Swine Research 2005

EFFECT OF INITIAL SORTING AND AMOUNT OF ADDED FAT ON PERFORMANCE OF GROWING-FINISHING PIGS REARED IN A COMMERCIAL FACILITY[1]

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

Summary

Two studies were conducted to determine whether the amount of dietary energy fed to pigs of different weight categories influenced growth performance, market weight, and economic return in a commercial grow-finish facility. In Experiment 1, a total of 1,032 pigs with initial weight of 67.7 lb were individually weighed, fitted with electronic ear tags, and sorted into ten, 5-lb weight categories. Pigs were then allotted to pens lighter and heavier then the barn mean or to pens remixed to create a normal distribution around the mean. To complete the 2×3 factorial, pigs were fed corn-soybean meal diets, with or without 6% choice white grease. For the overall trial, there were no fat $\times$ weight-category interactions ($P>0.15$). Pigs fed 6% added fat tended ($P<0.07$) to have greater ADG (1.79 vs. 1.76 lb), but added fat did not affect ($P>0.15$) SD or CV of gain for the overall trial. For weight category, regardless of diet, heavy pigs grew faster ($P<0.01$, 1.83, 1.72, and 1.76 lb) than either the light or mixed pigs, respectively. In Experiment 2, 1,176 pigs with an initial weight of 77.4 lb were tagged and visually sorted into five weight categories. Pigs (28 per pen) were then allotted to pens lighter and heavier than the barn mean or remixed to create a normal distribution around the mean. To complete the 2×3 factorial, pigs were fed corn-soybean meal diets, with or without 6% choice white grease. For the overall trial, there were no fat $\times$ weight-category interactions ($P>0.25$). Pigs fed 6% added fat had greater ($P<0.07$) ADG, but there was no difference ($P>0.61$) in SD or CV for ADG during the overall study. For weight category, regardless of diet, heavy pigs grew faster ($P<0.02$, 1.96, 1.92, and 1.94 lb) than either the light or mixed pigs, respectively. Although no interactions existed for growth or carcass data, there was a fat $\times$ weight-category interaction ($P<0.07$) for the financial response of margin over feed cost (MOF). Heavy pigs in both studies had greater ($P<0.01$) MOF than either light or mixed pigs; when comparing 0 and 6% added fat within weight category, however, the increase in MOF was greater for light pigs fed added fat than for heavy pigs fed added fat. These studies indicate that adding 6% added fat does not increase variation within or across a population. Because adding fat to the diets of lightweight pigs improves their growth rate, dietary fat can be used selectively in the barn to increase the weight of the lightest 50% of the pigs.

(Key Words: Finishing Pig, Dietary Fat, Variation.)

Introduction

The competitiveness of the modern swine industry dictates that feed, labor, and facilities must be used efficiently. The importance of growth rate has increased with the adoption of all-in, all-out (AIAO) technology to improve facility utilization and increase profitability. During the marketing period of AIAO finishing facilities, the normal distribution of the population of pig weights dictates that lightweight pigs will be present. Packer matrices in the United States impose large discounts for these lightweight pigs. Therefore, any technology or management technique that reduces the number of lightweight pigs will result in a higher net return. There are two methods to decrease the number of lightweight pigs without increasing days on feed. The first method is to reduce the amount of variation within the population. But reducing the amount of variation is difficult to achieve. A second method is by increasing the growth rate of the lightest pigs, thus shifting this portion of the population to heavier weights. The addition of dietary fat has been shown to increase the ADG in commercial field conditions. Thus, our objective was to determine whether adding dietary fat could be used on the lightest 50% of the population in a finishing barn to increase ADG and economic return. The second objective was to determine if adding dietary fat influenced the CV for ADG within heavy or lightweight pigs.

Procedures

General. The Kansas State University Institutional Animal Care and Use Committee approved all experimental protocols used in this study. The nutrient composition of ingredients provided by the NRC (1998) was used in diet formulation (Table 1). In Experiments 1 and 2, diets were fed in meal form and formulated to meet or exceed the NRC (1998) nutrient requirements. Amino acid percentages were greater than those previously demon-strated to maximize performance for pigs of the same genetic composition in the same facilities. Dietary treatments were fed in three phases. A constant lysine:energy ratio was maintained within each phase, with the ratios being 3.5, 2.9, and 2.4 g lysine / Mcal ME in the three phases, respectively. Both experiments were conducted in 41 ft × 250 ft barns in southwestern Minnesota. The barns contained 48 pens (10 × 18 ft). Each pen contained one 4-hole dry feeder and two cup waterers. The curtain-sided barn has a deep pit, with completely slatted floors, and operates on natural ventilation during the summer and mechanically assisted ventilation during the winter. Treatments were arranged as a 2 x 3 factorial. Main effects included diet energy density (none or 6% added fat) and pigs sorted into three weight categories.

