Title: Developing equations for rapid and accurate prediction of carcass fat quality - **NPB# 13-101**

Investigator: Mark Knauer

Institution: North Carolina State University

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Industry summary:

The concepts of least cost diet formulation, feeding of alternative feed ingredients and production throughput have become common practice in the swine industry. The inclusion of alternative ingredients containing greater levels of unsaturated fat in the diet can have negative effects on fat quality that reverberate throughout the entire pork chain. The literature indicates that carcasses with increased unsaturated fatty acids, particularly polyunsaturated fatty acids (PUFA), are subject to fat oxidation, color change, shortened shelf life and reduced processing efficiencies as a result of soft pork fat. Hence, the industry needs rapid predictive methods to quantify the impact of production factors (i.e. diet, heat stress, growth) on pork fat quality.

Iodine value (IV) is used as a predictive measure in determining pork fat quality by measuring the ratio of unsaturated to saturated fatty acids present in carcass adipose tissues. The greater the ratio of unsaturated to saturate fatty acids present, the greater the corresponding IV value. The objectives of this study were threefold. The first objective was to analyze the inherent biological variation that exists in fatty acid composition when all genetic, environmental, and managerial practices are held constant. The next objective was to quantify the impact of diet, sex, season and market pull on fatty acid composition and iodine value. The final objective was to develop accurate and precise predictive equations to determine iodine value of two relevant adipose depots in grow-finish pigs.

The experiment consisted of 480 crossbred pigs (240 barrows and 240 gilts) replicated over two seasons (winter and summer) and assigned to one of four dietary treatments. The dietary treatments consisted of: 6% supplemental beef tallow, 6% supplemental corn oil, 6% supplemental beef tallow and Ractopamine HCL and 6% supplemental corn oil and Ractopamine HCL. When pigs approached target market weights the heaviest hogs were marketed first removing 80 pigs (16 pens) in each of the first, second and third marketing cuts. Backfat and belly fat samples were collected at harvest from a commercial abattoir. Fat IV was calculated from fatty acid profile using the following equation (AOCS, 1998): $IV = C16{:}1 \times 0.9976 + C18{:}1 \times 0.8986 + C18{:}2 \times 1.810 + C18{:}3 \times 2.735 + C20{:}1 \times 0.8175 + C22{:}1 \times 0.7497$.

Results showed fatty acid composition from both sampling sites was greatly affected by the degree of unsaturation of the supplemental dietary fat source. Thus, diets containing corn oil as a dietary fat source had a higher concentration of monounsaturates and polyunsaturates when compared to diets containing tallow as the dietary fat source. Iodine values were also greater for corn oil diets when compared to tallow diets. Moreover, iodine value of both sampling locations were also affected by ractopamine, sex, season and market pull.

In the development of equations to predict iodine value of backfat and belly sample sites, dietary IVP was the first variable selected (backfat: $R^2 = 0.74$; belly: $R^2 = 0.66$). The inclusion of ractopamine, sex, season and market pull increased backfat and belly R^2 values to 0.78 and 0.69, respectively. In other words, 66% of the variation in belly IV was explained by dietary IVP and approximately 3% of the variation in belly IV was explained by ractopamine, sex, season and market pull. Equations produced by this project will enable swine production companies to better manage fat quality and optimize feed costs.

Key findings

- Dietary IVP explained the majority of the variation in IVP for both backfat and belly fat (R^2 = 74 and 66%, respectively)
- Accounting for ractopamine, sex, season and market pull improved IVP R^2 for backfat and belly fat by 4 and 3%, respectively

Scientific abstract:

The aim of this study was to develop standardized equations to predict carcass fatty acid composition and iodine value. Crossbred pigs (n=480) were blocked by sex and initial BW (48.7 ± 6.8 kg) into one of three marketing pulls. Pens (n=96) were then allocated to dietary treatments in a 2×2 factorial consisting of two fat sources: corn oil (CO) or beef tallow (TA) fed at an inclusion level of 6% and two levels of Ractopamine HCL (RAC) fed at an inclusion level of 0 or 9g/ton. The trial was replicated in the summer and winter seasons. The first, second, and third marketing pulls removed 80 pigs (16 pens) on d 56, 64, and 72, respectively. Adipose tissue samples were collected from loin backfat and belly fat depots and fatty acid composition were determined. Data were analyzed utilizing PROC MIXED and PROC REG functions of SAS. Dietary CO supplementation increased total PUFA ($P<0.01$) and UFA:SFA ($P<0.01$) in both fat sampling locations. Dietary CO increased ($P<0.01$) IV when compared to TA for both backfat (88.6 vs. 69.8) and belly fat (83.5 vs. 68.5). Gilts had greater IV than barrows in both backfat (80.6 vs. 77.8) and belly (76.7 vs. 75.3). Summer tended ($P=0.07$) to have greater backfat IV than winter (79.6 vs. 78.8) and had increased ($P<0.01$) belly IV (77.4 vs. 74.6). The last market pull had higher ($P<0.05$) backfat IV (80.9 vs. 77.8 and 78.8) and belly IV (77.1 vs. 75.8 and 75.1) than market pulls one and two, respectively. In the development of equations to predict iodine value of backfat and belly sample sites, dietary IVP was the first variable selected (backfat: $R^2 = 0.74$; belly: $R^2 =$

0.66). The inclusion of ractopamine, sex, season and market pull increased backfat and belly R^2 values to 0.78 and 0.69, respectively. In other words, 66% of the variation in belly IV was explained by dietary IVP and approximately 3% of the variation in belly IV was explained by ractopamine, sex, season and market pull. Equations produced by this project will enable swine production companies to better manage fat quality and optimize feed costs.

Keywords: fat quality, fatty acid composition, finishing, iodine value

Introduction

Pork fat quality has received heightened awareness due in part to a rise in feed cost, resulting in an increased use of alternative feed ingredients that may compromise fat quality by increasing unsaturated fat levels in diets. However, much is known about the influence of diet on pork fat quality. It is well established that fatty acid composition of pork is influenced by the level of unsaturated fat present in the diet (Ellis and Isabell, 1926). Thus, feeding strategy is a commonly used management tool to control pork fat quality in the production of meat. Consequently, change in diet may impact meat quality and carcass processing characteristics due to alterations in fatty acid composition of the adipose tissue. In addition to dietary management (Averette Gatlin et al., 2002a; Averette Gatlin et al., 2002b; Averette Gatlin et al., 2003), the composition and quality of fat in pigs can be manipulated through extrinsic and intrinsic factors including: genotype, growth rate, age, body weight, gender, season, etc. (Madsen et al., 1992; Correa et al., 2008; Wood et al., 2008). However, existing knowledge relating diet to fatty acid profile is more plentiful in comparison to non-dietary factors. Therefore, our project is designed to quantify the importance of multiple factors in relation to pork fat quality.

The determination of carcass fat quality is indirectly measured by fatty acid composition; the most common method is iodine value (IV) which measures the degree of unsaturation in the fatty acids for a given fat source. Iodine value is described as the number of iodine molecules absorbed by 100 g of fat and can be calculated from fatty acid profile using the following equation (AOCS, 1998): IV = C16:1 × 0.9976 + C18:1 × 0.8986 + C18:2 × 1.810 + C18:3 × 2.735 + C20:1 × 0.8175 + C22:1 × 0.7497.

Currently, two regression equations have been developed to allow the prediction of carcass backfat IV from dietary iodine value product (IVP). Madsen et al. (1992) was first to create an equation to estimate carcass backfat: Carcass IV = 47.1 + 0.14 x dietary IVP (R^2 = 0.86) followed by Boyd (1997): Carcass IV = 52.4 + 0.32 x dietary IVP (R^2 = 0.99). Differences in the prediction equations are attributed to the range in IVP spanned and heavier-weight animals allowed ad libitum access to feed in the research by Boyd (1997). Recent effort by Benz et al. (2011) to validate the dietary IVP with the actual carcass IV when using the Madsen or Boyd equations reported higher predictive values in pigs fed diets with higher levels of unsaturated fats; concluding that dietary C18:2n-6 content was a better predictor of carcass

IV than IVP. Collectively, the studies by Madsen et al. (1992) and Boyd (1997) clearly identified the relationship between carcass IV and IVP. However, a comprehensive evaluation of the multitude of factors that influence fatty acid profiles has not been reported.

Objectives

1.) Quantify the inherent variation in fatty acid composition and iodine value when all factors are held constant.

- How much does fatty acid composition within a single genetic line when sex, seasonality, diet, and market pull are held constant vary?
- How much does iodine value vary when sex, seasonality, diet, and market pull are held constant?

2.) Evaluate the impact of diet, season, gender and market pull on fatty acid composition and iodine value.

- Does diet, sex, seasonality, and market pull influence fatty acid composition of grow-finish pigs at two fat depots (belly and loin)?
- Does diet, sex, seasonality, and market pull influence iodine value of grow-finish pigs at two fat depots (belly and loin)?

