# Effects of Dietary Fat Source and Length of Fat Consumption on Performance and Carcass Composition of Growing-Finishing Swine

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## Story in Brief

Crossbred pigs (n = 288) were used to test the effects of dietary fat source and length of fat consumption on the performance and carcass composition of growing-finishing swine. Pigs were blocked by initial BW, allotted to pens (four pens/block), and, within blocks, pens (eight pigs/pen) were randomly assigned to either control corn-soybean meal grower-1, grower-II, finisher-I, and finisher-II diets (Ctrl) or diets containing 5% beef tallow (BT), poultry fat (PT), or soybean oil (SBO). Immediately prior to feeding experimental diets (referred to as 50 lb), one pig was randomly selected from each pen, slaughtered, and right carcass sides fabricated into wholesale cuts, which were dissected into lean, fat, bone, and skin components. Subsequently, one pig from each pen was randomly selected for slaughter and dissection at a mean block weight of 100, 150, 200, and 250 lb. Inclusion of fat into swine diets had no ($P \geq 0.35$) effect on ADG, ADFI, or F/G during the grower or finisher phases, regardless of fat source. Carcasses of pigs fed 5% dietary fat, regardless of source, had greater ($P < 0.05$) average backfat depths than carcasses from pigs fed the corn-SBM diets; however, dietary fat source had no ($P > 0.10$) effect on carcass composition. Results of this study indicate that dietary fat source has no appreciable effect on live performance or carcass composition of growing-finishing swine.

## Introduction

It has been repeatedly shown that increasing dietary energy density by the addition of fat to growing-finishing pig diets improved the rate and efficiency of gain. Feeding swine diets formulated with beef tallow (a highly saturated fat source; Stahly and Cromwell, 1979) or soybean oil (a highly polyunsaturated fat source; Odle and See, 1996) has been shown to reduce ADFI and improve F/G, but carcass fatness measures increased in response to feeding high amounts of dietary fat. On the other hand, poultry fat is a moderately polyunsaturated fat source produced in abundance in Arkansas, and, when included in swine diets, was shown to improve feed efficiency without affecting backfat depth or calculated lean yield (Engel et al., 2001). The aforementioned studies only compared the respective fat source to diets formulated without added fat, and none of the studies measured actual carcass composition. Therefore, the objective of this experiment was to test the effects of dietary fat source and length of fat consumption on the performance and carcass composition of growing-finishing swine.

## Experimental Procedures

A total of 288 crossbred barrows and gilts (Monsanto Choice Genetics, St. Louis, MO), with an average initial BW of 61.8 lb, were blocked by weight into nine blocks of 32 pigs/block. Pigs within blocks were allotted randomly to pens (eight pigs/pen) and stratified across gender and litter origin. Within each block, pens were randomly assigned to one of four dietary treatments, including a control (Ctrl), corn-soybean meal grower and finisher diets with no added fat, or grower and finisher diets supplemented with 5% of either beef tallow (BT), poultry fat (PF), or soybean oil (SBO). Pigs were fed a four-phase diet with transition from grower-I to grower-II, grower-II to finisher-I, and finisher-I to finisher-II when mean weight of each block was 100, 150, and 200 lb, respectively. All diets (Table 1) were formulated to meet, or exceed, NRC (1998) amino acid, energy, and other nutrient requirements of growing-finishing swine.

Pigs were housed in a curtain-sided building with 5 x 10 ft pens on totally slatted concrete floors. Each pen was equipped with a single-opening feeder and cup waterers, allowing pigs ad libitum access to feed and water. Individual pig weights were measured weekly, and feed disappearance was recorded at 7-d intervals during each feeding phase to calculate ADG, ADFI, and F/G.

Immediately after treatment allotment, one pig from each pen was randomly selected for slaughter at the University of Arkansas Red Meat Research Abattoir for initial carcass composition. Additionally, one pig was chosen at random from each pen when block weight averaged 100, 150, 200, and 250 lb. Pigs were slaughtered according to industry standards, weighed, and chilled for 48 h at 34°F. After the chilling period, midline backfat depths opposite the first rib, last rib, and last lumbar vertebra were measured on right sides. Then, right sides were weighed, leaf fat was removed and weighed, and sides were fabricated into wholesale cuts (ham, loin, shoulder, and belly). Wholesale cuts were weighed, and subsequently dissected into lean, fat, bone, and skin components. Weights of dissected components were recorded, and weights of wholesale cuts, as well as dissected components, were divided by the chilled carcass weight to calculate wholesale cut and dissected lean, fat, bone, and skin yields. In order for a carcass side to be included in the statistical analysis, the sum of dissected components must have been at least 97.5% of the chilled side weight.

