RESEARCH REPORT
PORK QUALITY

Title: Improving carcass fat quality by manipulating the amount and timing of feeding dietary fats with different iodine values – NPB #12-062

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Date submitted: 20 February 2014

Industry summary: This project speaks directly to the primary objectives of the Improving Fat Quality program, by seeking to maximize production efficiencies through optimizing the use of dietary fat and cost-effective ingredients to maximize economic goals for the producer while still achieving a desirable final carcass quality product. There appears to be a growing negativity regarding the use of unsaturated dietary fat. Producers need to achieve economic targets so the use of ingredients that are cost-effective is a must, while the packing sector sees increased problems with "soft fat" in the carcass. Neither goal (performance versus carcass) can be addressed in isolation of the other. Performance targets must consider final carcass quality, but at the same time, carcass quality must be considered in the context of pig performance in the barn. Alternative ingredients, such as conventional distillers grains, contain high levels of fat; optimizing the use of such products requires a thorough understanding of the impact of the fat component on carcass quality as well as on performance. Other alternative ingredients, such as high protein distillers' grains, require the use of added dietary fat to boost energy to levels that achieve pig growth targets. Again, optimum use of such ingredients requires a thorough understanding of the impact of the added fat on carcass quality as well as on pig performance. The outstanding question is how much fat can be added to the diet and for how long must the fat be removed from the diet prior to harvest, while maintaining minimum standards for carcass quality.

Fifty individually housed pigs were allotted based on sex and initial BW to 10 treatments for an 82 d experiment: 3 dietary fat withdrawal times prior to slaughter (21, 42 or 63d) by 3 dietary fat sources (5% animal-vegetable blend, 2.5% corn oil, or 5% corn oil), plus a control diet with no added fat. Pigs were weighed and jowl adipose samples were collected on days 0, 21, 42, 63 and at harvest on d82.

This study found that if the consumption of PUFAs is relatively low prior to the withdrawal of the unsaturated ingredient, the withdrawal technique will successfully lower carcass IV in a rapid and significant fashion. High amounts of 18:2 consumption via the addition of 5% CO showed that an elevated load of dietary unsaturated fat intake makes lowering carcass IV and diluting 18:2 from the depot very difficult and may take as long as 61d. The withdrawal of unsaturated dietary fat sources from the diet allowed the pig to produce fat metabolically, which results in a firmer, more saturated fat. However, contrary to our expectation, this change in diet did not result in the improvement of belly firmness, depth, weight, or fat color.

These research results were submitted in fulfillment of checkoff-funded research projects. This report is published directly as submitted by the project's principal investigator. This report has not been peer-reviewed.

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Keywords: dietary fat withdrawal, linoleic acid, carcass fat, iodine value, pigs

Scientific abstract: The inclusion of unsaturated fats in pig diets has raised issues related to pork carcass fat quality. The objective of this experiment was to understand how withdrawal from the diet of unsaturated dietary fat prior to slaughter impacts the composition of jowl fat during the growth cycle and at market. Fifty individually housed pigs (PIC 337 × C22/29; initial BW = 59.3 ± 0.55 kg), were allotted based on sex and initial BW to 10 treatments for an 82 d experiment as follows: 3 dietary fat withdrawal times prior to slaughter (21, 42 or 63d) by 3 dietary fat sources (5% animal-vegetable blend (AV; iodine value (IV) = 90.7), 2.5% corn oil (2.5% CO; IV = 122.7) or 5% corn oil (5% CO), plus a control diet with no added fat (CNTR) fed throughout the duration of trial. Pigs were weighed and jowl adipose samples were collected on days 0, 21, 42, 63 and at harvest on d82. Data were analyzed using PROCMIXED with treatment and sex as fixed effects. At market (d82) increasing the withdrawal of dietary fat further away from market increased 18:1 ($P < 0.01$) and tended to increase 14:0 concentrations ($P = 0.054$). It also significantly decreased 18:2 ($P < 0.01$), and tended to decrease 18:3 concentrations ($P = 0.08$). Dietary 5% CO resulted in the greatest 18:2 concentrations in jowl fat, followed by 2.5% CO; 5% AV resulted in the lowest 18:2 levels ($P < 0.01$). Dietary fat withdrawal before market significantly reduced carcass IV measured at d82 ($P < 0.01$). In conclusion, elevated 18:2 intake, such as adding feeding 5% CO makes lowering carcass IV in the depot fat very difficult and may take as long as 61d. The withdrawal of unsaturated dietary fat apparently encouraged de novo lipogenesis, resulting in a more saturated depot fat. Importantly, this alteration of deposited fat composition did not translate into improved belly firmness, depth, weight, or fat color.

Introduction: For nearly a century it has been known that the composition of fat in the carcass of the pig is reflective of the nature of the fat in the diet. Recently it has been shown that the composition of deposited fat can be altered quickly when diets differ in the quantity of polyunsaturated fatty acids (**PUFA**). The rate of elimination of linoleic acid (**18:2**) and other PUFAs from the adipose tissue is comparatively much slower than the deposition.

Increased PUFAs in the diet have resulted in softer fat, which may hinder the ability of pork producers and processors to meet export standards and may also affect processing characteristics. Therefore packers are employing iodine value (**IV**), a measurement of double bonds, as a proxy for carcass fat quality. Iodine value can be measured via direct titration or calculated from a fatty acid profile, but in either instance, quantifies the degree of unsaturation in a fat sample.

Since fatty acids generated de novo are largely saturated, it is logical to assume that withdrawal of the unsaturated fat from the diet would lower the IV. Ideally, producers need to meet carcass IV standards set by packers while at the same time taking advantage of cost savings from the use of ingredients which may contain highly unsaturated fats. To do so, information is required on the impact of fat withdrawal on carcass fat composition, especially the time line of change following dietary removal.

The objective of this study was to quantify changes in carcass fatty acid composition following the withdrawal of fats of differing composition from the diet. The hypothesis was that carcass IV declines in a direct relationship with the timing of dietary fat withdrawal.

