources formulated to the same energy density, data suggest that pigs fed NutriDense corn have almost exactly the same energetic efficiency when we assume a 5% greater ME value for NutriDense corn.

We also calculated an energy efficiency ratio by dividing the calculated ME intake by lb of gain. For this calculation, we used NRC (1998) ME values for yellow dent corn, soybean meal, and fat. Assuming that the energetic efficiency of gain within the three levels of added fat should be similar, we could then extrapolate the ME content of NutriDense corn compared to yellow dent corn. Using this procedure, the average ME value of NutriDense corn is 1,634 kcal/lb or 5.3% greater than that of yellow dent corn.

There were no differences (P>0.18) in carcass weight, backfat depth, loin depth, and percentage muscle, and fat-free lean index among pigs fed either NutriDense or yellow dent corn. However, pigs fed yellow dent corn had greater (P<0.05) yield percentage than those fed NutriDense corn. Increasing added fat increased (P<0.01) carcass weight, but had no effect (P>0.18) on percentage yield, muscle, or fat free lean index.

We calculated the economic value of NutriDense corn compared to yellow dent corn. We compared diets formulated to contain identical energy, lysine, and phosphorus concentrations with either NutriDense or yellow dent corn. We used a value of $2.24/bu for yellow dent corn, $180/ton for soybean meal $290/ton for monocalcium phosphorus,

$40/ton for limestone, and $240/ton for choice white grease in our calculations. Using the difference in diet cost and amount of corn in the diets, we calculated the extra value provided by using NutriDense corn. The economic comparison indicates producers can pay up to $0.13/bu premium for ND corn to realize the same growth performance benefits of a YD corn diet with added soybean meal and choice white grease.

In conclusion, our results are similar to previous research in nursery pigs at Kansas State University showing that NutriDense corn contains approximately 5% more ME than yellow dent corn. This agrees with data from the University of Illinois, which show that NutriDense corn has 6.5% more ME than yellow dent corn. The results of our study also show that increasing the dietary energy level above a corn-soybean meal-added fat diet with NutriDense corn improves ADG and F/G in grow-finish pigs. In summary, the use of NutriDense corn in grow-finish diets provides an opportunity to achieve higher dietary ME levels and improved growth performance compared to diets containing yellow dent corn.

Table 1. Composition of Corn Sources[a]

Item	Yellow Dent	NutriDense
Dry matter, %	89 (85.21)	88 (87.39)
Either extract, %	3.9 (3.48)	4.8 (4.56)
Protein, %	8.3 (7.39)	10 (9.33)
ME, kcal/lb	1,551	1,629
Crude Fiber, %	2.8 (2.38)	2.0 (2.26)
Ca, %	0.03 (0.02)	0.01 (0.06)
P (Total), %	0.28 (0.24)	0.32 (0.28)
P (Available), %	0.14	0.11
Mg, %	0.12 (0.10)	0.13 (0.11)
K, %	0.33 (0.32)	0.35 (0.32)
S, %	0.13	0.11
Amino acids, %		
Lysine	0.26 (0.23)	0.31 (0.28)
Arginine	0.37 (0.36)	0.52 (0.46)
Cystine	0.19 (0.19)	0.23 (0.24)
Isoleucine	0.28 (0.26)	0.41 (0.35)
Leucine	0.99 (0.92)	1.25 (1.25)
Methionine	0.17 (0.16)	0.21 (0.22)
Tryptophan	0.06 (0.06)	0.08 (0.07)
Threonine	0.29 (0.27)	0.34 (0.33)
Valine	0.39 (0.38)	0.55 (0.47)

[a]Values represent estimated composition from NRC, 1998 for yellow dent corn and NutriDense corn provided by BASF used in diet formulation. Values in ( ) represent actual analyzed chemical composition.