Data were analyzed as a randomized complete block design, with pen as the experimental unit and blocks based on initial pig weight. Analysis of variance was generated using the mixed-model procedure of SAS (SAS Inst., Inc., Cary, N.C.). For performance data, block and dietary fat source were included as the random and fixed effects, respectively, in the model. Carcass data were analyzed

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as repeated measures, with dietary fat source and slaughter weight, as well as the two-way interaction, included in the model as fixed effects, and block included in the model as a random effect. Least squares means were computed for main and interactive effects, and separated statistically using the PDIFF option when a significant F-test ($P < 0.05$) was detected. There were no ($P > 0.10$) dietary fat source x slaughter weight interactions; therefore, only main effects of fat source and length of fat consumption will be reported.

## Results and Discussion

Including 5% fat in diets of growing-finishing pigs, regardless of source, did not affect ADG ($P \geq 0.35$), ADFI ($P \geq 0.38$), or F/G ($P \geq 0.41$) during any feeding phase or across the entire feeding trial (Table 2). Several researchers have documented that increasing the energy content of swine diets reduces feed intake without impacting growth rate, resulting in improved feed efficiency (Stahly and Cromwell, 1979; Odle and See, 1996; Engel et al., 2001). Conversely, others have failed to detect an effect of feeding increased levels of dietary fat on pig performance (McDonald & Hamilton, 1976; Coffey et al., 1982). It should noted that the removal of four randomly selected pigs from each pen for slaughter could have easily resulted in greater variation within the pen, and may explain why performance, especially ADFI and F/G, was not affected by the addition of 5% dietary fat.

Carcass weight and dressing percentage did not ($P \geq 0.20$) differ among dietary treatments (Table 3). However, carcasses from pigs fed diets formulated with 5% PF and SBO had greater ($P < 0.05$) first rib fat depths than carcasses of pigs fed the Ctrl diets, whereas carcasses from BT- and SBO-fed pigs were fatter ($P < 0.05$) than those of Ctrl-fed pigs opposite the last lumbar vertebra. Moreover, carcasses from pigs fed 5% dietary fat, regardless of source, had greater ($P < 0.05$) average backfat depths than carcass from pigs fed the Ctrl diets. Stahly and Cromwell (1979) reported that feeding finishing pigs 5% BT increased carcass backfat depth and leaf fat percentage. On the other hand, other researchers have noted no effect of feeding finishing pigs elevated levels of BT (McDonald and Hamilton, 1976), PF (Seerley et al., 1978; Engel et al., 2001), or SBO (McDonald and Hamilton, 1976; Odle and See, 1996) on carcass backfat depths.

As expected, carcass weight and dressing percent were lowest ($P < 0.05$) in pigs slaughtered at 50 lb and greatest ($P < 0.05$) in pigs slaughtered at 250 lb (Table 4). Moreover, pigs slaughtered at 250 lb had the most ($P < 0.05$) backfat, whereas, pigs slaughtered before initiation of the feeding trial produced carcasses with the least ($P < 0.05$) backfat.

Dietary fat source had no ($P \geq 0.25$) effect on wholesale cut yields, nor was the proportion of lean ($P = 0.21$), fat ($P = 0.50$), or bone ($P = 0.55$) affected by dietary fat source (Table 5). However, carcasses from pigs fed BT had a higher ($P < 0.05$) percentage of dissected skin than carcasses from pigs fed PF and SBO. Neither Odle and See (1996) nor Engel et al. (2001) reported an effect of increasing dietary fat content on estimated lean muscle yields, and McDonald and Hamilton (1976) reported that ham yield was not affected by the inclusion of BT in swine finishing diets. However, Coffey et al. (1982) noted that feeding finishing pigs 9% PF reduced loin yields compared to feeding 0 or 2% PF.