Objectives: The overall objective of this proposal is to provide specific recommendations to pork producers on the use of two common dietary fats that vary in unsaturation (corn oil and AV blend) in grow/finishing diets so they can optimize performance in the barn while still maintaining carcass fat quality, as defined by iodine value (IV). Corn oil (IV = ~120) is commonly added by the pork industry, albeit through the use of corn DDGS, and AV blend (a source will be selected with an IV = 80 to 100) is one of the more economical dietary fat sources currently available; they represent fat sources that are considered high or intermediate in unsaturation and in iodine value. The specific objectives are:

1. To study the impact on carcass IV of dietary fat withdrawal from the feed at different times prior to harvest.
2. To compare the impact of feeding – and thence withdrawing – two levels of the high IV fat (2.5% or 5%) and one level of intermediate IV fat (5%). (Previous research has shown that feeding the lower level of the intermediate IV source is unlikely to elevate carcass IV excessively).
3. To predict the IV of carcass fat, measured in the jowl, from dietary concentration of IV and from daily intake of "IV" and specific fatty acids. (Previous research has shown a very, very strong correlation between loin and belly with jowl IV. Further, the jowl is the standard location for measurement of IV by packers).
4. To define how the fatty acid composition of jowl fat changes during the course of growth from weaning period to market, using the diets described above and collecting carcass fat samples by biopsy.

Materials & Methods: All experimental procedures adhered to guidelines for the ethical and humane use of animals for research, and were approved by the Iowa State University Institutional Animal Care and Use Committee (#5-12-7368-S).

Animals, Housing, and Experimental Design

A total of 50 pigs (PIC 337 × C22/C29, Pig Improvement Company, Hendersonville, TN) with an initial body weight of 59.3 ± 0.55 kg were randomly allotted to one of 10 treatments. Treatments included a corn soybean meal control diet with no added fat (**CNTR**) plus 9 additional treatments, arranged in a 3 by 3 factorial, incorporating 3 dietary fat withdrawal treatments (**WD**) 61d, 40d, or 19d prior to market (providing a dietary fat feeding duration period of 21d, 42d, or 63d) and 3 different dietary fat unsaturation loads (**DFUL**): 5% animal-vegetable blend (**5% AV**; IV = 90.7), 2.5% corn oil (**2.5% CO;** IV = 122.7) or 5% corn oil (**5% CO**). The dietary fat unsaturation load (DFUL) was defined as the concentration of unsaturated fatty acids present in the diet prior to the withdrawal of dietary fat from the diet. The DFUL in this experiment was selected to provide a high intake of unsaturated fatty acids (5% CO), a high intake of a mixture of saturated and unsaturated fatty acids (5% AV), and a moderate intake of unsaturated fatty acids (2.5% CO). This allowed for the comparison of fat sources and levels in terms of their effect on the composition of deposited fat. Pigs were housed individually in 1.8 × 1.9 m pens to permit measurement of individual feed – and thus fatty acid - intake. Each pen had a partially slatted concrete floor, a composite self-feeder, and a nipple drinker. Feed and water were available continuously throughout the experiment.

Diets and Feeding

All experimental diets (Table 1) were formulated on an ME to SID lysine ratio and met and or exceeded all specified nutrient requirements for pigs of this size (NRC, 2012). Diets contained 0.40% titanium dioxide as a digestibility marker. Representative feed samples were collected at the time of mixing and stored at -20℃ for later analysis.

Sample Collection

Pigs and feeders were weighed on d 0, 21, 42, 63, and 82 for determination of average daily gain, average daily feed intake, and feed conversion. Fecal grab samples were collected on day 21, 42, and 63 and immediately stored at -20℃ for later analysis.

Subcutaneous fat samples from the jowl were collected at d 0, 21, 42, and 63 by biopsy. The skin was removed from each 10 gram lipid sample and immediately inserted into a 7.62 × 12.70 cm plastic bag (FisherBrand, Fisher Science, Hanover Park, IL) and snap-frozen using liquid nitrogen. These samples were then stored in a -80°C freezer until analyzed.

On d 82, pigs were marketed at the JBS plant in Marshalltown, IA, where hot carcass weight, loin depth, and back fat thickness were measured. Samples of jowl, belly, and backfat were collected, vacuum packaged, and stored at -20℃ until analyzed. The right side belly from each pig was collected and measured for weight, temperature and thickness. Total thickness was measured in two locations in the center of the belly for middle thickness (**MT**) and at the center of the scribe edge of the belly for edge thickness (**ET**). A belly firmness test was conducted using a durometer (Model 1600-OOO-S, Electromatic Equipment Co., Inc., Cedarhurst, NY 11516) which measured compression of the fat (1-100 with 1 least firm and 100 firmest). A subjective belly firmness test was conducted by assigning a visual score (1-firm to 3-soft) based on the degree of flop of the belly. Objective color measures were obtained using a Minolta Chromameter CR-310 (Minolta Corp., Ramsey, NJ) equipped with a 50-mm orifice calibrated against a white tile. The objective color and durometer measures were taken in the middle of the belly with skin removed 3 cm from the proximal edge.

Analytical Methods

Fatty acids were extracted from adipose tissue and feed samples by a one-step direct transesterification procedure (Lepage and Roy, 1986). These samples were then assayed for total fatty acid content by gas chromatography using a Model 3900 gas chromatograph fitted with a CP-8400 automatic injector (Varian Analytical Instruments, Walnut Creek, CA) using a 60-m capillary column (0.25-mm diameter; Model DB-23; Agilent, Santa Clara, CA). Helium was used as the carrier gas at 0.5 mL/mm (1:50 split ratio). Oven temperature started at 50℃ and increased to 235℃ over a 26 minute period. The injector and detector were maintained at 250℃. Identification of fatty acid peaks was done by using purified fat samples from Sigma-Aldrich, Co. (St. Louis, MO). Carcass fat samples collected from the jowl, belly and back fat at harvest were sliced into 100 g samples, vacuum packaged and submitted for IV determination via direct titration (Barrow-Agee Labs, Memphis, TN). Diet samples were analyzed for IV via titration (Barrow-Agee Labs, Memphis, TN). In addition, the total ether extract content of the diets was determined following acid hydrolysis (Experiment Station Chemical Laboratories, UMC – Columbia, MO).

Fecal samples were thawed at room temperature, homogenized within sample and stored at -20°C. Later, feed and fecal samples were finely ground through a 1 mm screen in a Retsch grinder (Model ZM1, Retsch Inc., Newtown, PA). Dry matter was determined by drying samples in an oven at 105℃ to a constant weight. Gross energy was determined using a bomb calorimeter (Model 6200, Parr Instrument Co., Moline, IL). Benzoic acid (6318 kcal/kg; Parr Instruments, Moline, IL) was used as the standard for calibration and was determined to be 6322 ± 0.65 kcal/kg.

Calculations

IV was calculated from the fatty acid profile using the following equation: (IV) = [C16:1] × 0.95 + [C18:1] × 0.86 + [C18:2] × 1.732 + [C18:3] × 2.616 + [C20:1] × 0.785 + [C22:1] × 0.723; brackets indicate percentage concentration (AOCS, 1998).