Table 2. Composition of Phase 1 Experimental Diets (As-fed Basis)[a]

Corn Source:	Yellow Dent			NutriDense		
Ingredient, % — Fat level:	0	2.7	5.2	0	2.7	5.2
Yellow dent corn	68.65	64.09	59.98			
NutriDense corn				68.41	63.92	59.87
Soybean meal, 46.5% CP	28.60	30.41	31.99	28.91	30.66	32.17
Choice white grease		2.70	5.20		2.70	5.20
Monocalcium phosphate, 21% P	1.13	1.18	1.21	0.96	1.01	1.07
Limestone	0.95	0.95	0.95	1.05	1.04	1.03
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix with phytase	0.08	0.08	0.08	0.08	0.08	0.08
Trace mineral premix	0.10	0.10	0.10	0.10	0.10	0.10
Lysine HCl	0.15	0.15	0.15	0.15	0.15	0.15
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis						
Lysine, %	1.16	1.20	1.24	1.20	1.24	1.28
Lysine:calorie ratio, g/mcal	3.50	3.50	3.50	3.50	3.50	3.50
Isoleucine:lysine ratio, %	0.67	0.67	0.67	0.75	0.74	0.74
Leucine:lysine ratio, %	1.49	1.45	1.42	1.59	1.55	1.51
Methionine:lysine ratio, %	0.27	0.26	0.26	0.28	0.27	0.27
Met & Cys:lysine ratio, %	0.56	0.55	0.54	0.60	0.58	0.57
Threonine:lysine ratio, %	0.63	0.62	0.62	0.64	0.63	0.63
Tryptophan:lysine ratio, %	0.20	0.20	0.20	0.20	0.20	0.20
Valine:lysine ratio, %	0.79	0.78	0.77	0.86	0.84	0.83
ME, kcal/lb	1,504	1,558	1,609	1,558	1,609	1,656
Protein, %	19.13	19.59	19.97	20.28	20.65	20.95
Ca, %	0.69	0.70	0.71	0.68	0.69	0.70
P, %	0.63	0.64	0.64	0.62	0.63	0.64
Ca: tP Ratio	1.10	1.10	1.10	1.10	1.10	1.10
Available P, %	0.31	0.32	0.32	0.33	0.33	0.34

[a]Diets fed from d 0 to 14.

Table 3. Composition of Phase 2 Experimental Diets (As-fed Basis)[a]

Corn Source:	Yellow Dent			NutriDense		
Ingredient, % Fat level:	0	2.7	5.2	0	2.7	5.2
Yellow dent corn	68.65	64.09	59.98			
NutriDense corn				68.41	63.92	59.87
Soybean meal, 46.5% CP	28.60	30.41	31.99	28.91	30.66	32.17
Choice white grease		2.70	5.20		2.70	5.20
Monocalcium phosphate, 21% P	1.13	1.18	1.21	0.96	1.01	1.07
Limestone	0.95	0.95	0.95	1.05	1.04	1.03
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix with phytase	0.08	0.08	0.08	0.08	0.08	0.08
Trace mineral premix	0.10	0.10	0.10	0.10	0.10	0.10
Lysine HCl	0.15	0.15	0.15	0.15	0.15	0.15
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis:						
Lysine, %	0.97	1.00	1.04	1.00	1.04	1.08
Lysine:calorie ratio, g/mcal	2.90	2.90	2.90	2.90	2.90	2.91
Isoleucine:lysine ratio, %	0.66	0.66	0.66	0.77	0.76	0.75
Leucine:lysine ratio, %	1.60	1.55	1.51	1.73	1.67	1.62
Methionine:lysine ratio, %	0.28	0.28	0.27	0.30	0.29	0.29
Met & Cys:lysine ratio, %	0.60	0.58	0.57	0.65	0.63	0.61
Threonine:lysine ratio, %	0.64	0.63	0.63	0.65	0.65	0.64
Tryptophan:lysine ratio, %	0.19	0.19	0.19	0.19	0.19	0.19
Valine:lysine ratio, %	0.81	0.80	0.79	0.90	0.88	0.87
ME, kcal/lb	1,509	1,569	1,625	1,569	1,625	1,679
Protein, %	16.46	16.85	17.21	17.59	17.93	18.24
Ca, %	0.61	0.62	0.63	0.60	0.61	0.62
P, %	0.55	0.56	0.57	0.54	0.55	0.56
Ca: tP Ratio	1.10	1.10	1.10	1.10	1.10	1.10
Available P, %	0.26	0.27	0.28	0.27	0.27	0.29

[a]Diets fed from d 14 to 42.