Ham yield increased ($P < 0.01$), and loin yield decreased ($P < 0.01$), as live weight of pigs at slaughter increased from 50 to 250 lb (Table 6). Pigs slaughtered at 150, 200, and 250 lb had greater ($P < 0.01$) wholesale shoulder yields than pigs slaughtered at 50 and 100 lb. Pigs slaughtered at the beginning of this trial had the lowest ($P < 0.01$) belly yields, but belly yields were similar ($P > 0.05$) among pigs slaughtered at 150, 200, and 250 lb. Additionally, leaf fat yields were greatest ($P < 0.01$) in carcasses of pigs slaughtered at 250 lb and least ($P < 0.01$) in pigs slaughtered at 61 lb. The proportion of dissectible lean and bone decreased ($P < 0.01$), and the percentage of dissectible fat increased ($P < 0.01$) as slaughter weight increased from 61 to 250 lb. Furthermore, pigs slaughtered at 50, 100, and 150 lb produced carcasses with a greater ($P < 0.01$) percentage of skin than pigs slaughtered at 200 and 250 lb.

## Implications

Results of this study indicate that the inclusion of 5% fat, regardless of source, in diets of growing-finishing pigs had no appreciable effects on live pig performance, wholesale cut yields, or carcass composition. However, as expected, lean muscle content decreased, and carcass fat content increased, as slaughter weight increased from 50 to 250 lb.

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**Table 1. Diet composition.**

| | Grower I | | Grower II | | Finisher I | | Finisher II | |
|---|---|---|---|---|---|---|---|---|
| Ingredient, % | Control | Fat | Control | Fat | Control | Fat | Control | Fat |
| Corn | 76.825 | 68.655 | 81.78 | 73.97 | 86.37 | 79.41 | 89.568 | 82.47 |
| Soybean meal | 20.50 | 23.50 | 15.60 | 18.25 | 11.25 | 13.10 | 8.25 | 10.25 |
| Fat[a] | --- | 5.00 | --- | 5.00 | --- | 5.00 | --- | 5.00 |
| Dicalcium phosphate | 0.88 | 0.94 | 0.88 | 0.94 | 0.69 | 0.75 | 0.50 | 0.55 |
| Calcium carbonate | 0.70 | 0.77 | 0.73 | 0.80 | 0.68 | 0.71 | 0.72 | 0.75 |
| Salt | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Lysine | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| Mineral premix[b] | 0.14 | 0.15 | 0.14 | 0.15 | 0.14 | 0.15 | 0.117 | 0.125 |
| Vitamin premix[c] | 0.14 | 0.15 | 0.14 | 0.15 | 0.14 | 0.15 | 0.14 | 0.15 |
| Tylosin-40 | 0.125 | 0.125 | 0.05 | 0.05 | 0.05 | 0.05 | 0.025 | 0.025 |
| Ethoxiquin | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| Threonine | 0.01 | 0.02 | --- | 0.01 | --- | --- | --- | --- |
| Methionine | --- | 0.01 | --- | --- | --- | --- | --- | --- |
| Calculated composition, % | | | | | | | | |
| CP | 16.24 | 17.00 | 14.31 | 14.94 | 12.63 | 12.93 | 11.47 | 11.83 |
| Lysine | 0.94 | 1.00 | 0.80 | 0.86 | 0.68 | 0.72 | 0.60 | 0.64 |
| Calcium | 0.56 | 0.60 | 0.55 | 0.60 | 0.48 | 0.51 | 0.44 | 0.47 |
| Phosphorus | 0.52 | 0.53 | 0.50 | 0.51 | 0.45 | 0.45 | 0.40 | 0.40 |
| ME, kcal/lb | 1511.9 | | 1513.6 | | 1518.1 | | 1521.8 | |
| BT diets | | 1605.8 | | 1607.5 | | 1612.8 | | 1616.7 |
| PF diets | | 1617.2 | | 1618.9 | | 1624.2 | | 1628.1 |
| SBO diets | | 1622.2 | | 1623.9 | | 1629.2 | | 1633.0 |

[a]Fat sources included in diets were beet tallow (BT), poultry fat (PF), and soybean oil (SBO).
[b]Supplies 138 ppm Fe, 138 ppm Zn, 0.25 ppm SE, 33 ppm Mn, 13.8 ppm CU, and 0.25 ppm I (NutraBlend, Neosho, MO).
[c]Supplies 6614 IU vitamin A, 992 IU vitamin D, 26 IU vitamin E, 2.6 mg vitamin K, 19.8 mg pantothenic acid, 33 mg niacin, 6 mg riboflavin, and 26 µg $B_{12}$.