3.). Develop equations to accurately and rapidly estimate the impact of iodine value product, fat free lean, season and age on carcass fat quality.

- How accurate are equations for predicting iodine value products from loin and belly samples?

Methods and Materials

All animal procedures were reviewed by the Institutional Animal Care and Use committee of North Carolina State University.

Animals

A single experiment, was conducted in two sequential replications (winter and summer). A total of 480 pigs were utilized in this study (240 gilts and 240 barrows). , the genetic makeup of the pigs consisted of Smithfield Premium Genetics (SPG) Landrace x Large White dams mated to SPG Duroc boars (SPG Rose Hill, NC), and were housed in solid concrete floor indoor pens at North Carolina Swine Evaluation Station (Clayton, NC). Pigs were given 30 d to acclimate before being randomly assigned to one of four dietary treatments for each replication.

Experimental Diets

The feeding period was separated into four phases. Pigs were acclimation for 30 d (phase 1) with phase 1 diet (Table 1). After 30 d acclimation 240 pigs (n=120 gilt and n=120 barrows) were randomly allotted to 4 treatments in a randomized complete block design with their initial body weight (BW of 48.7 ± 6.8 kg) and sex as blocks. Each treatment had 12 pens (6 barrow pens and 6 gilt pens) with 5 pigs per pen. This arrangement was replicated in both summer and winter seasons.

During phase 1, all the pigs were fed in the same diet during acclimation. In phase 2, phase 3 and phase 4 pigs were fed experimental diets based on 2 x 2 factorial arrangements of the treatments with 2 fat sources: corn oil (CO) and beef tallow (TA), fed at an inclusion level of 6%, and 2 levels of Ractopamine HCL (RAC; Paylean, Elanco Animal Health, Greenfield, IN) inclusion: 0 and 10 ppm.

Table 1. Composition and calculated nutrient analysis of experimental diets (as-fed basis)

Ingredient, % in diet	Phase 1 (30 d) Pre-test	Phase 2 (107 to 162 lbs) Corn Oil	Phase 2 (107 to 162 lbs) Tallow	Phase 3 (162 to 218 lbs) Corn Oil	Phase 3 (162 to 218 lbs) Tallow	Phase 4 (218 to 269 lbs) Corn oil	Phase 4 (218 to 269 lbs) Tallow	Phase 4 (218 to 269 lbs) Corn oil +RAC	Phase 4 (218 to 269 lbs) Tallow +RAC
Corn, yellow dent	58.99	44.90	44.95	49.60	49.62	53.75	53.78	45.12	45.15
Corn DDGS, > 6 and 9% oil	20	-	-	-	-	-	-	-	-
Soybean meal, 47.5% CP	17.76	15.93	15.93	11.61	11.61	7.61	7.61	15.93	15.93
Wheat, hard red winter	-	30.00	30.00	30.00	30.00	30	30	30	30
Tallow	-	0.00	6.00	0.00	6.00	6	-	6	-
Corn oil	-	6.00	0.00	6.00	0.00	-	6	-	6
L-lysine HCl	0.42	0.42	0.40	0.41	0.40	0.41	0.39	0.42	0.40
DL-methionine	0.05	0.09	0.08	0.06	0.05	0.05	0.04	0.11	0.10
L-threonine	0.1	0.14	0.14	0.14	0.14	0.14	0.14	0.17	0.17
Monocalcium phosphate 21%	0.53	0.51	0.51	0.35	0.35	0.23	0.23	0.37	0.37
Limestone	1.46	1.31	1.29	1.18	1.18	1.16	1.16	1.14	1.14
Salt	0.5	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Market Swine Vitamins	0.01	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03
Trace mineral premix	0.03	0.15	0.15	0.10	0.10	0.10	0.10	0.15	0.15
Optiphos 2000	0.15	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Santoquin liquid[1]	-	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ractopamine HCL, 9g/lb	-	-	-	-	-	-	-	0.04	0.04
Calculated Nutrient Composition									
ME, kcal/lb.		1613	1593	1620	1600	1624	1604	1618	1597
Crude Protein, %		16.19	16.17	14.5	14.48	12.92	12.9	16.25	16.22
Linoleic Acid, %		4.43	1.41	4.5	1.48	4.56	1.54	4.43	1.41
IVP[2]		104.34	55.76	106.07	57.49	107.59	59	104.47	55.88
Standard ileal digestible (SID) amino acids,%									
Lys, %		0.93	0.92	0.82	0.81	0.72	0.71	0.93	0.92
Thr, %		0.59	0.59	0.53	0.53	0.48	0.47	0.62	0.61
Met, %		0.31	0.3	0.26	0.25	0.23	0.22	0.32	0.32

Met+Cys,%	0.56	0.55	0.49	0.49	0.44	0.44	0.58	0.57
Trp, %	0.16	0.16	0.91	0.9	0.12	0.12	0.16	0.16
Total Lys, %	1.03	1.02	0.551	0.551	0.80	0.79	1.03	1.02
Ca, %	0.64	0.63	0.40	0.40	0.51	0.51	0.55	0.55
Total P	0.46	0.46	0.27	0.27	0.36	0.36	0.43	0.43
Avail. P	0.31	0.31	0.28	0.28	0.24	0.24	0.28	0.28

[1]Phytase enzyme

[2]Iodine value product = % of diet lipids × iodine value of the dietary lipids × 0.1 (Madsen, 1992).

Growth and Carcass Measurements

Individual pig weights were taken on d 0, 24, 45, 56, 64 and 72 during the study period. All feed additions and feed weigh back amounts were recorded daily for ADG, ADFI and G:F. At the end of the test (day prior to shipment for harvest), pigs were individually weighed and a transverse ultrasound scan was taken at the 10th rib; backfat depth (over the middle of the longissimus muscle) and longissimus muscle area were measured from the cross-sectional image. Pens were taken off test in a multiple-group removal program with three sequential pulls at d 56, 64 and 72. On d 56, 64 and 72 pigs were harvested at a local abattoir and hot carcass weight collected.

Fat Tissue Sampling

Fat tissue samples were collected at two commercial abattoirs from two anatomical carcass locations: belly (posterior to the sternum, ventral edge of belly) and backfat (at the adjacent area of the 1^{st} lumbar vertebra). Samples of belly and 10th rib loin back fat were collected vacuum packaged and stored at -20 C until analyzed.

Dietary Fatty Acid Analysis

Dietary fat levels were determined using the Goldfish method of fat extraction. Diet samples were obtained from every third feed bag and collected during feed production. 5-10 g samples of each diet were weighed into cellulose thimbles. 40 ml of ethyl ether was weighed out and a small amount was poured over the diet sample. The remaining was poured into pre-dried and weighed beakers. Beakers and thimbles were attached to the Goldfish fat extraction system. During the process, all beakers were kept boiling and solvent levels were kept adequate. After 4 hours, beakers were allowed to cool. Cooled beakers were placed into a steam bath to evaporate solvent. After all solvent was evaporated, beakers were placed in an oven (105ºC-110ºC) to dry. Beakers were cooled in a desiccator. Beakers and fat were weighed and the weight of the empty beaker was subtracted. The grams of fat were then divided by the weight of the sample extracted and multiplied by 100 to obtain % fat (AOAC, 1998).

Tissue Fatty Acid Analysis

Fatty acids were extracted from adipose tissue in accordance to Gatlin et al., (2002). All backfat layers of the adipose tissue samples were combined and mixed thoroughly. Lipids were isolated from adipose tissue in duplicate by weighing 100 mg into a glass tube with a teflon-lined cap. One ml of a reagent containing 3.75M NaOH dissolved in a 1:1 (v/v) methanol, distilled water mixture was added and the tubes were heated in a boiling water bath for 5 min, vortexed and returned to the water bath for 25 min. The samples were then placed into cool water and 2 ml of a 1.7:1 (v/v) methyl alcohol and hydrochloric acid mixture was added. The samples were placed into the boiling water bath for 10 min and then immediately placed in cool water. Three ml of a 1:1 (v/v) methyl tert-butyl ether and hexane mixture was then added to the samples. Samples were vortexed and mixed continuously for 10 min until clear and the lower, aqueous phase was discarded. Finally 3 ml of 0.3M NaOH was added to the remaining organic layer and the tubes were mixed and centrifuged. Two-thirds of the top, organic layer were removed to a clean vial and dried under N 2 gas. The methyl esters were re-dissolved in 250 pi of hexane. A Hewlett Packard 5890 GC (Hewlett Packard, Avondale, PA) equipped with a flame ionization detector was used with a 100 m fused silica capillary column with an i.d. of 0.25 mm and a .20 pm film coating (Supelco, Inc. Bellefonte, PA). Operating conditions were as follows: helium carrier gas, split ratio 100:1, injector temperature 220°C, detector temperature 220°C, initial oven temperature 140°C increasing to 225°C at a rate of 3.2°C/min. The oven was held at 225°C for 14 min, then temperature increased by 2°C/min to 230°C and held for 6 min. Finally, the temperature was decreased by 8°C/min to 140°C and held for 4 min. Total run time was 65 min. Methyl ester standards were used to identify sample fatty acid methyl esters. Integration software (Millenium, Waters, Inc.) was used to calculate the proportion of each fatty acid present. Iodine value (IV) was calculated using the following equation-. C16:l (0.95) + C 18:1 (0.86) + C 18:2 (1.732) + C 18:3 (2.616) + C20:1 (0.785) + C22:l (0.723) (AOCS, 1998).