Statistical Analysis

The experiment was designed as a 3 X 3 factorial + 1, with fat level and fat source as the main effects. The "+ 1" was the control diet formulated to contain no added fat, as explained previously. For analysis of the 9 treatments arranged as a 3 X 3 factorial, the main effects of dietary fat unsaturation load (2.5% CO vs. 5% AV vs. 5% CO) and length of withdrawal of dietary fat prior to market (19 vs. 40 vs. 61d) and their interactions (**DFUL × WD**) were analyzed using the PROC MIXED procedure of SAS (SAS 9.3, Cary, NC) with treatment and sex as fixed effects, and sample data as a repeated measure. The above model was also employed to determine the main effect of gender. All *P*-values less than 0.05 were considered significant and *P*-values between 0.05 and 0.10 were considered trends.

The comparison of the CNTR treatment against the 9 treatments in the 3 × 3 factorial (reported as the *P*-value treatment) was analyzed using the least square means and PDIFF options of PROC MIXED with sample data as a repeated measure. Non-detectable fatty acid values (nd) were treated as zero.

Results: ***Length of dietary fat withdrawal prior to market effects on growth performance, fatty acid intake, deposited fat composition, and carcass characteristics***

Lengthening the time of dietary fat withdrawal from the diet had no adverse effect on average daily gain ($P > 0.50$; Table 2), tended to increase average daily feed intake as expected ($P = 0.09$), and tended to decrease the efficiency of converting gain from feed ($P = 0.08$). Increasing the withdrawal time obviously decreased the consumption of dietary fat, which in turn resulted in lower total intake (d0-82) of palmitic acid (**16:0**), stearic acid (**18:0**), oleic acid (**18:1**), linoleic acid (18:2), and linolenic acid (**18:3**) ($P < 0.01$; Table 3).

Increasing the length of dietary fat withdrawal resulted in decreased concentrations of 18:2 and increased concentrations of 16:0 and 18:1 in the jowl (d63; $P < 0.05$; Table 4). As hypothesized, increasing the withdrawal time of an unsaturated dietary fat decreased the PUFAs deposited in the pig carcass as evidenced by lower 18:2 (d82; $P < 0.01$; Table 4), and 18:3 concentrations in the jowl ($P = 0.08$). Conversely, lengthening the withdrawal time increased the jowl concentration of 18:1 (d82; $P < 0.01$) and tended to increase 14:0 ($P = 0.054$) at market.

Extending the withdrawal time of an unsaturated dietary fat source prior to market resulted in increased saturation of fat in the jowl, evidenced by lowering the carcass IV at market ($P < 0.01$; Table 7), when IV was determined by direct titration but not when the IV was determined by calculation from the fatty acid profile($P > 0.15$; Table 6). Lengthening the time of withdrawal of the unsaturated dietary fat source did not improve belly firmness, weight, depth, or fat color ($P > 0.25$; Table 8). Nor was there any impact on hot carcass weight, loin muscle depth, or back fat depth ($P > 0.30$; Table 9).

Dietary fat unsaturation load (DFUL) effects on growth performance, fatty acid intake, deposited fat composition, and carcass characteristics

The unsaturation load of the diet prior to withdrawal of dietary fat had no significant impact on average daily gain, average daily feed intake, or gain to feed ($P > 0.75$; Table 2).

Creating differing dietary loads of fatty acid unsaturation prior to the withdrawal of dietary fat resulted in different intakes of fatty acids; 2.5% CO had the lowest intake of 16:0, with 5% CO and 5% AV being similar ($P < 0.01$; Table 3). Animal-vegetable blend added at 5% resulted in the highest daily intake of 18:0, 18:1, and 18:3, with 5% CO having slightly higher intake of 18:0, 18:1, and 18:3 consumption compared to 2.5% CO ($P < 0.01$). The smaller than expected difference between 2.5 % and 5.0 % CO was the result of lower feed intake on the higher fat diet, an outcome that was not unexpected. Linoleic acid intake was similar on the diets containing 2.5% CO and 5% AV, both of which were significantly lower than in pigs fed the 5% CO treatment ($P < 0.01$).

The 2.5% CO diet resulted in higher concentrations of 16:0 in the jowl on d63 compared to 5% AV and 5% CO ($P < 0.05$; Table 4). On d63, the inclusion of 2.5% CO for any period of time period tended to increase the concentration of 18:1 ($P = 0.053$), and decreased concentrations of 18:3 and 20:1 when compared with either the 5% AV or 5% CO treatments ($P < 0.02$).

At market (d82), the diet containing 5.0% CO elevated 18:2 concentrations in the jowl compared against 2.5% CO or 5% AV ($P < 0.01$; Table 4). However, no other fatty was altered by the increase or decrease of DUFL prior to withdrawal ($P > 0.25$).

As hypothesized, increasing the DUFL through feeding a more unsaturated source at a higher inclusion rate resulted in an increased carcass IV at market (d82) irrespective of whether it was determined via titration ($P < 0.02$; Table 7) and was calculated ($P < 0.02$; Table 6). But, the DFUL had no impact on calculated IV on d21, 42, or 63 ($P > 0.10$; Table 6).

Increasing the DFUL resulted in poorer belly firmness measured by both a durometer and a subjective flop test ($P < 0.03$; Table 8). However, increasing the DFUL did not alter belly weight, belly depth, or fat color ($P > 0.30$). Increasing the DFUL did decrease back fat depth, evident as 5% CO had the least back fat depth in comparison with the other two dietary treatments ($P = 0.01$; Table 9).

Interactions between length of withdrawal of dietary fat and the dietary fat unsaturation load prior to withdrawal of dietary fat

Due to pigs consuming more feed and therefore more fatty acids as they increase in body weight, interactions between dietary treatment and withdrawal time were observed, for example in the total intake (d0-82) of 16:0, 18:0, and 18:1 ($P < 0.04$; Table 3). However, no interaction between DFUL × WD was evident for the total intake of 18:2 and 18:3 ($P > 0.14$).

Despite multiple DUFL × WD interactions for the intake of differing fatty acids, only a trend for a DFUL × WD interaction was evident in deposited jowl fat for 16:0 on d63, due to the more rapid increase in concentration of

16:0 when withdrawing 5% CO compared with 2.5% CO and 5% AV ($P = 0.057$; Table 4). No other DUFL × WD interactions were evident ($P > 0.10$).

Gender effects on growth performance, fatty acid intake, deposited fat composition, and carcass characteristics

As expected, barrows grew faster and ate more feed than gilts ($P > 0.02$; Table 2). However, there was no difference between the sexes for gain to feed ($P > 0.30$). No significant fatty acid intake differences were evident between barrows and gilts at any point in the experiment ($P > 0.10$; Table 3).