**Table 2. Effect of dietary fat source on performance of growing-finishing swine.**

| | Dietary treatments[a] | | | | |
|---|---|---|---|---|---|
| Trait | Ctrl | BT | PF | SBO | SEM |
| Grower I phase (60 to 100 lb) | | | | | |
| ADG, lb | 1.61 | 1.73 | 1.64 | 1.65 | 0.070 |
| ADFI, lb | 3.44 | 3.71 | 3.54 | 3.59 | 0.121 |
| F/G | 2.15 | 2.16 | 2.11 | 2.10 | 0.054 |
| Grower II phase (100 to 150 lb) | | | | | |
| ADG, lb | 1.83 | 1.83 | 1.74 | 1.80 | 0.057 |
| ADFI, lb | 4.81 | 4.70 | 4.74 | 4.77 | 0.163 |
| F/G | 2.70 | 2.66 | 2.71 | 2.71 | 0.072 |
| Finisher I phase (150 to 200 lb) | | | | | |
| ADG, lb | 1.93 | 1.87 | 1.86 | 1.95 | 0.077 |
| ADFI, lb | 6.03 | 6.04 | 6.10 | 5.84 | 0.295 |
| F/G | 3.37 | 3.41 | 3.41 | 3.12 | 0.136 |
| Finisher II phase (200 to 250 lb) | | | | | |
| ADG, lb | 2.39 | 2.13 | 2.26 | 2.16 | 0.108 |
| ADFI, lb | 6.97 | 6.25 | 6.64 | 6.13 | 0.372 |
| F/G | 2.97 | 3.00 | 2.90 | 2.96 | 0.122 |
| Overall (60 to 250 lb) | | | | | |
| ADG, lb | 1.86 | 1.85 | 1.81 | 1.82 | 0.053 |
| ADFI, lb | 5.01 | 4.97 | 4.98 | 4.86 | 0.152 |
| F/G | 2.72 | 2.70 | 2.68 | 2.63 | 0.056 |
| Live weights, lb | | | | | |
| Initial | 61.8 | 61.9 | 61.8 | 61.9 | 0.04 |
| Grower I | 95.9 | 98.8 | 97.7 | 99.1 | 1.19 |
| Grower II | 141.7 | 145.1 | 144.0 | 146.9 | 1.78 |
| Finisher I | 187.7 | 191.5 | 192.4 | 194.5 | 2.20 |
| Finisher II | 234.1 | 236.5 | 236.8 | 235.9 | 4.05 |

[a]Ctrl = corn-SBM grower and finisher diets; BT = control diets containing 5% beef tallow; PF = control diets containing 5% poultry fat; and SBO = control diets containing 5% soybean oil.

**Table 3. Effect of dietary fat source on carcass characteristics of growing-finishing swine.**

| | Dietary treatments[a] | | | | |
|---|---|---|---|---|---|
| Trait | Ctrl | BT | PF | SBO | SEM |
| Carcass wt, lb | 102.3 | 103.2 | 105.4 | 106.0 | 1.81 |
| Dressing percent | 66.5 | 67.4 | 67.2 | 67.4 | 0.34 |
| Backfat depth, in. | | | | | |
| First rib | $0.88^{y}$ | $1.00^{xy}$ | $1.04^{x}$ | $1.09^{x}$ | 0.045 |
| Last rib | 0.49 | 0.55 | 0.53 | 0.56 | 0.026 |
| Last lumbar vertebra | $0.37^{y}$ | $0.47^{x}$ | $0.43^{xy}$ | $0.49^{x}$ | 0.026 |
| Average | $1.04^{y}$ | $1.19^{x}$ | $1.19^{x}$ | $1.28^{x}$ | 0.047 |

[a]Ctrl = corn-SBM grower and finisher diets; BT = control diets containing 5% beef tallow; PF = control diets containing 5% poultry fat; and SBO = control diets containing 5% soybean oil.
[x,y]Within a row, least squares means lacking a common superscript letter differ (P < 0.05).