Statistical Analysis

Live animal performance data were analyzed with fat source, RAC level, sex, season and market pull as fixed effects with pen serving as the experimental unit using PROC MIXED of SAS 9.4 (SAS Institute, Inc., Cary, NC). Carcass characteristic and fatty acid data were analyzed with fat source, RAC level, sex, season and market pull as fixed effects and individual animal was used as the experimental unit using PROC MIXED. Least-squares means were compared using the PDIFF option. Statistical significance was predetermined at $P < 0.05$ and P-values within $P > 0.05$ and $P \leq 0.10$ were considered trends. Correlation analysis between dietary IVP, live performance measures, and carcass characteristics was carried out using the PROC CORR procedure of SAS. Regression analysis was carried out using the PROC GLMSELECT of SAS, utilizing the stepwise procedure with the following model criteria: selection method based on press statistic, stop base on adjusted R^2, and choose based on Schwarz Bayesian Criterion were used to select prediction equations. Additional model screening was conducted using PROC REG procedure of SAS, equations were chosen based on adjusted R^2 and residual RMSE. Models were developed for fat IV depot as the dependent variable.

Results

Growth Performance

Least square means for growth performance are shown in (Table 2). Average daily gain was affected by the inclusion of RAC ($P < 0.01$), sex ($P < 0.01$), season ($P < 0.01$) and market pull ($P < 0.01$). Average daily feed intake was affected by the inclusion of RAC ($P < 0.01$), sex ($P < 0.01$), and season ($P < 0.01$). Gain to feed was affected by the inclusion of RAC ($P < 0.01$), sex ($P < 0.01$), season ($P < 0.01$), and market pull ($P < 0.01$). Dietary fat source did not impact average daily gain, average daily feed intake or gain to feed ($P > 0.42$). Final body weight was affect by the inclusion of RAC ($P < 0.01$), sex ($P < 0.01$) and season ($P < 0.01$). There was also a trend for the association between market pull ($P < 0.09$) and final body weight. No difference ($P > 0.26$) was detected for final body weight between dietary fat sources.

Carcass Characteristics

Least square means for live ultrasound data and carcass characteristics are presented in Table 2. Loin muscle area was significantly impacted by RAC inclusion ($P < 0.01$) and season ($P < 0.02$) and a trend for a market pull ($P < 0.14$). There was no significant impact of dietary fat source ($P = 0.51$) or sex ($P = 0.47$) on ultrasound characteristics. Backfat thickness was impacted by sex ($P < 0.01$) and season ($P < 0.01$); however, backfat was not impacted by dietary fat source ($P = 0.32$), RAC inclusion ($P = 0.16$) or marketing pull ($P = 0.82$). Hot carcass weight was affected by RAC inclusion ($P < 0.01$), sex ($P < 0.01$), season ($P < 0.01$) and a trend in market pull ($P=0.13$), but was not impacted by dietary fat source ($P = 0.52$). Carcass yield percentage was significantly affected by sex ($P < 0.01$), season ($P < 0.01$), market pull ($P < 0.01$) and tended to be for RAC inclusion ($P = 0.10$). Carcass yield percentage was not impacred by differences in the saturation levels of the diets fed. Fat free lean percentage was impacted by RAC inclusion ($P < 0.01$), sex ($P < 0.01$), season ($P < 0.01$) and market pull ($P < 0.01$) however, no saturation level ($P = 0.33$) effect was observed.

Iodine Value

The iodine value of the dietary treatments and of fat removed from backfat and belly fat depots were determined via fatty acid profiles of the diet and two fat depots, values are presented in Table 3. Diets containing 6% corn oil significantly increased iodine value ($P < 0.01$) when compared to diets containing 6% tallow. Yet RAC did not significantly impact iodine value for carcass, backfat, or belly fat. When comparing sample locations; iodine value of backfat was greater than belly for all treatments.

Fatty Acid Composition

Descriptive statistics for fatty acid composition of backfat and belly fat depots are presented in Tables 4, 5 and 6. Mean values for fatty acid composition and iodine value varied at both sampling locations.

Least square means for the fatty acid concentrations of backfat and belly are presented in Tables 7 and 8, respectively. Feeding 6% corn oil during the grow-finish period impacted the fatty acid concentrations of both backfat and belly fat depots. Dietary corn oil increased total PUFA ($P < 0.01$) concentrations and UFA:SFA ($P < 0.01$) ratio; while total SFA ($P<0.01$) and total MUFA ($P<0.01$) were greater for dietary 6% tallow supplementation. Pigs fed corn oil had greater concentrations of 18:2 cis-9, cis-12 and 18:3 cis-9, cis-12, cis-15 ($P < 0.01$) than pigs fed tallow for backfat and belly fat depots. The most significant change occurred for 18:2 cis-9, cis-12 concentrations which were increased in backfat (31.0 vs. 15.6, $P < 0.01$) and belly fat (26.5 vs.14.0, $P < 0.01$) when pigs were fed corn oil in comparison to tallow. Moreover, concentrations of C14:0, C16:0, C16:1 cis-9, C18:0, C18:1 trans-9, C18:1cis-9 and C20:1 cis-11 were less for pigs fed corn oil than pigs fed tallow ($P < 0.01$). Pigs fed corn oil had greater ratios of unsaturated to saturated fatty acids for backfat (2.2 vs 1.7, $P < 0.01$) and belly fat (2.2 vs. 1.7, $P < 0.01$); a lower ratio of monounsaturated to polyunsaturated fatty acid for backfat (1.2 vs. 2.7, $P < 0.01$) and belly fat (1.5 vs. 3.2, $P < 0.01$) than tallow. Pigs fed corn oil had greater iodine value than pigs fed tallow for backfat (88.6 vs. 69.8, $P < 0.01$) and belly fat (83.5 vs 68.5, $P < 0.01$).

Prediction of Iodine Value

The greatest coefficient of determination and the lowest Schwarz's Bayesian criterion were used to develop prediction equations for iodine value of backfat and belly fat sample depots. Eleven independent variables were used that related to dietary composition, growth performance and carcass characteristics of the two fat depots using individual pig as the experimental unit: 1) RAC inclusion level, 2) dietary iodine value product (IVP) of the feed 3) dietary linoleic acid percentage., 4) gender 5) season , 6) day on feed (DOF), 7) initial body weight at being of trial, 8) final body weight of end of trial, 9) 10^{th} rib ultrasound BF, 10) 10^{th} rib ultrasound LMA, 11) Fat Free Lean Percentage. Additional variables were added to models where pen served as the experimental unit: 1) ADFI, 2) G:F, 3) dietary linoleic acid percentage.

Models to predict backfat IV and belly fat IV are shown in Tables 13 and 14, respectively. Significant single variable models used to predict backfat and belly fat IV included dietary IVP (Backfat $R^2 = 0.74$, Belly $R^2 = 0.66$) and C18:2 diet percentage (Backfat $R^2 = 0.75$, Belly $R^2 = 0.66$; Tables). Stepwise models utilizing variables from dietary composition, growth performance, and carcass characteristics, FFLP x IVP and BF x INT BW had the lowest SBC for all models tested for backfat IV. For belly fat IV, FFLP X IVP and ADG had the lowest SBC for all models tested. Models using pen as the experimental unit had greater R^2 than models using individual pig as the experimental unit. This is because pen reduces the variation associated with individual pigs.