At market (d82), gilts had a higher concentration of 18:2 in the carcass fat than barrows ($P > 0.02$), while barrows tended to have higher 16:0 than gilts ($P = 0.054$). Gilts also had a higher calculated carcass IV than barrows ($P < 0.02$; Table 6). However, when IV was measured via titration, there was no significant difference between gilts and barrows ($P > 0.30$; Table 7).

Barrows had firmer bellies than gilts via a subjective belly flop score ($P < 0.04$; Table 8), but this belly firmness difference was not significant when measured via a durometer ($P > 0.10$). Barrows had heavier and thicker bellies than gilts ($P < 0.04$). Barrows tended to had heavier hot carcass weights than gilts ($P = 0.06$; Table 9). Gilts had less back fat than barrows ($P < 0.01$), but there was no significant difference between sexes for loin muscle depth ($P > 0.15$).

Discussion: Withdrawal of unsaturated dietary fat further away from market successfully lowered carcass IV, at least when it was measured directly via titration; this was not the case when carcass IV was calculated from the fatty acid profile. However, withdrawal of dietary fat from the diet successfully lowered the concentration of 18:2, the key fatty acid measured when evaluating pork fat quality. To be effective and valuable, withdrawing dietary fat prior to market must work rapidly and consistently to allow producers to take advantage of cost saving ingredients. If the reduction is too slow, then the removal of lower cost ingredients containing highly saturated fats takes too long and producers miss significant feed cost savings. A 19d withdrawal of 2.5% CO or 5% AV blend allowed for carcass IV values to be lowered to acceptable levels, but 5% CO required a withdrawal of 61d prior to market before lowering IV below 74g/100g. It has been previously suggested that 18:2 was maintained in the subcutaneous adipose tissue as a reservoir for storage of the essential fatty acids, and that 18:2 is deposited preferentially at the expense of other non-essential fatty acids. Past research has used beef tallow to eliminate 18:2 from the pork fat depot; he also reported preferential storage of 18:2. Therefore, the elimination of 18:2 and the resulting lowering of carcass IV may be difficult when the diet in question contains a higher concentration of 18:2 or a higher DFUL. This conclusion is supported by the current data.

Previous studies have also showed that a diet containing sufficient energy to meet the needs of the growing pig reduced their reliance on lipid mobilization. Since lipolysis in the adipocyte is continual, released fatty acids will be re-esterified and remain in the adipocyte, and fatty acid turnover will not be a significant factor in altering the fatty acid composition. Thus, if the concentration of PUFAs deposited from the previously-fed diet leaves a large pool of unsaturated fat, the pace of dilution with more saturated fatty acids coming either from a follow-up diet or from de novo synthesis in the adipocyte will be slowed. In the pig, it has been shown that decreasing inclusion of fat in the diet will increase the rate of de novo lipogenesis. Additionally, the fatty acids synthesized from Acetyl Co-A in the pig is more saturated in structure. Thus, increasing the rate of de

novo synthesis can alter the saturation of pork fat and will result in the lowering of carcass IV. While, de novo lipogenesis was not measured directly in this experiment, these data did show that 18:2 concentrations can be diluted by withdrawing dietary fat prior to market or feeding a diet with a lower DFUL.

As hypothesized, carcass IV was improved by lengthening the period of withdrawal of unsaturated dietary fat prior to harvest. Surprisingly though, this improvement in carcass IV did not translate into any improvement in belly firmness, weight, depth, or fat color. Previous studies have shown negative effects of unsaturated dietary fat sources on belly firmness in comparison with saturated dietary fat sources. Withdrawal of unsaturated dietary fat in this study did not provide the improvement we expected. This may be due to the low number of experimental units utilized in this model to quantify the change in the deposited profile of fatty acids in the pig. Clearly, more research on this aspect of carcass fat quality is required, in order to fine tune PUFA withdrawal strategies.

It has been shown previously that deposited fat will be largely reflective of the composition of dietary fat. By design, altering the composition of the depot fat prior to withdrawal was done by differing consumption loads of PUFAs. Inclusion of different dietary fat treatments showed that deposited fat will increase in unsaturation based on the fatty acid intake of the diet. However, the relationship is not as tight as one might expect, because the DUFL is influenced by both the fatty acid composition of the diet and the daily intake of that diet. Depending on the energy status of the pig, adding higher levels of fat to the diet may result in lower daily feed intake. Increasing the DUFL prior to fat withdrawal certainly had the expected effect of increasing belly softness and carcass IV. Thus, withdrawal time and diet fat concentration and profile must all be taken into account when seeking carcass fat quality improvements.

At similar body weights, barrows have a greater lipid deposition rate than gilts. Thus, carcass IV and belly characteristics may differ among sexes even when raised in similar environments and on similar feeding programs. In this study, differences between sexes were evident at market for calculated carcass IV, 18:2 concentration, belly firmness, depth, and weight. Barrows presented the more favorable carcass fat quality as compared to gilts.

To summarize, if the consumption of PUFAs is relatively low prior to the withdrawal of the unsaturated ingredient, the withdrawal technique will successfully lower carcass IV in a rapid and significant fashion. High amounts of 18:2 consumption via the addition of 5% CO showed that an elevated load of dietary unsaturated fat intake makes lowering carcass IV and diluting 18:2 from the depot very difficult and may take as long as 61d. The withdrawal of unsaturated dietary fat sources from the diet allowed de novo lipogenesis to make the depot fat in the pig more saturated, but this alteration of deposited fat composition did not translate into the improvement of belly firmness, depth, weight, or fat color that we had expected and hoped for.