Table 4. Composition of Phase 3 Experimental Diets (As-fed Basis)[a]

	Corn Source	Yellow Dent			NutriDense		
Ingredient, %	Fat level:	0	3.2	6.2	0	3.2	6.2
Yellow dent corn		80.99	76.16	71.69			
NutriDense corn					81.28	76.49	72.01
Soybean meal, 46.5%		16.98	18.59	20.03	16.80	18.35	19.81
Choice white grease			3.20	6.20		3.20	6.20
Monocalcium Phosphate, 21% P		0.59	0.63	0.67	0.37	0.43	0.47
Limestone		0.85	0.84	0.82	0.96	0.94	0.93
Salt		0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix with phytase		0.06	0.06	0.06	0.06	0.06	0.06
Trace mineral premix		0.08	0.08	0.08	0.08	0.08	0.08
Lysine HCl		0.10	0.10	0.10	0.10	0.10	0.10
Total		100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis:							
Lysine, %		0.80	0.84	0.87	0.84	0.87	0.90
Lysine:calorie ratio, g/mcal		2.40	2.40	2.40	2.40	2.40	2.40
Isoleucine:lysine ratio, %		0.69	0.69	0.69	0.83	0.82	0.80
Leucine:lysine ratio, %		1.77	1.71	1.66	1.95	1.87	1.81
Methionine:lysine ratio, %		0.31	0.30	0.29	0.34	0.33	0.32
Met & Cys:lysine ratio, %		0.66	0.64	0.62	0.73	0.70	0.68
Threonine:lysine ratio, %		0.68	0.67	0.66	0.70	0.69	0.68
Tryptophan:lysine ratio, %		0.20	0.20	0.20	0.20	0.20	0.20
Valine:lysine ratio, %		0.87	0.86	0.84	0.99	0.96	0.94
ME, kcal/lb		1,517	1,582	1,643	1,582	1,643	1,701
Protein, %		14.78	15.12	15.41	15.94	16.18	16.41
Ca, %		0.51	0.52	0.52	0.50	0.51	0.51
P, %		0.47	0.47	0.48	0.45	0.46	0.47
Ca: tP Ratio		1.10	1.10	1.10	1.10	1.10	1.10
Available P, %		0.18	0.19	0.20	0.19	0.20	0.21

[a]Diet fed from d 42 to 78.

Table 5. Effects of Corn Source and Added Fat on Growth Performance of Grow-Finish Pigs in a Commercial Facility[a]

	Yellow Dent			NutriDense			Probability P <				Fat Level, %			Probability P<			Corn Source		
Item, Fat %[b]	0	3	6	0	3	6	Level	Source	Level x Source	SE	0	3	6	Linear	Quad	SE	YD	ND	SE
Phase 1[c]																			
ADG, lb	1.84	1.96	1.99	1.93	1.94	2.02	0.01	0.27	0.21	0.054	1.88	1.95	2.01	0.01	0.76	0.049	1.96	1.93	0.047
ADFI, lb	4.11	4.00	4.01	4.15	3.89	3.96	0.01	0.35	0.36	0.032	4.13	3.94	3.98	0.01	0.02	0.041	4.04	4.00	0.034
F/G	2.24	2.04	2.01	2.16	2.00	1.96	0.01	0.05	0.80	0.032	2.20	2.02	1.99	0.01	0.01	0.023	2.10	2.04	0.018
Phase 2[d]																			
ADG, lb	1.95	1.98	1.91	1.98	1.99	2.00	0.51	0.04	0.28	0.040	1.96	1.98	1.96	0.84	0.26	0.035	1.94	1.99	0.033
ADFI, lb	5.36	4.95	4.74	4.90	4.81	4.75	0.01	0.01	0.02	0.131	5.13	4.88	4.75	0.01	0.40	0.116	5.02	4.82	0.110
F/G	2.76	2.50	2.49	2.48	2.42	2.37	0.01	<0.01	0.05	0.048	2.62	2.46	2.43	0.01	0.09	0.038	2.58	2.43	0.033
Phase 3[e]																			
ADG, lb	1.66	1.75	1.69	1.66	1.73	1.77	0.05	0.37	0.32	0.034	1.66	1.74	1.73	0.05	0.13	0.024	1.70	1.72	0.020
ADFI, lb	5.43	5.19	4.90	5.19	5.17	5.00	0.01	0.31	0.06	0.112	5.31	5.18	4.96	0.01	0.45	0.099	5.18	5.12	0.094
F/G	3.28	2.98	2.91	3.13	2.99	2.84	0.01	0.08	0.25	0.051	3.21	2.98	2.87	0.01	0.16	0.040	3.06	2.99	0.035
Overall																			
ADG, lb	1.80	1.87	1.83	1.83	1.87	1.90	0.01	0.04	0.13	0.021	1.81	1.87	1.86	0.01	0.08	0.017	1.83	1.86	0.015
ADFI, lb	5.15	4.87	4.67	4.88	4.79	4.71	0.01	0.01	0.01	0.072	5.02	4.83	4.69	0.01	0.55	0.046	4.90	4.79	0.059
F/G	2.87	2.60	2.56	2.67	2.57	2.49	0.01	0.01	0.01	0.033	2.77	2.59	2.52	0.01	0.01	0.024	2.68	2.52	0.026
Energy Efficiency[f]	4,335	4,097	4,197	4,216	4,196	4,185	0.01	0.97	0.03	47.4	4,276	4,147	4,177	0.02	0.03	38.2	4,201	4,199	34.6