Key findings

- Dietary IVP explained the majority of the variation in IVP for both backfat and belly fat ($R^2 = 74$ and 66%, respectively)

- Accounting for ractopamine, sex, season and market pull improved IVP R^2 for backfat and belly fat by 4 and 3%, respectively

Table 2. Least squares means for the effects of saturation level, RAC inclusion, sex, season, and market pull on growth performance and carcass characteristics

	Saturation level			RAC Level			Sex			Season			Pull				*P-value*				
	High	Low	SEM	No RAC	RAC	SEM	B	G	SEM	Sum	Wint	SEM	1	2	3	SEM	Sat level	RAC	Sex	Season	Pull
Growth Performance																					
Final BW, kg	121.9	122.9	0.57	121.0	123.8	0.57	126.1	118.7	0.57	116.5	128.3	0.57	122.4	123.5	121.3	0.69	0.26	0.00	0.00	0.00	0.09
ADG, kg	1.13	1.14	0.01	1.12	1.16	0.01	1.18	1.09	0.01	1.03	1.24	0.01	1.17[a]	1.16[a]	1.08[b]	0.01	0.42	0.01	0.01	0.01	0.01
ADFI, kg	2.87	2.88	0.08	2.95	2.80	0.08	2.87	2.88	0.08	3.22	2.54	0.08	2.75	2.88	3.01	0.10	0.89	0.17	0.85	0.00	0.15
G:F, kg	0.41	0.41	0.01	0.39	0.43	0.01	0.44	0.38	0.01	0.43	0.39	0.01	0.44[a]	0.42[ab]	0.37[b]	0.02	0.90	0.03	0.00	0.02	0.01
Live Ultrasound																					
BF, mm	20.12	19.22	2.71	20.12	19.67	2.71	22.15	17.86	2.71	18.54	21.48	2.94	20.12	19.22	20.12	2.71	0.32	0.16	0.01	0.01	0.21
LMA, cm^2	40.84	41.10	0.26	40.00	41.94	0.32	41.10	40.77	0.32	41.48	40.45	0.32	40.77	40.58	41.55	0.39	0.51	0.00	0.47	0.02	0.14
Carcass Characteristics																					
HCW	96.4	96.9	0.49	95.2	98.1	0.49	99.1	94.2	0.50	88.3	104.9	0.50	97.8	97.8	95.7	0.61	0.52	0.01	0.01	0.01	0.13
Carcass Yield,%	73.1	73.0	0.20	72.8	73.2	0.20	72.6	73.4	0.20	71.8	74.2	0.20	73.5[a]	72.6[ab]	72.9[b]	0.24	0.77	0.10	0.01	0.01	0.03
Fat Free Lean, %[1]	49.5	49.7	0.15	49.3	49.9	0.15	48.2	51.0	0.15	51.0	48.2	0.17	49.4[a]	49.3[a]	50.1[b]	0.18	0.33	0.01	0.01	0.01	0.01

[a,b,] Means within a row with different superscripts are different ($P \leq 0.05$)

[1]fat-free lean: (1.006 x sex (1 = barrow or 2 = gilt)) - (18.838 x 10th rib fat depth, in) + (4.357 x 10th rib loin muscle area, in) + (0.401 x HCW, lbs)

Table 3. Effects of treatment on iodine value (IV)

Treatment

	Tallow		Corn Oil		SEM	P-value		
	No RAC	RAC	No RAC	RAC		SAT	RAC	SAT x RAC
Dietary IV[1]	74.8	71.0	122.1	121.7	-	-	-	-
Carcass IV[2]	68.6 [a]	69.6 [a]	86.3 [b]	85.9 [b]	0.40	0.01	0.45	0.14
Loin BF IV[1]	69.4[a]	70.1[a]	88.5[b]	88.7 [b]	0.52	0.01	0.36	0.73
Belly IV[1]	67.8 [a]	69.1 [a]	84.1 [b]	82.9 [b]	0.51	0.01	0.92	0.02

[a,b,]Row means followed by the same letter do not differ (P > 0.05).

[1]Iodine value calculated from fatty acid composition: (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 concentration (AOCS, 1998).

[2]Carcass fat IV was averaged across the 2 sampling sites: belly fat IV and backfat IV.

Table 4. Descriptive statistics of fatty acid profile of loin and belly fat depots

	Belly	Backfat

Fatty Acid, %	Avg	SD	Max	Min	Avg	SD	Max	Min
14:0	1.94	0.38	2.95	0	1.87	0.38	3	0.85
16:0	22.79	2.09	28.33	17.84	22.46	2.35	27.89	16.05
16:1 *cis*-9	2.97	0.73	5.53	1.06	2.51	0.69	4.83	0.89
18:0	8.25	1.58	13.73	5.34	8.19	1.56	13.44	4.44
18:1 *trans*-9	0.37	0.31	1.25	0	0.46	0.38	1.58	0
18:1 *cis*-9	39.34	4.3	51.48	28.2	37.07	4.53	46.33	27.37
18:2 *cis*-9, *cis*-12	20.21	7.27	37.69	5.01	23.33	8.51	43.54	10.16
18:3 *cis*-9, *cis*-12, *cis*-15	0.74	0.16	1.17	0	0.85	0.12	1.2	0.5
20:1 *cis*-11	0.53	0.14	1.2	0	0.46	0.09	0.8	0.23
Monounsaturates (MUFA) [1]	43.25	5.02	54.65	30.81	40.55	5.4	50.78	28.84
Polyunsaturates (PUFA) [2]	21.56	7.38	39.68	5.46	24.77	8.6	45.66	11.21
Saturates (SFA) [3]	34.39	3.38	45.6	26.5	33.92	3.84	43.28	23.26
MUFA/PUFA ratio	2.33	1.01	5.94	0.78	1.93	0.89	4.13	0.63
U/S ratio	1.91	0.29	2.75	1.18	1.96	0.35	2.98	1.29
Iodine Value[4]	75.97	9.26	98.44	54.58	79.28	10.89	109.55	59.24

[1]MUFA: total mono-unsaturated fatty acid = C14:1 + C16:1 + C17:1 + C18:1 + C20:1 + C22:1.

[2]PUFA: total poly-unsaturated fatty acid = C18:2 + C18:3 + C20:2 + C20:3 + C20:4 + C20:3 + C22:4.

[3]SFA: total saturated fatty acid = C10:0 + C12:0 + C14:0 + C15:0 + C16:0 + C17:0 + C18:0 + C20:0 + C22:0. 10

[4]Iodine value calculated from fatty acid composition: (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 concentration (AOCS, 1998).

Table 5. Descriptive statistics for the fatty acid profile of lipid from backfat sample site depot by season, dietary fat saturation (low & high), sex and market pull (1, 2 & 3)