Table 1. Ingredient composition (as-fed basis) of the experimental diets

	d 0 to 42				d 42 to 82			
Item	CNTR	2.5% CO	5% AV	5% CO	CNTR	2.5% CO	5% AV	5% CO
Ingredient, %								
Corn	79.35	75.40	71.44	71.44	82.91	78.95	74.98	74.98
Soybean meal (46.5% CP)	17.11	18.56	20.01	20.01	13.78	15.23	16.67	16.67
Corn Oil	-	2.50	-	5.00	-	2.50	-	5.00
A-V Blend	-	-	5.00	-	-	-	5.00	-
Limestone	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Monocalcium Phosphate	0.77	0.77	0.77	0.77	0.67	0.67	0.50	0.51
Salt	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
L-lysine HCL	0.30	0.30	0.30	0.30	0.25	0.25	0.25	0.25
DL-methionine	0.05	0.07	0.08	0.08	-	0.02	0.03	0.03
L-threonine	0.09	0.10	0.10	0.10	0.06	0.07	0.08	0.08
Vitamin premix[1]	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Trace mineral premix[2]	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Titanium Dioxide	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Santoquin	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Analyzed Composition								
DM, %	90.23	90.83	90.37	89.77	90.40	90.51	89.63	90.68
GE, Mcal/kg	3.80	3.96	4.09	4.11	3.78	3.94	4.07	4.10
CP (N × 6.25), %	14.9	15.3	15.6	15.5	13.7	13.9	14.2	14.3
Crude Fat, %	2.99	4.95	6.98	6.85	2.75	4.61	7.32	7.28
Dietary Fat IV[3], g/100g	-	122.7	90.7	122.7	-	122.7	90.7	122.7
Diet IV[4], g/100g	124.8	122.8	103.5	120.6	123.3	120.5	102.0	117.4

[1]Provided per kilogram of complete diet: vitamin A, 6,614 IU; vitamin D, 827 IU; vitamin E, 26 IU; vitamin K, 2.6 mg; niacin, 29.8 mg; pantothenic acid, 16.5 mg; riboflavin, 5.0 mg; vitamin B12, 0.023 mg.

[2]Provided per kilogram of diet: Zn, 165 mg as zinc sulfate; Fe, 165 mg as iron sulfate; Mn, 39 mg as manganese sulfate; Cu, 17 mg as copper sulfate; I, 0.3 mg as calcium iodate; and Se, 0.3 mg as sodium selenite.
[3]Iodine value assayed via titration (Barrow-Agee Labs)
[4]Iodine value calculated by: (IV) = [C16:1] X 0.95 + [C18:1] X 0.86 + [C18:2] X 1.732 + [C18:3] X 2.616 + [C20:1] X 0.785 + [C22:1] X 0.723; brackets indicate concentration (AOCS, 1998)

Table 2. Effects of dietary fat withdrawal and dietary fat unsaturation load on growth performance

Item	Treatments										Sex		*P-Value*					
Source	2.5% Corn Oil			5% AV Blend			5% Corn Oil											
Duration, d	21	42	63	21	42	63	21	42	63	0	B	G	Trt	Trt	Sex	DFUL	WD	DFUL × WD
WD, d	61	40	19	61	40	19	61	40	19	82			SEM					
ADG, kg	0.92	0.95	1.02	0.94	0.94	0.93	0.98	0.88	0.96	1.02	0.99	0.91	0.016	0.77	0.014	0.77	0.57	0.71
ADFI, kg	2.72	2.66	2.99	2.80	2.69	2.67	2.92	2.41	2.81	3.12	2.91	2.61	0.041	0.09	0.002	0.75	0.09	0.27
G:F, kg	0.34	0.36	0.34	0.34	0.35	0.35	0.33	0.37	0.34	0.33	0.34	0.35	0.003	0.38	0.34	0.95	0.08	0.71

Table 3. Effects of dietary fat withdrawal and dietary fat unsaturation load on fatty acid intake

Item	Treatments										*P-Value*					
Source	2.5% Corn Oil			5% AV Blend			5% Corn Oil									
Duration, d	21	42	63	21	42	63	21	42	63	0	Trt	Trt	Sex	DFUL	WD	DFUL × WD
WD, d	61	40	19	61	40	19	61	40	19	82	SEM					
d0-21																
16:0, g/d	17.7^{d}	17.3^{d}	19.3^{d}	28.9^{a}	27.6^{ab}	28.5^{a}	25.2^{abc}	24.5^{bc}	23.1^{c}	11.2^{e}	0.38	<0.001	0.48	<0.001	-	-
18:0, g/d	2.9^{bc}	2.8^{bc}	3.1^{b}	12.9^{a}	12.4^{a}	12.7^{a}	3.9^{b}	3.8^{b}	3.6^{b}	1.8^{c}	0.12	<0.001	0.47	<0.001	-	-
18:1, g/d	22.6^{d}	22.0^{d}	24.6^{cd}	40.7^{a}	38.8^{a}	40.0^{a}	31.2^{b}	30.3^{b}	28.6^{bc}	14.3^{e}	0.50	<0.001	0.44	<0.001	-	-
18:2, g/d	59.9^{c}	58.4^{c}	65.1^{bc}	61.9^{c}	59.0^{c}	60.9^{c}	81.3^{a}	79.0^{a}	74.5^{ab}	38.1^{d}	1.06	<0.001	0.72	<0.001	-	-
18:3, g/d	3.6^{c}	3.5^{cd}	3.9^{bc}	6.1^{a}	5.8^{a}	6.0^{a}	4.6^{b}	4.5^{b}	4.2^{bc}	2.8^{d}	0.08	<0.001	0.32	<0.001	-	-
d21-42																
16:0, g/d	14.1^{d}	21.8^{c}	23.5^{c}	14.8^{d}	36.7^{a}	36.5^{a}	14.5^{d}	29.9^{b}	32.1^{ab}	15.3^{d}	0.50	<0.001	0.29	<0.001	<0.001	0.004
18:0, g/d	2.2^{e}	3.5^{cde}	3.8^{bcd}	2.3^{e}	16.4^{a}	16.4^{a}	2.3^{e}	4.7^{bc}	5.0^{b}	2.4^{d}	0.14	<0.001	0.44	<0.001	<0.001	<0.001
18:1, g/d	18.1^{d}	27.8^{c}	30.0^{c}	18.8^{d}	51.6^{a}	51.4^{a}	18.6^{d}	37.0^{b}	39.8^{b}	19.5^{d}	0.65	<0.001	0.28	<0.001	<0.001	<0.001
18:2, g/d	48.1^{c}	73.7^{b}	79.5^{b}	50.2^{c}	78.5^{b}	78.2^{b}	49.5^{c}	96.5^{a}	103.7^{a}	51.9^{c}	1.49	<0.001	0.27	<0.001	<0.001	0.15
18:3, g/d	3.5^{e}	4.4^{de}	4.7^{cd}	3.7^{e}	7.7^{a}	7.7^{b}	3.6^{e}	5.5^{bc}	5.9^{b}	3.8^{de}	0.10	<0.001	0.14	<0.001	<0.001	<0.001