Experiment 1. This experiment began in March 2004 with 1,232 (PIC L337 x C1050) gilts. Pigs were individually tagged with 1.2-inch round electronic identification tags (EID) with unique 15-digit code numbers. Pigs were weighed individually and sorted into pens by 5-lb weight categories. Pigs were then allotted to pens lighter and heavier than the barn mean or to pens remixed to create a normal distribution around the mean (Light, Heavy, and Mixed). There were 24 or 25 pigs per pen and 7 pens per treatment. Pens of pigs were weighed, and feed disappearance was determined, every 14 days during the entire experiment. Individual pig weights were recorded at the beginning, approximately 8 wk after the start of experiment (d 56), approximately 3 wk before conclusion (d 88), and at the conclusion of the experiment (d 109). In conjunction with the third individual weigh period, the barn was "topped" to simulate commercial production practices. The two heaviest pigs from heavy pens and the heaviest pig from mixed pens were visually selected, removed, and marketed. At the end of the experiment, pigs from each pen were individually tattooed and shipped to Swift proc-

essing plant (Worthington, MN), where standard carcass criteria (loin and fat depth, hot carcass weight, dressing percentage, lean percentage, and fat-free-lean index) were measured.

Experiment 2. This experiment started in October 2004 with 1,176 pigs (PIC L337 × 1050) gilts. Pigs were individually tagged with 1.2-inch round electronic identification tags (EID) with unique 15-digit code numbers. Pigs were then visually categorized and marked into five weight groups around the population mean (very light, light, average, heavy, and very heavy). Pigs were sorted into weight treatments with 28 pigs per pen by randomly selecting pigs within each sort category. Each weight-treatment pen contained 12 average pigs. Light pens were completed by adding 8 very light, and 8 light pigs; heavy pens were completed by adding 8 heavy and 8 very heavy pigs. For mixed pens, 4 each of very light, light, heavy, and very heavy pigs were added. Next, pigs within each weight treatment pen were individually weighed. For the duration of the experiment, pens of pigs were weighed, and feed disappearance was determined, every 14 days; individual pig weights were recorded at the beginning, approximately 8 wk after the start of experiment (d 49), approximately 3 wk before conclusion (d 81), and at the conclusion of the experiment (d 95). As in the first experiment, the two heaviest pigs from heavy pens and the heaviest pig from mixed pens were visually selected and removed to simulate topping of barns. At the end of the experiment, pigs from each pen were individually tattooed and shipped to Swift processing plant (Worthington, MN), where standard carcass criteria (loin and fat depth, hot carcass weight, dressing percentage, lean percentage, and fat-free-lean index) were measured. Because the packing plant lost 60% of the carcass data from this experiment, sort discount was calculated from the individual final weights. Final weight was converted to market weight by using a historical yield

from this production system of 76.45%. The sort discount was determined by applying the weight of each pig to the weight matrix being used by the processing plant.

Statistical Analysis. Data from both experiments were analyzed as a complete randomized design with pen as the experimental unit. Analysis of variance was performed by using the MIXED procedure of SAS (SAS Inst., Inc., Cary, NC). Contrasts were used to determine the main affects of sorting, added fat, and their interaction on growth performance. Preplanned nonorthogonal contrasts also were used to compare the mean weight of the pens of sorted pigs (heavy and light pens combined) with that of the unsorted pens of pigs, as well as heavy vs. light by fat interaction.

Results

Experiment 1. The addition of fat to diets increased ($P<0.04$) ADG in the first two periods and tended ($P<0.08$) to increase growth for the overall study (Table 2). In addition, adding fat reduced ($P<0.01$) feed intake and improved ($P<0.01$) feed efficiency during each period. For the overall study and d 88 to 109, there was a heavy vs. light × fat interaction (P<0.04) for ADG. This occurred because there was an increase in ADG when fat was added to diets for light pigs but not heavy weight pigs. There also was a heavy vs. light × fat interaction ($P<0.05$) for ADFI for d 88 to 109 and the overall study. There was a greater reduction in ADFI for heavy pigs than for light pigs when fat was added to the diets. There were no interactions ($P>0.12$) of fat, sorting, and weight on feed efficiency. The addition of fat to diets increased ($P<0.03$) weight at d 88, but had no effect ($P>0.11$) on overall weight, CV of weight, or CV for ADG (Table 3). There was no difference ($P>0.42$) in backfat, fat-free lean, % lean, or loin depth between pigs fed diets with or without added fat. Adding fat increased ($P<0.02$) feed cost

per lb of gain, but had no effect on sort discount or MOF.

For initial sort, as expected, the initial weight of heavy pigs was greater than weight of light pigs; but, when combined, weights were similar to weights of mixed pigs. Pigs sorted into light or heavy pens maintained lower ($P<0.02$) weight CV throughout the study. Because of the interaction of fat on ADG in heavy pigs, there was a heavy vs. light $\times$ fat interaction ($P<0.05$) for final weight. Further evaluating the effects of sorting on weight CV, sorting pigs into light and heavy pens decreased ($P<0.05$) CV for weight for the overall trial, compared with the CV of mixed pigs. But sorting had no effect ($P>0.30$) on CV for ADG or carcass traits. Pigs sorted into heavy pens had greater ($P<0.01$) feed cost per lb of gain and had greater MOF. Although growth and carcass data did not show interactions, differences in the financial response were evident in MOF. Comparing added fat within initial sort category, adding 6% dietary fat decreased MOF for heavy ($95.72 vs. $94.11) and mixed ($91.13 vs. $90.48) pigs, but increased MOF for light pigs ($86.92 vs. $88.38).