Season	Summer																							
Saturation level	Low												High											
Sex	Barrow						Gilt						Barrow						Gilt					
Market pull	1		2		3		1		2		3		1		2		3		1		2		3	
Fatty acid	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD
CAPRIC (C10:0)	0.17	0.03	0.16	0.04	0.16	0.03	0.15	0.04	0.13	0.05	0.14	0.04	0.16	0.03	0.17	0.06	0.20	0.06	0.15	0.04	0.14	0.04	0.15	0.04
LAURIC (C12:0)	0.15	0.03	0.15	0.03	0.16	0.03	0.14	0.03	0.13	0.03	0.16	0.03	0.13	0.02	0.13	0.04	0.16	0.02	0.13	0.03	0.12	0.03	0.13	0.02
MYRISTIC (C14:0)	2.20	0.29	2.18	0.34	2.34	0.25	2.13	0.19	2.10	0.28	2.35	0.34	1.74	0.19	1.67	0.20	1.79	0.22	1.64	0.20	1.61	0.28	1.60	0.19
MYRISTOLEIC (C14:1)	0.07	0.02	0.06	0.02	0.06	0.04	0.06	0.03	0.07	0.03	0.06	0.05	0.01	0.02	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00
PENTADCANOIC (C15:0)	0.14	0.04	0.13	0.03	0.14	0.07	0.10	0.06	0.13	0.06	0.12	0.10	0.05	0.04	0.04	0.03	0.05	0.02	0.05	0.02	0.04	0.03	0.06	0.03
PALMITIC (C16:0)	24.43	1.48	24.94	2.13	24.36	1.01	24.30	0.82	24.00	1.68	23.66	1.60	22.23	1.16	21.42	1.38	21.48	1.36	20.88	1.29	20.47	1.92	19.19	1.26
PALMITOLEIC (C16:1)	3.14	0.47	3.02	0.62	2.98	0.43	3.04	0.41	3.04	0.66	2.91	0.37	2.05	0.39	2.11	0.33	1.88	0.31	2.06	0.30	2.00	0.53	1.57	0.28
MARGARIC (C17:0)	0.56	0.07	0.50	0.10	0.58	0.10	0.51	0.09	0.56	0.09	0.68	0.11	0.26	0.12	0.24	0.06	0.23	0.04	0.25	0.06	0.25	0.09	0.27	0.08
HEPTADECENOIC (C17:1)	0.56	0.09	0.48	0.09	0.56	0.10	0.49	0.09	0.56	0.13	0.63	0.10	0.24	0.10	0.21	0.05	0.20	0.03	0.26	0.05	0.25	0.06	0.24	0.05
STEARIC (C18:0)	9.37	1.15	9.65	1.46	9.33	1.39	9.29	1.00	9.26	1.90	9.08	1.11	8.29	0.79	7.57	1.39	7.69	0.97	7.28	0.76	7.30	1.64	6.73	1.16
ELAIDIC (C18:1)	0.83	0.08	0.77	0.17	0.96	0.12	0.77	0.18	0.90	0.15	1.09	0.13	0.18	0.21	0.11	0.06	0.15	0.10	0.15	0.07	0.20	0.21	0.23	0.16
OLEIC (C18:1)	39.66	1.81	40.15	2.49	39.94	1.43	39.56	1.06	40.22	1.25	38.78	1.85	32.68	1.80	32.66	1.40	31.06	1.37	32.13	1.70	32.92	3.42	29.89	1.49
LINOLEIC (C18:2n-6)	0.08	0.01	0.08	0.02	0.10	0.01	0.07	0.03	0.09	0.02	0.10	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
LINOLEIC (C18:2-trans-10)	15.83	1.67	15.09	4.69	15.58	1.73	16.64	1.66	16.03	2.63	17.36	1.81	29.15	3.42	30.86	2.82	32.22	2.88	32.11	3.12	31.78	6.02	36.84	2.99
ARACHIDIC (C20:0)	0.12	0.06	0.12	0.03	0.09	0.03	0.11	0.04	0.12	0.07	0.07	0.03	0.12	0.02	0.10	0.03	0.09	0.03	0.09	0.02	0.09	0.04	0.08	0.03
γ-LINOLENIC (C18:3)	0.05	0.02	0.04	0.03	0.04	0.03	0.05	0.02	0.05	0.02	0.06	0.03	0.08	0.02	0.08	0.03	0.09	0.02	0.10	0.02	0.08	0.03	0.12	0.03
GONDOIC (C20:1)	0.51	0.12	0.53	0.09	0.50	0.08	0.50	0.06	0.49	0.10	0.42	0.09	0.43	0.05	0.42	0.07	0.40	0.05	0.39	0.05	0.39	0.09	0.33	0.05
α-LINOLENIC (C18:3)	0.83	0.09	0.76	0.12	0.85	0.11	0.82	0.10	0.84	0.14	0.95	0.11	0.83	0.07	0.86	0.09	0.90	0.10	0.90	0.11	0.90	0.16	1.05	0.10
HENEICOSYLIC (C21:0)	0.41	0.03	0.39	0.09	0.45	0.03	0.37	0.06	0.43	0.05	0.48	0.04	0.10	0.07	0.06	0.04	0.07	0.02	0.09	0.02	0.09	0.08	0.08	0.02
EICOSADIENOIC (C20:2)	0.07	0.15	0.02	0.02	0.03	0.04	0.04	0.04	0.03	0.03	0.04	0.03	0.01	0.02	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01
BEHENIC (C22:0)	0.39	0.08	0.42	0.13	0.40	0.04	0.46	0.12	0.41	0.06	0.39	0.06	0.77	0.10	0.82	0.09	0.82	0.07	0.79	0.08	0.80	0.16	0.82	0.06
DIHOMO-γ-LINOLENIC, (C20:3)	0.09	0.02	0.07	0.04	0.07	0.04	0.08	0.03	0.09	0.04	0.08	0.04	0.12	0.02	0.10	0.05	0.11	0.04	0.13	0.03	0.12	0.03	0.13	0.03
EICOSATRIENOIC (20:3)	0.07	0.03	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.02	0.04	0.03	0.04	0.03	0.06	0.02	0.05	0.02	0.04	0.03
ARACHIDONIC (C20:4)	0.27	0.04	0.25	0.05	0.27	0.05	0.27	0.05	0.27	0.06	0.33	0.06	0.32	0.04	0.34	0.04	0.35	0.05	0.36	0.07	0.37	0.06	0.42	0.08
IV	69.43	2.74	67.95	6.65	69.07	3.10	70.44	2.71	70.11	4.80	71.69	3.57	84.86	4.55	87.82	4.75	88.83	4.53	89.86	4.61	89.92	7.90	96.28	4.69
SFA	37.40	1.84	38.11	2.97	37.42	1.91	37.08	1.45	36.71	2.77	36.55	2.44	33.71	1.92	32.12	2.56	32.47	2.21	31.21	1.99	30.78	2.98	28.98	2.25
MUFA	44.20	1.76	44.54	2.91	44.45	1.59	43.92	1.20	44.71	1.45	43.25	1.88	35.35	2.27	35.30	1.47	33.49	1.56	34.74	1.89	35.52	3.91	32.02	1.62
PUFA	17.30	1.74	16.35	4.83	16.98	1.94	18.03	1.79	17.44	2.84	18.97	1.98	30.56	3.46	32.27	2.97	33.72	3.04	33.66	3.31	33.32	6.18	38.60	3.16

Table 5 continued. Descriptive statistics for the fatty acid profile of lipid from backfat sample site depot

Season	Winter																							
Saturation level	LOW												HIGH											
Sex	Barrow						Gilt						Barrow						Gilt					
Market pull	1		2		3		1		2		3		1		2		3		1		2		3	
Fatty acid	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD
CAPRIC (C10:0)	0.11	0.02	0.12	0.03	0.12	0.04	0.13	0.03	0.11	0.03	0.11	0.03	0.12	0.05	0.12	0.03	0.12	0.03	0.11	0.03	0.11	0.03	0.11	0.02
LAURIC (C12:0)	0.12	0.03	0.12	0.03	0.12	0.02	0.12	0.03	0.12	0.03	0.11	0.03	0.10	0.03	0.10	0.02	0.11	0.02	0.11	0.03	0.10	0.02	0.10	0.02
MYRISTIC (C14:0)	2.12	0.26	2.06	0.31	2.07	0.26	2.02	0.28	2.03	0.29	1.99	0.31	1.57	0.34	1.59	0.19	1.63	0.22	1.64	0.25	1.45	0.30	1.54	0.24
MYRISTOLEIC (C14:1)	0.06	0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.06	0.02	0.07	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
PENTADCANOIC (C15:0)	0.12	0.05	0.14	0.05	0.13	0.04	0.12	0.03	0.15	0.03	0.14	0.04	0.06	0.03	0.05	0.03	0.06	0.02	0.05	0.02	0.06	0.03	0.06	0.03
PALMITIC (C16:0)	24.90	1.24	23.82	1.67	23.38	1.85	24.10	1.63	23.69	1.60	22.85	1.58	21.12	1.77	21.89	1.75	20.97	1.69	21.46	2.17	19.81	2.22	19.86	1.71
PALMITOLEIC (C16:1)	3.13	0.51	3.05	0.34	3.18	0.52	3.16	0.32	2.97	0.40	2.93	0.28	2.13	0.75	1.99	0.29	2.04	0.25	2.07	0.47	1.86	0.29	2.08	0.34
MARGARIC (C17:0)	0.48	0.09	0.55	0.12	0.51	0.11	0.44	0.13	0.55	0.08	0.55	0.09	0.26	0.10	0.24	0.08	0.24	0.05	0.25	0.07	0.29	0.09	0.27	0.10
HEPTADECENOIC (C17:1)	0.60	0.15	0.67	0.18	0.64	0.15	0.59	0.13	0.66	0.10	0.68	0.15	0.30	0.12	0.25	0.10	0.30	0.09	0.31	0.12	0.32	0.07	0.32	0.09
STEARIC (C18:0)	9.15	1.35	8.97	1.47	8.05	1.33	8.99	1.37	9.02	0.97	8.52	0.84	7.80	1.36	7.62	1.21	6.96	1.32	7.51	1.35	6.96	1.08	6.42	0.88
ELAIDIC (C18:1)	41.86	1.80	42.17	2.10	42.27	2.87	41.86	2.13	42.07	1.81	42.05	2.27	36.12	2.94	34.87	1.90	35.02	1.62	34.02	2.84	33.62	2.38	34.93	2.24
OLEIC (C18:1)	0.68	0.33	0.50	0.46	0.70	0.27	0.71	0.15	0.66	0.47	0.56	0.41	0.22	0.18	0.15	0.17	0.16	0.10	0.20	0.32	0.21	0.18	0.19	0.14
LINOLEIC (C18:2n-6)	13.84	1.20	14.78	2.21	15.73	3.38	14.75	2.34	15.01	1.61	16.31	2.16	27.23	5.04	29.19	4.17	29.44	2.85	29.48	4.67	32.15	3.87	31.13	3.72
LINOLEIC (C18:2-trans-10)	0.08	0.02	0.08	0.02	0.10	0.03	0.08	0.02	0.08	0.03	0.10	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.03	0.01	0.02	0.01	0.02
ARACHIDIC (C20:0)	0.12	0.03	0.11	0.04	0.10	0.03	0.10	0.03	0.11	0.02	0.10	0.01	0.12	0.03	0.11	0.04	0.10	0.03	0.10	0.04	0.11	0.03	0.10	0.02
γ-LINOLENIC (C18:3)	0.03	0.03	0.04	0.03	0.04	0.03	0.05	0.03	0.04	0.03	0.05	0.03	0.06	0.04	0.07	0.03	0.07	0.03	0.06	0.04	0.08	0.03	0.07	0.04
GONDOIC (C20:1)	0.55	0.06	0.55	0.09	0.53	0.07	0.50	0.08	0.50	0.06	0.50	0.08	0.50	0.11	0.41	0.05	0.44	0.05	0.41	0.08	0.41	0.08	0.41	0.07
α-LINOLENIC (C18:3)	0.78	0.08	0.81	0.10	0.83	0.10	0.83	0.13	0.83	0.08	0.86	0.14	0.78	0.12	0.77	0.14	0.79	0.11	0.84	0.10	0.89	0.11	0.86	0.10
HENEICOSYLIC (C21:0)	0.45	0.08	0.46	0.12	0.52	0.09	0.48	0.06	0.50	0.06	0.51	0.08	0.13	0.11	0.11	0.05	0.13	0.03	0.11	0.09	0.14	0.06	0.16	0.05
EICOSADIENOIC (C20:2)	0.04	0.03	0.06	0.03	0.06	0.03	0.05	0.03	0.06	0.04	0.08	0.02	0.03	0.04	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02
BEHENIC (C22:0)	0.40	0.05	0.43	0.06	0.44	0.09	0.47	0.19	0.41	0.07	0.48	0.15	0.92	0.24	0.80	0.12	0.86	0.12	0.78	0.14	0.87	0.14	0.85	0.13
DIHOMO-γ-LINOLENIC, (C20:3)	0.07	0.03	0.09	0.04	0.07	0.03	0.08	0.03	0.07	0.04	0.09	0.04	0.09	0.05	0.09	0.04	0.10	0.04	0.09	0.04	0.11	0.03	0.11	0.04
EICOSATRIENOIC (20:3)	0.06	0.02	0.08	0.02	0.07	0.02	0.06	0.03	0.06	0.03	0.07	0.03	0.04	0.04	0.04	0.03	0.06	0.02	0.04	0.03	0.07	0.02	0.05	0.03
ARACHIDONIC (C20:4)	0.23	0.04	0.25	0.05	0.28	0.09	0.24	0.07	0.24	0.05	0.27	0.05	0.30	0.08	0.30	0.07	0.32	0.05	0.30	0.06	0.35	0.05	0.35	0.07
IV	67.34	2.94	69.31	4.29	71.41	4.94	69.16	4.31	69.56	3.28	72.02	3.82	84.35	6.80	86.44	7.62	87.29	5.06	86.45	6.58	90.99	5.97	90.38	5.32
SFA	37.41	2.35	36.19	3.01	34.79	3.04	36.38	2.83	36.04	2.44	34.73	2.42	32.00	2.96	32.47	2.66	30.99	2.89	31.98	3.36	29.69	3.14	29.26	2.44
MUFA	46.29	1.80	46.34	2.20	46.74	3.26	46.29	2.03	46.26	1.90	46.10	2.09	38.98	3.63	37.43	1.97	37.67	1.58	36.71	3.44	36.11	2.57	37.61	2.47
PUFA	15.13	1.35	16.20	2.36	17.18	3.48	16.13	2.52	16.39	1.74	17.84	2.36	28.54	5.21	30.51	4.36	30.84	3.03	30.84	4.76	33.68	4.02	32.60	3.86