d42-63																
16:0, g/d	14.5^{d}	14.0^{d}	25.2^{c}	14.9^{d}	14.3^{d}	37.8^{b}	14.9^{d}	12.7^{d}	43.8^{a}	16.6^{d}	0.53	<0.001	0.77	0.002	<0.001	<0.001
18:0, g/d	2.7^{cd}	2.6^{cd}	4.0^{c}	2.7^{cd}	2.6^{cd}	18.8^{a}	2.7^{cd}	2.3^{d}	6.4^{b}	3.0^{cd}	0.16	<0.001	0.71	<0.001	<0.001	<0.001
18:1, g/d	18.1^{d}	17.4^{d}	30.7^{c}	18.5^{d}	17.8^{d}	57.2^{a}	18.6^{d}	15.8^{d}	45.2^{b}	20.6^{d}	0.67	<0.001	0.66	0.003	<0.001	<0.001
18:2, g/d	49.7^{c}	48.0^{c}	81.0^{b}	51.1^{c}	48.9^{c}	83.7^{b}	51.1^{c}	43.5^{c}	121.9^{a}	56.8^{c}	1.48	<0.001	0.69	0.016	<0.001	<0.001
18:3, g/d	4.1^{c}	3.9^{c}	5.1^{b}	4.2^{bc}	4.0^{c}	7.8^{a}	4.2^{bc}	3.6^{c}	7.3^{a}	4.7^{bc}	0.11	<0.001	0.45	0.014	<0.001	0.004
d63-82																
16:0, g/d	10.8^{cd}	11.6^{bcd}	15.2^{a}	11.8^{abcd}	12.1^{abcd}	12.4^{abc}	13.8^{abc}	8.8^{d}	15.1^{a}	14.4^{ab}	0.35	0.013	0.12	0.85	0.003	0.034
18:0, g/d	2.0^{cd}	2.1^{bcd}	2.8^{a}	2.2^{abcd}	2.2^{abcd}	2.3^{abc}	2.5^{abc}	1.6^{d}	2.8^{a}	2.6^{ab}	0.06	0.013	0.12	0.85	0.003	0.034
18:1, g/d	13.4^{cd}	14.4^{bcd}	18.9^{a}	14.7^{abcd}	15.0^{abcd}	15.4^{abc}	17.1^{abc}	10.9^{d}	18.8^{a}	18.9^{ab}	0.44	0.013	0.12	0.85	0.003	0.034
18:2, g/d	36.9^{cd}	39.7^{bcd}	52.1^{a}	40.4^{abcd}	41.3^{abcd}	42.5^{abc}	47.2^{abc}	30.0^{d}	51.8^{a}	49.2^{ab}	1.21	0.013	0.12	0.85	0.003	0.034
18:3, g/d	3.0^{cd}	3.3^{bcd}	4.3^{a}	3.3^{abcd}	3.4^{abcd}	3.5^{abc}	3.9^{abc}	2.5^{d}	4.3^{a}	4.0^{ab}	0.10	0.013	0.12	0.85	0.003	0.034
d0-82																
16:0, g/d	14.4^{e}	16.3^{de}	20.9^{bc}	17.8^{cd}	22.9^{b}	29.2^{a}	17.2^{de}	19.2^{cd}	28.9^{a}	14.3^{e}	0.34	<0.001	0.32	<0.001	<0.001	0.10
18:0, g/d	2.4^{e}	2.8^{de}	3.4^{d}	5.1^{c}	8.5^{b}	12.8^{a}	2.9^{de}	3.1^{de}	4.5^{c}	2.4^{de}	0.10	<0.001	0.43	<0.001	<0.001	<0.001
18:1, g/d	18.1^{e}	20.6^{de}	26.2^{c}	23.4^{cd}	31.2^{b}	41.6^{a}	21.5^{de}	23.8^{de}	33.4^{cd}	18.1^{b}	0.44	<0.001	0.28	<0.001	<0.001	0.036
18:2, g/d	48.9^{e}	55.3^{de}	69.9^{b}	51.1^{e}	57.3^{cde}	66.9^{bc}	57.5^{cde}	63.0^{bcd}	88.9^{a}	48.9^{e}	0.97	<0.001	0.30	0.014	<0.001	0.14
18:3, g/d	3.5^{e}	3.8^{de}	4.5^{c}	4.3^{cd}	5.3^{b}	6.3^{a}	4.1^{cde}	4.0^{cde}	5.4^{b}	3.8^{cde}	0.07	<0.001	0.11	0.003	<0.001	0.19

[a,b,c]Within a row, means without a common superscript differ (P<0.05)

Table 4. Effects of dietary fat withdrawal and dietary fat unsaturation load on fatty acid composition

Item	Treatments										*P-Value*				
Source	2.5% Corn Oil			5% AV Blend			5% Corn Oil								
Duration, d	21	42	63	21	42	63	21	42	63	0	Trt	Trt	DFUL	WD	DUFL × WD
WD, d	61	40	19	61	40	19	61	40	19	82	SEM				
d0															
14:0, %	0.9	1.1	1.1	0.9	0.9	1.1	0.9	0.9	1.2	1.1	0.06	0.96	0.95	-	-
16:0, %	23.5	21.7	21.9	21.4	22.8	22.5	23.8	21.7	23.1	20.3	0.28	0.39	0.68	-	-
18:0, %	12.0	12.4	11.2	12.5	11.3	11.5	10.8	11.6	11.9	11.1	0.20	0.76	0.74	-	-
18:1, %	42.3^{a}	37.1^{b}	42.6^{a}	41.3^{a}	43.2^{a}	43.1^{a}	42.1^{a}	40.0^{ab}	41.1^{a}	43.0^{a}	0.35	0.030	0.25	-	-
18:2, %	17.1^{c}	20.7^{ab}	17.3^{c}	18.9^{abc}	17.5^{bc}	15.7^{c}	16.6^{c}	21.8^{a}	17.4^{bc}	19.1^{abc}	0.35	0.029	0.43	-	-
18:3, %	0.5	1.0	0.6	0.5	0.4	0.4	0.7	0.7	0.9	0.8	0.06	0.53	0.16	-	-
20:1, %	0.3	0.9	0.7	0.6	0.4	0.6	0.6	0.2	0.7	0.9	0.05	0.13	0.63	-	-
d21															
14:0, %	0.9	1.2	1.2	1.2	1.2	1.3	1.2	0.9	0.9	1.1	0.04	0.32	0.12	0.98	0.25
16:0, %	22.1	19.9	21.8	21.9	22.8	22.6	21.9	18.3	21.7	20.8	0.44	0.59	0.33	0.34	0.65
18:0, %	11.3	10.6	9.3	10.7	10.3	11.1	10.8	8.7	11.2	11.3	0.23	0.41	0.77	0.22	0.27