For the overall 109-d trial, there were no weight category $\times$ fat interactions ($P>0.44$). Again there was a heavy vs. light $\times$ fat interaction ($P<0.03$) for ADG. This occurs because the addition of fat to diets for lightweight pigs increases ADG, but did not increase ADG for heavy pigs. This interaction was unexpected and suggested that a second study was needed.

Experiment 2. Pigs fed diets with added fat had greater ($P<0.01$) ADG for d 0 to 49 and overall (Table 4). Furthermore, adding fat reduced ($P<0.01$) ADFI and improved feed efficiency during every period and for the overall study. In contrast to Experiment 1, there was no ($P>0.37$) heavy vs. light $\times$ fat interaction for ADG. Similar to results of Experiment 1, Experiment 2 found that pigs sorted into heavy pens had greater ($P<0.01$) ADG overall, compared with that of pigs in light or mixed pens.

Unlike Experiment 1, there was no heavy vs. light $\times$ fat interaction of ADFI. Pigs in heavy pens had greater ($P<0.01$) ADFI than did mixed or light pigs, and there was not an interaction of added fat and sorting on feed efficiency. As in Experiment 1, lightweight pigs had a better ($P<0.01$) overall feed efficiency than heavy or mixed pigs had.

Adding dietary fat increased ($P<0.01$) weight in every period (Table 5), but adding fat had no effect ($P>0.41$) on CV of weight in any period or overall. Feeding pigs diets with fat did reduce ($P<0.01$) CV of ADG for d 49 to 81, but this response was not found ($P>0.64$) in other periods or for the overall trial.

For the effects of initial sorting, pigs in light or heavy pens maintained weight differences, compared with pigs in mixed pens, for the entire study. At the end of the study, there was a heavy vs. light $\times$ fat interaction ($P<0.05$) for final weight. Adding fat to diets for light pigs increased final weight to a greater extent than adding fat to diets for heavy pigs did. Pigs sorted by weight maintained differences in CV for weight during the entire study. There also was a heavy vs. light $\times$ fat interaction for CV of weight on d 49 ($P<0.06$) and d 81 ($P<0.04$). This occurred because adding fat to diets increased CV for heavy pigs and decreased weight CV for lightweight pigs.

A heavy vs. light $\times$ fat interaction ($P<0.03$) was also found for CV for ADG from d 0 to 49. Again this response occurred because CV for ADG increased when fat was added to diets for heavy pigs, whereas adding fat to diets for lightweight pigs decreased CV for ADG. The influence for sorting on CV of ADG was inconsistent, with a response

(*P*<0.04) from d 0 to 49 and d 81 to 95, but no response from d 49 to 81 or for the overall trial.

In contrast to the response in Experiment 1, there was a heavy vs. light × fat interaction (*P*<0.01) for MOF. But numerical trends were similar between studies. Comparing added fat within weight category, adding 6% dietary fat decreased MOF for heavy ($96.69 vs. $95.88) and mixed ($92.56 vs. $92.29) pigs, but increased MOF for light pigs ($91.72 vs. $88.53). Looking at the effects of sort, heavy pigs had a higher (*P*<0.01) feed cost per lb of gain and had greater MOF than either light or mixed pigs ($96.28, $90.13, and $92.42, respectively).

Discussion

Lightweight pigs are a costly problem in AIAO swine production. Variation in growth is significant because it reduces the amount of product sold, increases number of days to bring lightweight pigs to market weights, and results in extra facility cost. Variation in growth within AIAO systems is caused by differences in health, genetic makeup, and social interactions. Days to market for a group of pigs is dictated by the growth rate of the lightest 50% of the pigs in the barn because they must reach a minimum weight to minimize sort discount at the processor. Thus, within a population of pigs, increasing the ADG has more value in lightweight pigs than in their heavy counterparts.

Increasing dietary energy, such as with addition of dietary fat, is one of few nutrition tools available to increase ADG for pigs fed an otherwise nutritionally adequate diet. Previous studies have shown that the addition of dietary fat to corn-soybean meal diets increases ADG. In commercial swine production, dietary energy level often limits ADG. In general, for every 1% added dietary fat, average daily gain is expected to increase 1% and

feed efficiency is expected to improve approximately 2%. In our studies, adding fat in diets for light pigs increased ADG by 3.8 and 4.0% for Experiments 1 and 2, respectively. In Experiment 1, heavy pigs had a slight decrease (1.83 vs. 1.85 lb) in ADG when fed diets with added fat. This was an unexpected response, and prompted us to conduct the second study. For Experiment 2, providing fat in the diets increased ADG by 1.2% for heavy pigs. The magnitude of the response for increasing ADG by adding fat was greater for light pigs in both experiments. The increase in weight in light pigs from adding dietary fat moved a larger number of lightweight pigs closer, and into, the packer's marketing window.