Table 6. Descriptive statistics for the fatty acid profile of lipid from belly sample site depot

Season	Summer																							
Saturation level	LOW												HIGH											
Sex	Barrow						Gilt						Barrow						Gilt					
Market pull	1		2		3		1		2		3		1		2		3		1		2		3	
Fatty acid	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD
CAPRIC (C10:0)	0.16	0.04	0.18	0.03	0.18	0.05	0.15	0.03	0.16	0.04	0.17	0.04	0.17	0.03	0.18	0.04	0.20	0.06	0.16	0.03	0.17	0.03	0.19	0.05
LAURIC (C12:0)	0.14	0.03	0.16	0.02	0.15	0.04	0.14	0.03	0.14	0.04	0.15	0.02	0.14	0.02	0.13	0.03	0.15	0.04	0.12	0.02	0.14	0.03	0.14	0.03
MYRISTIC (C14:0)	2.19	0.28	2.22	0.23	2.30	0.25	2.22	0.28	2.20	0.23	2.35	0.15	1.89	0.17	1.80	0.20	1.99	0.32	1.73	0.23	1.76	0.19	1.95	0.26
MYRISTOLEIC (C14:1)	0.07	0.02	0.06	0.02	0.06	0.03	0.06	0.01	0.05	0.03	0.07	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.02
PENTADCANOIC (C15:0)	0.11	0.03	0.10	0.03	0.12	0.03	0.11	0.03	0.09	0.04	0.14	0.04	0.05	0.02	0.03	0.02	0.04	0.04	0.05	0.02	0.04	0.02	0.06	0.03
PALMITIC (C16:0)	24.71	1.04	24.02	1.21	23.64	1.58	23.65	1.36	23.99	1.34	23.83	1.16	21.99	1.01	21.26	1.24	21.58	1.66	21.51	1.18	20.96	0.83	21.61	2.06
PALMITOLEIC (C16:1)	3.49	0.54	3.65	0.54	3.46	0.61	3.68	0.56	3.55	0.68	3.62	0.68	2.54	0.36	2.73	0.45	2.71	0.65	2.62	0.50	2.48	0.29	2.62	0.74
MARGARIC (C17:0)	0.44	0.08	0.45	0.07	0.48	0.09	0.38	0.08	0.48	0.14	0.54	0.07	0.22	0.05	0.21	0.08	0.25	0.08	0.20	0.04	0.22	0.06	0.25	0.10
HEPTADECENOIC (C17:1)	0.56	0.11	0.52	0.07	0.52	0.13	0.53	0.10	0.50	0.10	0.55	0.08	0.27	0.06	0.21	0.06	0.26	0.08	0.27	0.06	0.24	0.06	0.25	0.07
STEARIC (C18:0)	8.95	1.23	8.84	1.21	8.45	0.85	7.97	1.18	8.88	1.24	8.52	1.32	7.34	0.82	7.13	0.83	7.52	1.13	7.20	0.93	7.24	0.75	7.38	1.13
ELAIDIC (C18:1)	0.70	0.11	0.69	0.06	0.77	0.18	0.65	0.12	0.56	0.26	0.83	0.15	0.12	0.07	0.13	0.07	0.21	0.19	0.11	0.07	0.14	0.13	0.25	0.16
OLEIC(C18:1)	41.60	1.84	42.60	1.59	41.11	3.28	42.09	1.94	41.92	1.62	41.33	1.67	34.69	1.64	35.12	2.04	35.76	2.16	36.05	3.35	35.02	2.75	34.79	3.16
LINOLEIC (C18:2n-6)	0.07	0.02	0.07	0.02	0.08	0.03	0.08	0.01	0.07	0.03	0.09	0.02	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.02
LINOLEIC (C18:2-trans-10)	14.15	1.00	13.68	1.44	15.87	5.47	15.44	1.95	14.79	2.14	15.00	2.16	27.76	1.81	28.21	3.18	26.45	4.78	27.13	3.94	28.73	3.38	27.60	6.08
ARACHIDIC (C20:0)	0.10	0.02	0.13	0.02	0.11	0.01	0.10	0.03	0.10	0.05	0.10	0.03	0.11	0.02	0.10	0.04	0.11	0.03	0.10	0.02	0.11	0.03	0.11	0.03
γ-LINOLENIC (C18:3)	0.04	0.02	0.04	0.02	0.06	0.02	0.04	0.03	0.04	0.03	0.05	0.03	0.08	0.01	0.08	0.03	0.07	0.04	0.08	0.03	0.09	0.04	0.10	0.04
GONDOIC (C20:1)	0.52	0.07	0.59	0.06	0.53	0.09	0.51	0.07	0.46	0.18	0.48	0.09	0.44	0.04	0.44	0.12	0.49	0.06	0.44	0.06	0.43	0.09	0.42	0.09
α-LINOLENIC (C18:3)	0.74	0.08	0.73	0.08	0.78	0.12	0.80	0.10	0.81	0.13	0.81	0.12	0.81	0.08	0.83	0.10	0.80	0.08	0.79	0.12	0.84	0.12	0.83	0.14
HENEICOSYLIC (C21:0)	0.36	0.03	0.41	0.04	0.40	0.12	0.37	0.04	0.38	0.13	0.45	0.06	0.08	0.02	0.08	0.04	0.12	0.11	0.08	0.01	0.08	0.03	0.11	0.07
EICOSADIENOIC (C20:2)	0.09	0.05	0.04	0.03	0.07	0.08	0.12	0.07	0.03	0.03	0.07	0.09	0.05	0.05	0.00	0.01	0.05	0.08	0.04	0.04	0.00	0.01	0.02	0.04
BEHENIC (C22:0)	0.39	0.05	0.40	0.05	0.42	0.11	0.41	0.05	0.40	0.06	0.37	0.04	0.74	0.07	0.79	0.08	0.76	0.17	0.73	0.11	0.76	0.07	0.70	0.13
DIHOMO-γ-LINOLENIC, (C20	0.07	0.03	0.10	0.05	0.09	0.03	0.10	0.01	0.06	0.04	0.08	0.03	0.11	0.02	0.13	0.07	0.10	0.06	0.13	0.02	0.13	0.08	0.13	0.04
EICOSATRIENOIC (20:3)	0.04	0.03	0.05	0.03	0.05	0.02	0.05	0.03	0.04	0.03	0.04	0.03	0.05	0.02	0.04	0.03	0.04	0.03	0.05	0.02	0.04	0.03	0.04	0.03
ARACHIDONIC (C20:4)	0.30	0.12	0.27	0.04	0.30	0.07	0.31	0.05	0.28	0.09	0.34	0.06	0.34	0.04	0.35	0.08	0.32	0.08	0.40	0.07	0.38	0.06	0.42	0.12
IV	68.14	2.27	68.28	2.48	70.94	6.85	71.30	3.53	69.42	3.28	69.97	3.43	84.67	2.71	86.02	4.37	83.44	6.67	84.96	4.48	86.74	4.16	84.99	8.19
SFA	46.37	2.02	47.60	1.85	45.93	3.83	47.00	2.13	46.54	1.84	46.34	2.09	37.80	1.84	38.42	2.38	39.18	2.74	39.24	3.82	38.08	2.93	38.10	3.90
MUFA	15.50	1.14	14.98	1.57	17.30	5.61	16.95	2.09	16.12	2.29	16.49	2.35	29.21	1.96	29.65	3.31	27.84	4.95	28.62	4.07	30.20	3.59	29.15	6.32
PUFA	3.01	0.30	3.21	0.39	2.82	0.57	2.82	0.41	2.96	0.52	2.88	0.57	1.30	0.14	1.32	0.20	1.50	0.53	1.42	0.39	1.29	0.29	1.44	0.71