18:1, %	42.5	42.6	41.5	38.9	40.7	40.8	41.5	48.0	40.6	40.6	1.12	0.92	0.56	0.57	0.88
18:2, %	17.8	19.2	20.4	20.1	18.6	19.0	18.8	18.2	20.0	21.3	0.59	0.98	0.98	0.80	0.92
18:3, %	0.8	0.9	0.8	1.0	0.9	0.8	0.9	0.9	0.8	1.0	0.04	0.91	0.62	0.51	0.90
20:1, %	0.9	0.8	0.8	0.9	1.0	0.7	0.9	0.9	0.7	0.9	0.03	0.81	0.87	0.23	0.80
d42															
14:0, %	1.0	1.1	0.8	1.3	1.1	1.0	1.2	1.2	1.1	1.2	0.05	0.80	0.26	0.49	0.92
16:0, %	21.3	20.5	21.5	21.0	21.4	21.3	20.2	21.7	20.3	21.6	0.35	0.99	0.89	0.95	0.87
18:0, %	13.3	10.3	11.8	12.0	11.8	11.5	11.5	11.9	13.1	10.2	0.27	0.39	0.83	0.37	0.34
18:1, %	42.8	41.7	39.7	41.6	45.1	43.6	41.6	40.8	39.1	42.9	0.54	0.51	0.16	0.45	0.64
18:2, %	17.3	21.6	21.8	18.4	15.6	17.1	19.5	19.4	21.0	17.5	0.57	0.38	0.12	0.56	0.49
18:3, %	0.6	0.9	0.6	0.9	0.8	0.8	0.9	0.8	0.8	0.8	0.05	0.94	0.47	0.88	0.80
20:1, %	0.6	0.8	0.5	0.7	0.8	0.9	0.9	0.7	1.1	0.9	0.04	0.32	0.12	0.72	0.36
d63															
14:0, %	1.1	1.3	1.0	1.4	1.2	1.1	1.2	1.1	1.1	1.2	0.04	0.61	0.58	0.25	0.66
16:0, %	22.0^{ab}	21.8^{ab}	22.3^{a}	22.6^{a}	20.6^{bc}	20.6^{bc}	22.6^{a}	22.6^{a}	20.6^{bc}	19.3^{c}	0.17	0.001	0.040	0.002	0.057
18:0, %	10.7	10.8	10.3	10.9	10.6	10.6	11.2	10.5	9.3	10.9	0.18	0.84	0.89	0.36	0.76
18:1, %	47.0^{bc}	43.5^{bcd}	43.0^{bcd}	43.8^{bc}	43.4^{bcd}	41.0^{cd}	44.5^{ab}	40.4^{d}	41.8^{bcd}	43.6^{bc}	0.30	0.005	0.053	0.002	0.35
18:2, %	14.6^{d}	17.8^{bcd}	19.1^{abc}	15.7^{cd}	18.9^{abc}	21.3^{ab}	15.3^{cd}	22.4^{a}	23.2^{a}	17.2^{cd}	0.39	<0.001	0.11	<0.001	0.51

18:3, %	0.6^{b}	0.6^{b}	0.6^{b}	0.7^{ab}	1.1^{a}	1.0^{a}	0.7^{ab}	0.9^{ab}	1.1^{a}	0.6^{b}	0.04	0.038	0.003	0.20	0.62
20:1, %	0.4	0.8	0.5	0.8	0.8	0.8	0.9	0.9	0.8	0.7	0.04	0.13	0.014	0.29	0.37
d82															
14:0, %	1.2	1.3	1.2	1.3	1.3	1.2	1.4	1.1	0.9	1.1	0.03	0.13	0.25	0.054	0.31
16:0, %	22.1	20.4	21.6	22.5	20.2	22.6	19.4	21.3	19.7	17.9	0.58	0.91	0.59	0.89	0.79
18:0, %	10.9	11.1	11.8	9.2	11.3	11.8	10.7	11.0	10.3	11.6	0.24	0.69	0.64	0.40	0.50
18:1, %	44.9	45.1	40.4	49.2	46.1	40.7	45.8	40.0	42.4	49.2	0.67	0.11	0.47	0.045	0.38
18:2, %	14.5^{de}	16.6^{cd}	18.9^{abc}	12.2^{e}	15.4^{cde}	17.4^{bcd}	16.6^{cd}	20.5^{ab}	21.4^{a}	15.0^{cde}	0.37	<0.001	<0.001	<0.001	0.96
18:3, %	0.7	0.6	0.7	0.4	0.6	1.0	0.5	0.7	0.7	0.4	0.03	0.16	0.81	0.08	0.17
20:1, %	0.7	0.9	1.0	0.5	0.7	0.9	0.6	1.4	1.2	0.4	0.08	0.35	0.26	0.12	0.82

^{a,b,c}Within a row, means without a common superscript differ (P<0.05)

Table 5. Effects of gender on fatty acid composition

Item	Sex			*P*-Value
Source				
Duration, d	**B**	G	Sex	Sex
WD, d			SEM	
d0				
14:0, %	1.0	1.0	0.06	0.80
16:0, %	22.1	22.4	0.29	0.69
18:0, %	11.8	11.4	0.22	0.40
18:1, %	41.7	41.1	0.48	0.56
18:2, %	18.0	18.8	0.46	0.39
18:3, %	0.6	0.7	0.07	0.45
20:1, %	0.6	0.6	0.07	0.91
d21				
14:0, %	1.2	1.0	0.05	0.17
16:0, %	21.5	21.0	0.53	0.56
18:0, %	10.6	10.2	0.28	0.40

18:1, %	41.5	42.1	1.32	0.79
18:2, %	19.0	19.8	0.66	0.55
18:3, %	0.9	0.9	0.04	0.66
20:1, %	0.9	0.8	0.04	0.25
d42				
14:0, %	1.1	1.0	0.05	0.34
16:0, %	21.8	20.1	0.36	0.018
18:0, %	12.0	11.6	0.31	0.51
18:1, %	40.6	43.5	0.60	0.014
18:2, %	19.5	18.3	0.69	0.35
18:3, %	0.8	0.8	0.05	0.98
20:1, %	0.8	0.8	0.05	0.96
d63				
14:0, %	1.2	1.1	0.04	0.31
16:0, %	21.7	21.2	0.23	0.28
18:0, %	10.6	10.7	0.21	0.82
18:1, %	43.1	43.4	0.44	0.72
18:2, %	18.4	18.5	0.61	0.91