For pigs heavier than the population mean, providing additional energy will increase market weight and move a larger portion of pigs out of the optimal weight range for the packer, increasing sort discounts. A secondary analysis of our data was performed to evaluate the implications of feeding the lightest 50% of the population diets with added fat while feeding diets without added fat to the heaviest 50% of the population. This population (combined) was then compared with the unsorted mixed populations that were fed diets either with or without added fat. Individual weights from these treatments in both studies were used to create a cumulative sum graph (Figure 1) to represent the portion of the population that would be at, or below, a specific weight. As the graph illustrates, adding fat to the diet for the mixed population simply shifts the population to the right, resulting in fewer pigs being lower than the desired weight range for the packer. But this shift of the curve for the mixed population also results in more pigs being heavier than the optimal weight range for the packer. If pigs would be sorted at the beginning of the finishing period, with the lightest 50% of pigs on one feed line and the heaviest 50% of pigs on another feed line, dietary fat could be fed to only the population

that needed the extra weight gain (light pigs). This situation is simulated in the combined group in Figure 1. When this approach is used, the lower end of the curve is shifted to the right because adding dietary fat increased ADG for the light pigs. The upper end of the curve is not shifted to the right because the heavy pigs would be fed the lower-energy diet without added fat. This illustrates that an initial sort, in conjunction with feeding two different dietary energy treatments, may be effective in moving a larger percentage of the pigs into the packer's ideal marketing grid.

Results from these studies show that increasing growth rate by the addition of fat to diets for the lightest 50% of the population results in a greater MOF for lightweight pigs. In our studies, however, the addition of dietary fat in heavy pigs reduced MOF. The value of the additional weight will depend on the availability of finishing space. If extra space already exists, the increase in ADG is worth only fewer days in the facility. When space is limited, increasing the ADG is worth the extra pounds sold at market. The economics of adding fat to a growing-finishing diet depend on the design of the production system, as well as the prices of corn, soybean meal, fat, and carcass price. The performance results from Experiment 2 were used to evaluate the effects of adding fat on heavy, light, and mix pigs. Using monthly historical prices for Iowa-Southern Minnesota corn, high protein soybean meal, fat, and carcass prices over a period from January 1989 until December 2003 showed that feeding fat to the lightest 50% of the populations was economically justified (maximized MOF) in all 180 months in the period (Table 6). For the heavy pigs, adding dietary fat increased MOF in only 9 of the 180 months evaluated. A major reason for the poorer economic return to dietary fat in the heavy pigs is that they were already past the optimal market weight, and extra weight gain

led to greater sort discounts. If lower sort discounts are used in the analysis, such as those from Experiment 1, adding fat to diets for heavy pigs increased MOF in 146 out of 180 months evaluated. This demonstrates the importance of understanding the value of incremental increases in weight on economic return for each subpopulation of pigs.

Many producers try to minimize variation and discounts by sorting pigs into more uniform weight groups at placement into the finishing barn. Several studies have reported that sorting pigs into uniform-weight pens did not improve overall performance. Our studies also support those findings, inasmuch as the mean of pigs sorted into light and heavy pens had the same ADG as that of mixed pigs that were not sorted. In Experiment 2, there was an inconsistent response of sorting on CV for ADG. Feeding diets with added fat reduced CV of ADG for lightweight pigs in periods 0 to 49 and 81 to 95, and increased CV for heavy pigs. This effect of sorting was not seen in Experiment 1, and no explanations are readily obvious. Sorting pigs at or near time of marketing can reduce sort discounts, but pigs that remain in the facility assume greater facility cost and reduced profitability. Thus, it is important to increase ADG of lightweight pigs in conjunction with sorting.

These results show that adding 6% dietary fat to the lightest 50% of the population increased ADG and reduced the number of lightweight pigs sold. By feeding 6% dietary fat to the light pigs and removing fat for heavy pigs, producers can increase MOF more than by feeding mixed populations of heavy and light pigs. These studies also show that initial sort did not increase variation within or across a population. Furthermore, feeding pigs 6% added fat diets did not increase the CV of growth rate, compared with that of pigs fed diets without added fat.

Table 1. Composition of Diets in Experiments 1 and 2 (As-Fed Basis)[a]

Ingredient	Phase 1[b]		Phase 2[c]		Phase 3[d]	
	Added Fat		Added Fat		Added Fat	
	0%	6%	0%	6%	0%	6%
Corn	68.70	58.64	75.82	66.26	75.28	65.75
Soybean meal (46.5% CP)	28.92	32.91	22.02	25.49	22.73	26.18
Choice white grease	-	6.00	-	6.00	-	6.00
Monocalcium P (21% P)	0.73	0.85	0.60	0.75	0.50	0.58
Limestone	0.85	0.80	0.80	0.80	0.80	0.80
Salt	0.35	0.35	0.35	0.35	0.35	0.35
Vitamin premix	0.15	0.15	0.13	0.10	0.08	0.08
Trace mineral premix	0.15	0.15	0.13	0.10	0.08	0.08
Ractopamine HCl	-	-	-	-	0.03	0.03
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, %	1.17	1.26	0.98	1.06	1.00	1.08
Lysine:calorie, g/mcal	3.51	3.51	2.93	2.93	2.98	2.98
ME, kcal/kg	3,334	3,602	3,345	3,612	3,350	3,618
Protein, %	19.29	20.29	16.68	17.49	16.97	17.76
Calcium, %	0.58	0.59	0.51	0.55	0.50	0.52
Phosphorus, %	0.54	0.57	0.49	0.52	0.47	0.49

[a]Diet composition was calculated according to NRC (1998) composition values for all ingredients.