Table 6 continued. Descriptive statistics for the fatty acid profile of lipid from belly sample site depot

Season	Winter																							
Saturation level	LOW												HIGH											
Sex	Barrow						Gilt						Barrow						Gilt					
Market pull	1		2		3		1		2		3		1		2		3		1		2		3	
Fatty acid	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD	AVG	SD
CAPRIC (C10:0)	0.13	0.06	0.16	0.04	0.10	0.06	0.12	0.05	0.18	0.16	0.10	0.07	0.12	0.06	0.15	0.05	0.11	0.06	0.12	0.08	0.21	0.27	0.11	0.06
LAURIC (C12:0)	0.13	0.04	0.14	0.03	0.10	0.05	0.13	0.03	0.15	0.15	0.11	0.08	0.10	0.04	0.12	0.03	0.11	0.06	0.10	0.03	0.14	0.11	0.09	0.06
MYRISTIC (C14:0)	2.14	0.32	2.10	0.37	2.04	0.35	2.03	0.30	1.89	0.50	1.94	0.39	1.61	0.24	1.68	0.32	1.73	0.29	1.52	0.42	1.54	0.23	1.64	0.30
MYRISTOLEIC (C14:1)	0.07	0.02	0.06	0.03	0.06	0.03	0.07	0.02	0.06	0.03	0.05	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.05	0.02	0.01
PENTADCANOIC (C15:0)	0.14	0.10	0.12	0.08	0.10	0.04	0.11	0.02	0.10	0.05	0.08	0.07	0.06	0.04	0.06	0.08	0.05	0.03	0.05	0.03	0.11	0.18	0.05	0.04
PALMITIC (C16:0)	25.18	2.02	24.82	2.19	23.82	1.62	24.20	1.40	23.99	2.04	22.30	1.90	22.07	1.46	22.70	2.00	21.29	1.52	21.63	1.78	21.49	1.95	20.43	1.66
PALMITOLEIC (C16:1)	3.40	0.50	3.26	0.56	3.41	0.56	3.51	0.57	3.29	0.48	2.95	0.55	2.29	0.46	2.49	0.54	2.28	0.35	2.34	0.54	2.35	0.44	2.38	0.52
MARGARIC (C17:0)	0.43	0.12	0.50	0.25	0.46	0.21	0.47	0.22	0.43	0.13	0.52	0.16	0.29	0.16	0.21	0.06	0.26	0.09	0.23	0.10	0.27	0.09	0.25	0.09
HEPTADECENOIC (C17:1)	0.54	0.15	0.51	0.10	0.59	0.23	0.55	0.08	0.52	0.17	0.66	0.20	0.27	0.13	0.23	0.07	0.32	0.11	0.28	0.11	0.29	0.09	0.32	0.15
STEARIC (C18:0)	9.21	1.77	9.71	2.05	8.48	1.23	8.87	1.54	9.57	2.10	9.44	2.03	8.51	1.51	8.43	2.19	7.71	1.44	7.97	1.72	8.63	2.31	7.07	1.13
ELAIDIC (C18:1)	0.41	0.33	0.49	0.27	0.41	0.35	0.44	0.36	0.46	0.28	0.69	0.25	0.17	0.14	0.11	0.10	0.16	0.10	0.13	0.13	0.15	0.16	0.13	0.12
OLEIC(C18:1)	42.22	3.32	43.07	2.81	44.19	2.43	43.08	1.81	43.66	3.65	43.40	2.35	36.93	2.04	36.88	3.06	36.76	2.88	36.02	2.96	38.91	4.79	36.74	3.17
LINOLEIC (C18:2n-6)	0.09	0.05	0.07	0.02	0.13	0.18	0.09	0.02	0.12	0.10	0.20	0.32	0.05	0.07	0.03	0.08	0.08	0.16	0.03	0.06	0.02	0.02	0.02	0.03
LINOLEIC (C18:2-trans-10)	12.91	4.65	12.11	2.25	13.36	2.69	13.20	1.54	12.78	1.02	14.26	1.99	24.66	2.25	24.09	2.91	26.01	2.52	26.71	3.85	22.89	7.01	27.67	3.19
ARACHIDIC (C20:0)	0.12	0.03	0.13	0.04	0.10	0.04	0.13	0.06	0.12	0.06	0.18	0.39	0.13	0.05	0.14	0.05	0.12	0.04	0.11	0.04	0.15	0.06	0.11	0.07
γ-LINOLENIC (C18:3)	0.03	0.03	0.03	0.02	0.04	0.03	0.05	0.02	0.03	0.03	0.03	0.03	0.05	0.03	0.05	0.03	0.05	0.03	0.06	0.04	0.08	0.10	0.07	0.05
GONDOIC (C20:1)	0.62	0.11	0.63	0.14	0.58	0.19	0.58	0.11	0.56	0.17	0.64	0.17	0.58	0.08	0.54	0.17	0.58	0.18	0.48	0.18	0.61	0.21	0.50	0.12
α-LINOLENIC (C18:3)	0.70	0.16	0.66	0.20	0.66	0.18	0.75	0.09	0.66	0.23	0.76	0.13	0.68	0.08	0.66	0.12	0.71	0.11	0.67	0.27	0.60	0.29	0.75	0.10
HENEICOSYLIC (C21:0)	0.38	0.13	0.43	0.07	0.40	0.16	0.45	0.04	0.46	0.14	0.43	0.08	0.08	0.04	0.10	0.05	0.10	0.04	0.11	0.07	0.10	0.10	0.10	0.07
EICOSADIENOIC (C20:2)	0.06	0.06	0.04	0.03	0.07	0.04	0.06	0.04	0.05	0.03	0.05	0.06	0.04	0.06	0.01	0.01	0.08	0.18	0.02	0.03	0.02	0.03	0.03	0.02
BEHENIC (C22:0)	0.47	0.24	0.36	0.10	0.41	0.17	0.43	0.19	0.38	0.11	0.49	0.15	0.86	0.11	0.75	0.16	0.87	0.33	0.77	0.26	0.75	0.21	0.87	0.18
DIHOMO-γ-LINOLENIC (C20:3)	0.08	0.06	0.06	0.03	0.07	0.05	0.09	0.03	0.06	0.04	0.09	0.12	0.09	0.04	0.08	0.05	0.07	0.04	0.11	0.06	0.10	0.06	0.11	0.07
EICOSATRIENOIC (20:3)	0.05	0.03	0.05	0.03	0.06	0.04	0.07	0.02	0.05	0.04	0.05	0.04	0.06	0.06	0.04	0.03	0.05	0.03	0.04	0.04	0.05	0.03	0.04	0.03
ARACHIDONIC (C20:4)	0.23	0.12	0.22	0.05	0.32	0.27	0.27	0.08	0.25	0.08	0.29	0.28	0.22	0.12	0.27	0.06	0.37	0.13	0.28	0.09	0.28	0.15	0.46	0.40
IV	65.93	6.88	65.02	4.77	68.70	4.08	67.67	2.36	66.83	3.95	69.70	4.16	80.34	4.00	79.37	5.21	83.16	2.97	83.24	5.43	79.02	9.98	86.30	4.52
SFA	46.72	3.75	47.51	2.90	48.65	2.52	47.68	2.12	48.03	3.61	47.73	2.31	39.98	2.20	40.03	3.26	39.80	2.90	38.99	3.41	42.06	5.21	39.76	3.48
MUFA	14.14	4.86	13.25	2.45	14.71	2.65	14.58	1.66	14.01	1.23	15.74	2.19	25.84	2.36	25.22	3.07	27.43	2.66	27.94	3.89	24.03	7.48	29.14	3.53
PUFA	3.69	1.60	3.70	0.68	3.40	0.57	3.32	0.51	3.46	0.44	3.09	0.44	1.56	0.18	1.62	0.28	1.47	0.24	1.44	0.35	2.11	1.31	1.39	0.25