[a]A total of 1,144 pigs (27 or 28 pigs per pen and 7 pens per treatment) with and average initial BW of 110.4 lbs. [b]Actual fat used in diets was 0, 2.7, 5.2 for phases 1 and 2, and 0, 3.2 and 6.2 for phase 3. [c]Phase 1 diets fed d 0 to 14; Lysine:Calorie 3.50; Ca:tP 1.10; AveP:ME 0.93. [d]Phase 2 diets fed d 14 to 42; Lysine:Calorie 2.90; Ca:tP 1.10; AveP:ME 0.77. [e]Phase 3 diets fed d 42 to 78; Lysine:Calorie 2.40; Ca:tP 1.10; AveP:ME 0.55 . [f]Calculated as energy required per kg of gain (kcal ME/lb of gain) using ME values of 1,551 for corn, 1,533 for soybean meal, 3,608 for fat, and 1,629 for NutriDense corn.

Table 6. Effects of Corn Source and Levels of Fat on Carcass Traits of Grow-Finish Pigs in a Commercial Facility

	Yellow Dent			NutriDense			Probability P <				Fat Level, %			Probability P <			Corn Source		
Item, Fat %[a]	0	3	6	0	3	6	Level	Source	Level x Source	SE	0	3	6	Linear	Quad.	SE	YD	ND	SE
Final wt, lb	251.03	256.42	254.96	252.53	257.57	257.89	0.01	0.140	0.82	2.305	251.78	256.99	256.42	0.01	0.03	2.049	254.13	256.00	1.956
Carcass wt, lb	190.12	194.01	191.19	189.75	192.74	194.55	0.01	0.51	0.11	1.744	189.93	193.37	192.87	0.01	0.04	1.573	192.35	191.77	1.509
Yield	75.52	75.61	74.85	75.03	74.85	74.73	0.19	0.05	0.51	0.003	75.27	75.23	74.79	0.09	0.39	0.002	75.33	74.87	0.002
Backfat[b]	0.58	0.60	0.61	0.58	0.60	0.59	0.28	0.65	0.64	0.013	0.58	0.60	0.60	0.22	0.32	0.009	0.60	0.59	0.007
Loin depth[b]	2.20	2.21	2.19	2.17	2.16	2.17	0.97	0.13	0.94	0.038	2.19	2.18	2.18	0.84	0.97	0.019	2.20	2.17	0.016
Lean, %[b]	56.55	56.35	56.18	56.50	56.08	56.37	0.33	0.81	0.58	0.221	56.56	56.19	56.26	0.28	0.32	0.150	56.36	56.31	0.123
FFLI[b]	51.03	50.92	50.83	51.11	50.83	51.06	0.42	0.55	0.59	0.149	51.07	50.88	50.95	0.42	0.31	0.105	50.93	51.00	0.083

[a]Actual fat used in diets was 0, 2.7, 5.2 for phases 1 and 2, and 0, 3.2 and 6.2 for phase 3.
[b]Carcass weight was used as a covariate in analysis.