[b]Phase 1 diets fed d 0 to 42 in Experiment 1 and d 0 to 49 in Experiment 2.

[c]Phase 2 diets fed d 42 to 88 in Experiment 1 and d 49 to 81 in Experiment 2.

[d]Phase 3 diets fed d 88 to 109 in Experiment 1 and d 81 to 95 in Experiment 2.

Table 2. Effects of Added Fat and Initial Sort on Growth Performance in Growing-finishing Pigs, Experiment 1[a]

| Item, | Interactive Means | | | | | | | Main Effects | | | | | | | Probability, $P <$ | | | | |
| | 6% Fat | | | No Fat | | | | Fat Addition | | | Weight | | | | | | Sort vs. Mixed | Sort vs. Mixed by Fat IntAct | Heavy vs. Light by Fat IntAct |
	Heavy	Light	Mixed	Heavy	Light	Mixed	SE	6% Fat	No Fat	SE	Heavy	Light	Mixed	SE	Fat	Sort			
ADG, lb																			
d 0 to 56	1.70	1.52	1.57	1.65	1.41	1.54	0.03	1.59	1.54	0.02	1.68	1.48	1.54	0.02	0.04	0.01	0.42	0.45	0.27
d 56 to 88	1.92	1.85	1.87	1.87	1.81	1.81	0.03	1.90	1.83	0.02	1.90	1.83	1.85	0.02	0.02	0.06	0.50	0.68	1.00
d 88 to 109	2.20	2.20	2.23	2.36	2.16	2.20	0.05	2.20	2.25	0.03	2.29	2.18	2.23	0.03	0.35	0.10	0.65	0.28	0.04
Overall	1.83	1.76	1.79	1.85	1.70	1.76	0.02	1.79	1.76	0.01	1.83	1.72	1.76	0.01	0.08	0.01	0.51	0.66	0.03
ADFI, lb																			
d 0 to 56	3.73	3.15	3.35	4.03	3.24	3.62	0.07	3.42	3.64	0.04	3.88	3.20	3.48	0.05	0.01	0.01	0.33	0.73	0.10
d 56 to 88	5.22	4.78	4.94	5.82	5.07	5.38	0.09	4.98	5.42	0.05	5.53	4.92	5.16	0.06	0.01	0.01	0.37	0.99	0.11
D 88 to 109	5.73	5.38	5.64	6.66	5.89	6.11	0.10	5.60	6.22	0.06	6.19	5.62	5.86	0.07	0.01	0.01	0.63	0.13	0.03
Overall	4.48	4.01	4.21	4.98	4.25	4.54	0.07	4.23	4.59	0.04	4.74	4.17	4.39	0.05	0.01	0.01	0.41	0.76	0.05
Feed/Gain																			
d 0 to 56	2.22	2.08	2.17	2.44	2.33	2.38	0.03	2.16	2.38	0.04	2.33	2.27	2.22	0.02	0.01	0.01	0.56	0.79	0.76
d 56 to 88	2.78	2.63	2.63	3.13	2.86	2.94	0.05	2.70	2.94	0.03	2.94	2.70	2.78	0.03	0.01	0.01	0.22	0.12	0.12
d 88 to 109	2.63	2.44	2.56	2.78	2.70	2.78	0.05	2.56	2.78	0.03	2.70	2.56	2.63	0.03	0.01	0.02	0.99	0.99	0.25
Overall	2.44	2.33	2.38	2.78	2.56	2.63	0.02	2.38	2.63	0.01	2.56	2.44	2.50	0.02	0.01	0.01	0.89	0.45	0.90

[a]A total of 1,032 gilts (24 or 25 pigs per pen and 7 pens per treatment) with an initial average weight of 67.7 lb.

Table 3. Effects of Added Fat and Initial Sort on Weight Variation, Carcass Traits, and Economic Value in Growing-finishing Pigs, Experiment 1[a]