18:3, %	0.7	0.8	0.05	0.34
20:1, %	0.7	0.8	0.05	0.58
d82				
14:0, %	1.2	1.1	0.04	0.25
16:0, %	22.0	19.7	0.59	0.054
18:0, %	10.7	11.2	0.27	0.34
18:1, %	44.1	43.5	0.83	0.71
18:2, %	15.9	18.6	0.52	0.012
18:3, %	0.64	0.68	0.04	0.62
20:1, %	0.91	0.87	0.09	0.83

[a,b,c]Within a row, means without a common superscript differ ($P<0.05$)

Table 6. Effects of dietary fat withdrawal and dietary fat unsaturation load on calculated iodine value[1]

Item	Treatments										Sex		*P-Value*					
Source	2.5% Corn Oil			5% AV Blend			5% Corn Oil											
Duration, d	21	42	63	21	42	63	21	42	63	0	B	G		Trt	Sex	DFUL	WD	DFUL × WD
WD, d	61	40	19	61	40	19	61	40	19	82			Trt SEM					
d0[1]	70.2	73.7	71.4	72.5	71.7	68.9	69.4	76.6	70.9	75.4	71.9	72.8	0.56	0.17	0.50	0.63	-	-
d21[1]	72.3	75.7	76.5	74.5	73.0	73.1	73.8	78.0	74.9	77.5	74.1	76.0	0.58	0.52	0.16	0.40	0.51	0.51
d42[1]	70.8	77.9	75.8	73.3	70.7	72.3	74.9	73.5	75.1	72.6	73.4	74.0	0.73	0.61	0.71	0.39	0.73	0.40
d63[1]	70.0^{e}	72.5^{cde}	74.4^{bcde}	69.9^{e}	75.8^{abcd}	77.7^{abc}	69.8^{e}	78.5^{ab}	81.5^{a}	72.0^{de}	73.7	74.4	0.54	0.002	0.67	0.12	<0.001	0.38
d82[1]	68.9	72.5	72.2	68.2	71.2	70.9	73.2	75.1	78.0	72.0	70.5	74.5	0.68	0.20	0.011	0.017	0.18	0.95

[a,b,c]Within a row, means without a common superscript differ ($P<0.05$)

[1]IV was calculated by: (IV) = [C16:1] X 0.95 + [C18:1] X 0.86 + [C18:2] X 1.732 + [C18:3] X 2.616 + [C20:1] X 0.785 + [C22:1] X 0.723; brackets indicate concentration, % (AOCS, 1998)

Table 7. Effects of dietary fat withdrawal and dietary fat unsaturation load on carcass IV measured via direct titration

Item	Treatments										Sex		*P-Value*					
Source	2.5% Corn Oil			5% AV Blend			5% Corn Oil											
Duration, d	21	42	63	21	42	63	21	42	63	0	B	G	Trt	Trt	Sex	DFUL	WD	DFUL × WD
WD, d	61	40	19	61	40	19	61	40	19	82			SEM					
Jowl IV[1]	70.2^{cd}	70.5^{bcd}	72.3^{bc}	67.3^{d}	70.4^{bcd}	71.9^{bcd}	70.3^{bcd}	74.2^{ab}	77.4^{a}	68.7^{cd}	71.1	72.4	0.42	0.003	0.30	0.010	0.006	0.43

[1]Iodine value assayed via titration (Barrow-Agee Labs)

Table 8. Effects of dietary fat withdrawal and dietary fat unsaturation load on carcass fat and belly characteristics

Item	Treatments										Sex		*P-Value*					
Source	2.5% Corn Oil			5% AV Blend			5% Corn Oil											
Duration, d	21	42	63	21	42	63	21	42	63	0	B	G	Trt	Trt	Sex	DFUL	WD	DFUL × WD
WD, d	61	40	19	61	40	19	61	40	19	82			SEM					
Durometer	39.8	38.0	38.4	43.3	44.8	30.8	32.5	28.8	31.6	36.7	38.3	34.1	1.14	0.10	0.14	0.023	0.45	0.27
Belly Firmness[1]	1.8	2.3	2.4	2.3	2.0	2.5	2.5	3.0	2.8	2.7	2.21	2.65	0.08	0.16	0.031	0.022	0.31	0.58
Belly Weight, kg	7.9	7.4	8.6	8.9	8.6	7.8	8.1	7.5	8.2	8.4	8.5	7.7	0.18	0.84	0.034	0.61	0.68	0.60
Belly ET[2], cm	3.0	3.0	3.3	3.6	3.3	2.8	3.0	2.5	2.8	3.0	3.3	2.5	0.02	0.85	<0.001	0.35	0.89	0.62
Belly MT[3], cm	2.4	2.1	2.5	2.8	2.3	2.0	2.2	2.1	2.2	2.5	2.5	1.8	0.05	0.46	0.012	0.53	0.28	0.21
l star	73.9	72.9	75.0	74.6	75.4	72.8	75.6	74.2	74.5	76.4	75.0	73.8	0.35	0.68	0.13	0.79	0.89	0.44
a star	6.4	5.8	5.0	4.9	6.0	5.3	5.9	6.0	6.1	5.8	5.6	6.0	0.15	0.57	0.22	0.52	0.51	0.34
b star	5.5	5.4	5.9	4.6	5.8	5.0	6.2	5.7	5.7	7.2	5.6	5.8	0.15	0.07	0.68	0.38	0.98	0.57

[a,b,c]Within a row, means without a common superscript differ ($P<0.05$)

[1]Measured by a subjective score of 1, 2, or 3 with 1 being the firmest

[2]Measured on the middle scribe side edge of the belly

[3]Measured in the middle of the belly

Table 9. Effects of dietary fat withdrawal and dietary fat unsaturation load on carcass characteristics

Item	Treatments										Sex		*P-Value*					
Source	2.5% Corn Oil			5% AV Blend			5% Corn Oil											
Duration, d	21	42	63	21	42	63	21	42	63	0	B	G	Trt	Trt	Sex	DFUL	WD	DFUL × WD
WD, d	61	40	19	61	40	19	61	40	19	82			SEM					
HCW, kg	103.3	96.1	104.9	102.8	105.3	100.2	105.5	100.6	100.6	104.7	104.6	99.6	1.26	0.90	0.062	0.96	0.68	0.60
Loin depth, cm	5.9	6.6	6.5	6.9	7.3	5.6	6.8	6.2	6.6	6.2	6.6	6.2	0.13	0.61	0.17	0.88	0.76	0.24
Backfat depth, cm	2.04	1.79	2.24	2.25	2.31	1.97	1.99	1.53	1.98	1.93	2.15	1.82	0.05	0.14	0.006	0.010	0.33	0.12

[a,b,c]Within a row, means without a common superscript differ ($P<0.05$)