**Table 4. Effect of slaughter weight on carcass characteristics of growing-finishing swine.**

| | Slaughter weight, lb | | | | | |
|---|---|---|---|---|---|---|
| | 50 | 100 | 150 | 200 | 250 | SEM |
| Carcass wt, lb | $39.2^{z}$ | $61.8^{y}$ | $100.8^{x}$ | $141.7^{w}$ | $177.3^{v}$ | 1.94 |
| Dressing percent | $63.1^{x}$ | $63.7^{x}$ | $67.1^{w}$ | $70.4^{v}$ | $71.2^{v}$ | 0.38 |
| Backfat depth, in. | | | | | | |
| First rib | $0.43^{z}$ | $0.68^{y}$ | $1.00^{x}$ | $1.31^{w}$ | $1.57^{v}$ | 0.051 |
| Last rib | $0.18^{z}$ | $0.28^{y}$ | $0.50^{x}$ | $0.75^{w}$ | $0.96^{v}$ | 0.029 |
| Last lumbar vertebra | $0.20^{y}$ | $0.28^{y}$ | $0.43^{x}$ | $0.52^{w}$ | $0.77^{v}$ | 0.029 |
| Average | $0.48^{z}$ | $0.74^{y}$ | $1.15^{x}$ | $1.56^{w}$ | $1.95^{v}$ | 0.053 |

[v,w,x,y,z]Within a row, least squares means lacking a common superscript letter differ (P < 0.05).

**Table 5. Effect of dietary fat source on carcass composition of growing-finishing swine.**

| | Dietary treatments[a] | | | | |
|---|---|---|---|---|---|
| Trait | Ctrl | BT | PF | SBO | SEM |
| Primal cut yields, % | | | | | |
| Ham | 29.12 | 29.23 | 29.29 | 29.30 | 0.238 |
| Loin | 25.40 | 25.38 | 25.45 | 24.83 | 0.266 |
| Shoulder | 24.90 | 25.13 | 25.20 | 25.31 | 0.242 |
| Belly | 18.53 | 18.24 | 18.02 | 18.41 | 0.232 |
| Leaf fat | 1.87 | 1.80 | 1.87 | 1.84 | 0.060 |
| Carcass composition, % | | | | | |
| Lean | 57.85 | 56.62 | 57.18 | 57.69 | 0.439 |
| Fat | 15.88 | 16.94 | 16.56 | 16.62 | 0.496 |
| Bone | 17.94 | 17.85 | 18.10 | 17.56 | 0.268 |
| Skin | $7.82^{xy}$ | $8.07^{x}$ | $7.67^{y}$ | $7.45^{y}$ | 0.135 |

[a]Ctrl = corn-SBM grower and finisher diets; BT = control diets containing 5% beef tallow; PF = control diets containing 5% poultry fat; and SBO = control diets containing 5% soybean oil.

[x,y]Within a row, least squares means lacking a common superscript letter differ ($P < 0.05$).

**Table 6. Effect of slaughter weight on carcass composition of growing-finishing swine.**

| | Slaughter weight, lb | | | | | |
|---|---|---|---|---|---|---|
| | 50 | 100 | 150 | 200 | 250 | SEM |
| Primal cut yields, % | | | | | | |
| Ham | $32.16^{v}$ | $29.93^{w}$ | $29.47^{w}$ | $28.01^{x}$ | $26.62^{y}$ | 0.266 |
| Loin | $23.24^{z}$ | $24.22^{y}$ | $25.22^{x}$ | $26.07^{w}$ | $27.56^{v}$ | 0.294 |
| Shoulder | $26.38^{v}$ | $26.68^{v}$ | $24.27^{w}$ | $24.53^{w}$ | $23.81^{w}$ | 0.270 |
| Belly | $16.92^{x}$ | $17.66^{w}$ | $18.91^{v}$ | $19.06^{v}$ | $18.95^{v}$ | 0.254 |
| Leaf fat | $1.23^{y}$ | $1.52^{x}$ | $1.70^{x}$ | $2.12^{w}$ | $2.65^{v}$ | 0.064 |
| Carcass composition, % | | | | | | |
| Lean | $64.14^{v}$ | $61.08^{w}$ | $55.55^{x}$ | $53.40^{y}$ | $52.49^{y}$ | 0.489 |
| Fat | $7.12^{z}$ | $12.17^{y}$ | $17.11^{x}$ | $21.88^{w}$ | $24.22^{v}$ | 0.555 |
| Bone | $20.27^{v}$ | $17.99^{w}$ | $18.82^{w}$ | $16.89^{x}$ | $15.33^{y}$ | 0.299 |
| Skin | $7.94^{v}$ | $8.25^{v}$ | $7.87^{v}$ | $7.45^{w}$ | $7.26^{w}$ | 0.151 |

[v,w,x,y,z]Within a row, least squares means lacking a common superscript letter differ ($P < 0.05$).