| | Interactive Means | | | | | | | Main Effects | | | | | | | Probability, $P <$ | | | | |
| | 6% Fat | | | No Fat | | | | Fat Addition | | | Weight | | | | | | Sort vs. Mixed | Sort vs. Mixed by Fat IntAct | Heavy vs. Light by Fat IntAct |
Item,	Heavy	Light	Mixed	Heavy	Light	Mixed	SE	6% Fat	No Fat	SE	Heavy	Light	Mixed	SE	Fat	Sort	Mixed	IntAct	IntAct
Wt, lb																			
d 0	76.5	59.1	67.5	76.5	59.1	67.9	0.7	67.7	67.8	0.4	76.5	59.1	67.7	0.5	0.88	0.01	0.91	0.75	0.95
d 56	172.8	145.9	156.7	171.1	140.0	156.1	2.1	158.4	155.7	1.2	172.0	142.9	156.4	1.5	0.11	0.01	0.55	0.38	0.32
d 88	234.8	205.2	217.4	232.4	198.3	214.8	2.2	219.1	215.1	1.3	233.6	201.8	216.1	1.6	0.03	0.01	0.40	0.60	0.31
d 109	274.3	251.5	262.8	277.0	244.5	258.9	2.4	262.9	260.1	1.4	275.6	248.0	260.8	1.7	0.17	0.01	0.63	0.68	0.05
Wt, CV																			
d 0	8.72	12.67	15.42	8.72	11.02	15.87	0.706	12.27	11.87	0.407	8.72	11.85	15.65	0.499	0.49	0.01	0.01	0.30	0.25
d 56	12.76	14.72	16.20	11.55	15.69	15.05	1.257	14.56	14.10	0.726	12.16	15.21	15.62	0.889	0.65	0.02	0.08	0.64	0.39
d 88	11.38	12.77	14.08	9.07	13.34	13.25	0.997	12.74	11.89	0.576	10.23	13.06	13.67	0.705	0.30	0.01	0.02	0.98	0.16
d 109	9.98	12.79	12.59	8.38	12.18	12.40	0.933	11.79	10.99	0.539	9.18	12.48	12.50	0.660	0.30	0.01	0.05	0.58	0.60
ADG, CV																			
d 0 to 56	19.75	20.35	21.23	18.61	23.68	20.09	2.184	20.44	20.79	1.261	19.18	22.02	20.66	1.544	0.85	0.44	0.97	0.56	0.31
d 56 to 88	15.21	17.11	17.33	14.52	14.41	17.35	1.312	16.55	15.43	0.758	14.86	15.76	17.34	0.928	0.30	0.18	0.08	0.45	0.45
d 88 to 109	18.99	21.75	18.60	19.06	17.74	22.47	2.526	19.78	19.76	1.458	19.02	19.75	20.54	1.786	0.99	0.84	0.60	0.19	0.42
Overall	12.89	15.18	14.14	10.83	14.54	14.48	1.236	14.07	13.28	0.713	11.86	14.86	14.31	0.874	0.44	0.05	0.38	0.43	0.57
Carcass traits																			
Back Fat (mm)	15.02	14.41	14.59	14.99	14.15	14.44	0.013	14.67	14.53	0.193	15.00	14.28	14.51	0.236	0.59	0.10	0.66	1.00	0.75
FFLI	51.53	51.35	51.58	51.63	51.30	51.53	0.153	51.49	51.48	0.089	51.58	51.32	51.55	0.109	0.98	0.20	0.46	0.80	0.63
Lean, %	57.02	57.16	57.48	56.95	57.56	57.14	0.290	57.22	57.22	0.167	56.99	57.36	57.31	0.205	0.99	0.38	0.58	0.32	0.43
Loin depth, cm	6.11	5.91	6.27	6.02	6.11	5.90	0.134	6.10	6.01	0.077	6.07	6.01	6.09	0.094	0.42	0.85	0.70	0.07	0.30
Economic value																			
FC/lb gain, $	0.172	0.163	0.163	0.168	0.159	0.163	0.001	0.168	0.163	0.001	0.168	0.159	0.163	0.001	0.02	0.01	0.82	0.46	0.82
Sort discount, $	-2.66	-2.02	-2.98	-2.47	-2.14	-2.23	0.348	-2.55	-2.28	0.201	-2.57	-2.08	-2.66	0.246	0.34	0.25	0.35	0.25	0.65
MOF[b], $	94.11	88.38	90.48	95.72	86.92	91.13	1.583	90.99	91.26	0.914	94.92	87.65	90.81	1.119	0.83	0.01	0.73	0.84	0.34

[a]A total of 1,032 gilts (24 or 25 pigs per pen and 7 pens per treatment) with an initial average weight of 67.7 lb.
[b]Margin over feed; calculated by using corn $2.16/bu, SBM $186.19, fat $13.34/cwt, carcass base price $45.39

Table 4. Effects of Added Fat and Initial Sort on Growth and Variation of Grow in Growing-finishing Pigs, Experiment 2[a]

| Item,	Interactive Means							Main Effects										Probability, $P <$		
	6% Fat			No Fat				Fat Addition			Weight								Sort vs.	Sort vs. Mixed by Fat	Heavy vs. Light by Fat
	Heavy	Light	Mixed	Heavy	Light	Mixed	SE	6% Fat	No Fat	SE	Heavy	Light	Mixed	SE		Fat	Sort	Mixed	IntAct	IntAct
ADG, lb																				
d 0 to 49	1.90	1.83	1.87	1.83	1.74	1.79	0.02	1.87	1.79	0.01	1.85	1.79	1.83	0.02		0.01	0.01	0.89	0.81	0.40
d 49 to 81	2.09	2.12	2.09	2.07	2.05	2.05	0.04	2.09	2.05	0.02	2.09	2.07	2.07	0.03		0.16	0.96	0.80	0.83	0.77
d 81 to 95	2.31	2.05	2.14	2.25	1.98	2.09	0.10	2.18	2.12	0.06	2.27	2.03	2.12	0.07		0.43	0.04	0.75	0.88	0.99
Overall	2.01	1.96	1.98	1.94	1.87	1.92	0.02	1.98	1.92	0.01	1.96	1.92	1.94	0.01		0.01	0.02	0.91	0.89	0.37
ADFI, lb																				
d 0 to 49	4.37	3.97	4.19	4.67	4.25	4.48	0.06	4.19	4.45	0.03	4.52	4.10	4.32	0.04		0.01	0.01	0.83	0.99	0.84
d 49 to 81	5.40	5.03	5.20	5.82	5.49	5.67	0.07	5.20	5.67	0.04	5.60	5.25	5.45	0.05		0.01	0.01	0.94	0.84	0.82
d 81 to 95	6.37	5.67	5.91	6.77	6.24	6.59	0.11	6.00	6.53	0.06	6.57	5.95	6.26	0.07		0.01	0.01	0.99	0.26	0.40
Overall	5.53	4.61	5.00	5.95	5.03	5.42	0.06	5.05	5.47	0.03	5.73	4.81	5.22	0.04		0.01	0.01	0.25	0.97	0.91
Feed/Gain																				
d 0 to 49	2.33	2.17	2.22	2.56	2.44	2.50	0.03	2.22	2.50	0.02	2.44	2.27	2.33	0.02		0.01	0.01	0.93	0.67	0.30
d 49 to 81	2.56	2.38	2.44	2.86	2.70	2.78	0.06	2.44	2.78	0.04	2.70	2.50	2.56	0.04		0.01	0.01	0.78	0.52	0.75
d 81 to 95	2.78	2.78	2.78	3.03	3.13	3.13	0.11	2.78	3.13	0.06	2.86	2.94	2.94	0.07		0.01	0.86	0.75	0.86	0.67
Overall	2.44	2.33	2.38	2.78	2.63	2.70	0.03	2.38	2.70	0.01	2.56	2.44	2.50	0.02		0.01	0.01	0.68	0.83	0.28

[a]A total of 1,176 gilts (28 pigs per pen and 7 pens per treatment) with an initial average weight of 77.4 lb.

Table 5. Effects of Added Fat and Initial Sort on Weight Variation, Carcass Traits, and Economic Value in Growing-finishing Pigs, Experiment 2[a]

| | Interactive Means | | | | | | | Main Effects | | | | | | | Probability, P < | | | | |
| | 6% Fat | | | No Fat | | | | Fat Addition | | | Weight | | | | | | Sort vs. Mixed | Sort vs. Mixed by Fat IntAct | Heavy vs. Light by Fat IntAct |
Item,	Heavy	Light	Mixed	Heavy	Light	Mixed	SE	6% Fat	No Fat	SE	Heavy	Light	Mixed	SE	Fat	Sort			
Wt, lb																			
d 0	82.9	71.8	77.4	83.2	71.7	77.8	1.2	77.4	77.6	0.7	83.1	71.7	77.6	0.8	0.83	0.01	0.87	0.88	0.87
d 49	175.6	161.7	168.9	172.6	156.7	164.9	1.6	168.7	164.7	0.9	174.1	159.2	166.9	1.1	0.01	0.01	0.86	0.99	0.53
d 81	242.6	229.3	235.9	238.8	222.5	230.7	1.7	235.9	230.7	1.0	240.7	225.9	233.3	1.2	0.01	0.01	1.00	0.97	0.38
d 95	271.3	257.9	264.3	267.3	250.4	259.0	1.9	264.5	258.9	1.1	269.3	254.2	261.7	1.4	0.01	0.01	0.97	0.89	0.36
Wt, CV																			
d 0	9.99	12.08	15.88	9.33	12.56	15.85	0.751	12.65	12.58	0.434	9.66	12.32	15.86	0.531	0.91	0.01	0.01	0.96	0.46
d 49	9.30	10.37	12.92	8.18	11.87	13.12	0.691	10.86	11.06	0.399	8.74	11.12	13.02	0.488	0.73	0.01	0.01	1.00	0.06
d 81	8.69	8.69	10.95	8.02	10.39	11.05	0.551	9.44	9.82	0.318	8.36	9.54	11.00	0.390	0.41	0.01	0.01	0.66	0.04
d 95	7.47	8.67	9.65	7.23	9.78	9.78	0.479	8.60	8.93	0.276	7.35	9.22	9.71	0.338	0.41	0.01	0.01	0.71	0.17
ADG, CV																			
d 0 to 49	13.03	12.58	14.36	10.68	15.00	14.78	1.028	13.32	13.49	0.594	11.86	13.79	14.57	0.727	0.84	0.04	0.06	0.83	0.03
d 49 to 81	14.21	10.82	12.69	15.61	15.80	14.55	1.134	12.57	15.32	0.653	14.91	13.31	13.62	0.800	0.01	0.33	0.62	0.50	0.12
d 81 to 95	19.23	23.07	21.02	18.92	27.30	18.69	1.766	21.11	21.64	1.020	19.07	25.19	19.86	1.249	0.72	0.01	0.15	0.17	0.21
Overall	9.44	9.41	9.74	8.86	10.64	9.79	0.612	9.53	9.76	0.353	9.15	10.03	9.77	0.432	0.64	0.34	0.74	0.80	0.15
Economic value																			
FC/lb gain, $	0.168	0.159	0.163	0.163	0.154	0.159	0.002	0.163	0.159	0.001	0.168	0.159	0.163	0.001	0.03	0.01	0.82	0.53	0.30
Sort discount, $	-3.87	-1.66	-3.72	-2.83	-2.13	-2.71	0.563	-3.08	-2.56	0.325	-3.35	-1.90	-3.22	0.398	0.26	0.03	0.23	0.47	0.19
MOF[b], $	95.88	91.72	92.29	96.69	88.53	92.56	0.741	93.30	92.59	0.428	96.28	90.13	92.42	0.524	0.25	0.01	0.23	0.26	0.01

[a]A total of 1,176 gilts (28 pigs per pen and 7 pens per treatment) with an initial average weight of 77.4 lb.

[b]Margin over feed; calculated by using corn $2.16/bu, SBM $186.19, fat $13.34/cwt, carcass base price $45.39

Weighted Averages
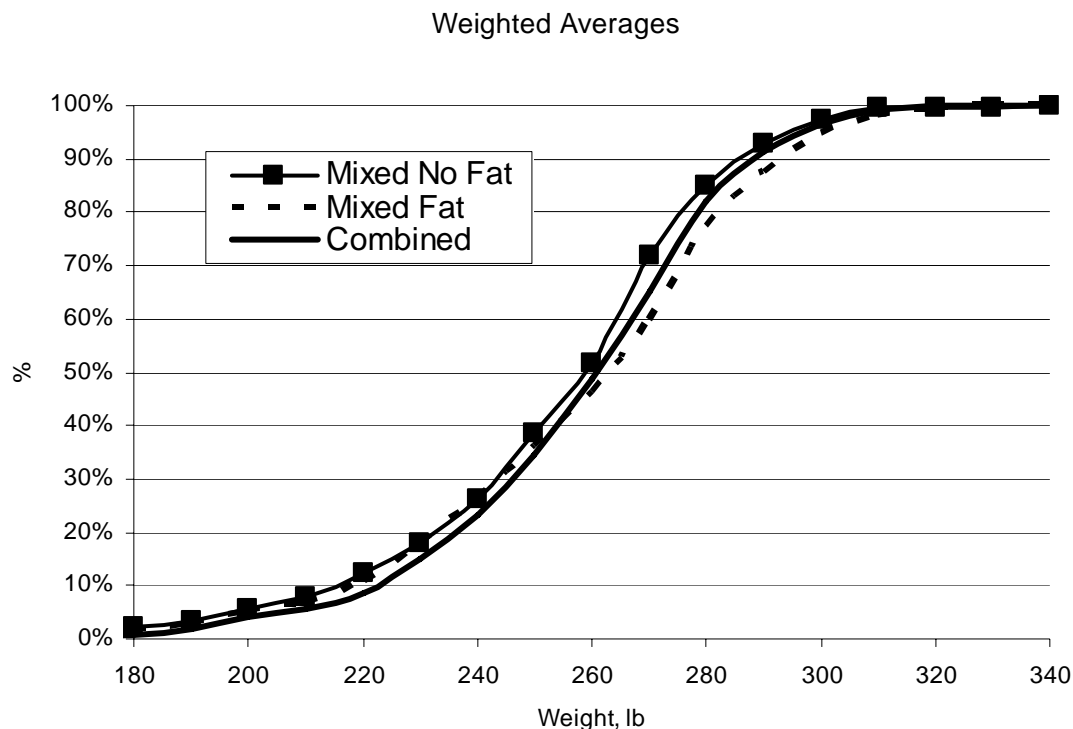
Figure 1. Cumulative-sum Graph Showing Percentage of Population at or Below Specific Weights. [a]Combined represents the light (added fat) and heavy (no added fat) treatments.

Table 6. Number of Times Added Dietary Fat had a Positive or Negative Effect on Margin Over Feed Over a 15-year Time Period[a]

	Weight		
	Light	Heavy	Mixed
Positive[b]	180	9	23
Negative[c]	0	171	157

[a]Ingredient prices from 1989 to 2003. Corn prices were from Agricultural Statistics Board (USDA) (http://www.nass.usda.gov:81/ipedb/grains.htm), soybean meal and fat prices from *Feedstuffs*, and market hog prices from Economic Research Service (http://www.ers.usda.gov/Data/sdp/view.asp?f=livestock/94006/&arc=C).
[b]Number of months that fat had a positive value for MOF over the 180-month series.
[c]Number of months that fat had a negative value for MOF over the 180-month series.