Table 7. Least squares means for the effects of saturation level, RAC inclusion, sex, season, and market pull on the fatty acid profile of backfat fat samples

Item	Saturation level			RAC			Sex			Season			Pull				*P-value*				
	High	Low	SEM	RAC	No RAC	SEM	B	G	SEM	Sum	Win	SEM	1	2	3	SEM	Fat	RAC	Sex	Season	Pull
Myristic acid (14:0)	1.62	2.13	0.01	1.87	1.89	0.02	1.91	1.84	0.02	1.94	1.81	0.02	1.88^{ab}	1.83^{a}	1.91^{b}	0.02	0.01	0.38	0.01	0.01	0.04
Palmitic acid (16:0)	20.91	24.03	0.11	22.56	22.38	0.10	22.92	22.02	0.11	22.62	22.31	0.10	22.92^{a}	22.51^{a}	21.97^{b}	0.13	0.01	0.26	0.01	0.05	0.01
Palmitoleic acid (16:1 cis-9)	1.99	3.05	0.29	2.53	2.50	0.29	2.56	2.48	0.29	2.49	2.55	0.29	2.60^{a}	2.50^{ab}	2.46^{b}	0.35	0.01	0.48	0.04	0.13	0.02
Stearic acid (18:0)	7.34	9.05	0.08	8.21	8.18	0.08	8.37	8.02	0.08	8.41	7.99	0.08	8.45^{a}	8.32^{a}	7.82^{b}	0.1	0.01	0.83	0.01	0.01	0.01
Elaidic acid (18:1 trans -9)	0.18	0.76	0.02	0.46	0.47	0.02	0.45	0.49	0.02	0.52	0.41	0.02	0.46	0.44	0.50	0.02	0.01	0.56	0.08	0.01	0.13
Oleic acid (18:1 cis-9)	33.33	40.89	0.14	37.20	37.02	0.14	37.37	36.85	0.14	35.83	38.39	0.14	37.22^{a}	37.3 9^{a}	36.73^{b}	0.17	0.01	0.37	0.01	0.01	0.02
Linoleic acid (18:2 cis-9, cis-12)	30.95	15.59	0.22	23.14	23.39	0.22	22.41	24.12	0.22	24.08	22.45	0.22	22.40^{a}	23.03^{a}	24.37^{b}	0.27	0.01	0.44	0.01	0.01	0.01
α-Linolenic acid (18:3 cis-9, cis-12, cis-15)	0.41	0.51	0.01	0.45	0.47	0.01	0.48	0.44	0.01	0.44	0.48	0.01	0.83^{a}	0.83^{a}	0.88^{b}	0.01	0.01	0.01	0.01	0.01	0.01
Eicosenoic acid (20:1 cis-11)	0.86	0.83	0.01	0.83	0.86	0.01	0.82	0.88	0.01	0.87	0.82	0.01	0.47^{a}	0.47^{a}	0.44^{b}	0.01	0.01	0.08	0.01	0.01	0.01
Monounsaturates (MUFA)[1]	35.92	45.27	0.16	40.68	40.50	0.16	40.89	40.29	0.16	39.32	41.86	0.16	40.79^{a}	40.83^{a}	40.16^{b}	0.19	0.01	0.42	0.01	0.01	0.02
Polyunsaturates (PUFA)[2]	32.41	17.00	0.23	24.56	24.85	0.23	23.80	25.62	0.23	25.56	23.85	0.23	23.80^{a}	24.44^{a}	25.88^{b}	0.28	0.01	0.39	0.01	0.01	0.01
Saturates (SFA)[3]	31.31	36.55	0.17	34.02	33.85	0.17	34.60	33.27	0.17	34.39	33.48	0.17	34.64^{a}	34.04^{a}	33.12^{a}	0.21	0.01	0.49	0.01	0.01	0.01
MUFA/PUFA, ratio	1.15	2.74	0.03	1.95	1.93	0.03	2.02	1.87	0.03	1.83	2.06	0.03	2.00^{ab}	2.00^{a}	1.83^{a}	0.03	0.01	0.63	0.01	0.01	0.01
U/S, ratio	2.21	1.72	0.02	1.96	1.97	0.02	1.90	2.02	0.02	1.92	2.00	0.02	1.90^{a}	1.95^{a}	2.04^{b}	0.02	0.01	0.58	0.01	0.01	0.01
Iodine Value[4]	88.60	69.81	0.34	79.02	79.38	0.34	77.83	80.57	0.34	79.64	78.77	0.34	77.77^{a}	78.81^{a}	80.93^{b}	0.41	0.01	0.46	0.01	0.07	0.01

^{a,b,c,d}Means within a row with different superscripts are different ($P \leq 0.05$)

[11]MUFA: total mono-unsaturated fatty acid = C14:1 + C16:1 + C17:1 + C18:1 + C20:1 + C22:1.

[2]PUFA: total poly-unsaturated fatty acid = C18:2 + C18:3 + C20:2 + C20:3 + C20:4 + C20:3 + C22:4.

[3]SFA: total saturated fatty acid = C10:0 + C12:0 + C14:0 + C15:0 + C16:0 + C17:0 + C18:0 + C20:0 + C22:0. 10

[4]Iodine value calculated from fatty acid composition: (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 concentration (AOCS, 1998).

Table 8. Least squares means for the effects of saturation level, RAC inclusion, sex, season, and market pull on the fatty acid profile of belly fat samples

	Saturation level			RAC			Sex			Season			Pull				*P-value*				
Item	High	Low	SEM	RAC	No RAC	SEM	B	G	SEM	Sum	Win	SEM	1	2	3	SEM	Fat	RAC	Sex	Season	Pull
Myristic acid (14:0)	1.74	2.13	0.02	1.92	1.95	0.02	1.97	1.90	0.02	2.05	1.82	0.02	1.92 [ab]	1.90 [a]	1.99 [b]	0.03	0.01	0.19	0.01	0.01	0.02
Palmitic acid (16:0)	21.54	24.02	0.11	22.80	22.76	0.11	23.10	22.46	0.11	22.72	22.84	0.11	23.12 [a]	22.91 [a]	22.32 [b]	0.13	0.01	0.80	0.00	0.44	0.01
Palmitoleic acid (16:1 cis-9)	2.49	3.44	0.04	2.98	2.95	0.04	2.98	2.95	0.04	3.09	2.83	0.04	2.98	2.96	2.95	0.05	0.01	0.49	0.54	0.01	0.86
Stearic acid (18:0)	7.64	8.87	0.10	8.25	8.26	0.10	8.34	8.17	0.10	7.95	8.55	0.1	8.25 [ab]	8.48 [a]	8.04 [b]	0.12	0.01	0.93	0.22	0.01	0.03
Elaidic acid (18:1 trans -9)	0.15	0.59	0.01	0.37	0.37	0.01	0.36	0.38	0.10	0.43	0.31	0.01	0.34 [a]	0.34 [a]	0.43 [b]	0.02	0.01	0.97	0.35	0.01	0.01
Oleic acid (18:1 cis-9)	36.14	42.54	0.19	39.36	39.31	0.19	39.25	39.43	0.19	3.51	40.17	0.19	39.07	39.64	39.30	0.23	0.01	0.84	0.49	0.01	0.20
Linoleic acid (18:2 cis-9, cis-12	26.50	13.95	0.24	20.23	20.22	0.24	19.92	20.52	0.24	21.25	19.20	0.24	20.26 [ab]	19.68 [a]	20.73 [b]	0.29	0.01	0.96	0.08	0.01	0.04
α-Linolenic acid (18:3 cis-9, cis-12, cis-15)	0.50	0.56	0.01	0.51	0.54	0.01	0.55	0.51	0.01	0.48	0.58	0.01	0.74	0.73	0.76	0.01	0.42	0.33	0.06	0.01	0.12
Eicosenoic acid (20:1 cis-11)	0.75	0.74	0.01	0.74	0.75	0.01	0.73	0.76	0.01	0.80	0.69	0.01	0.52	0.53	0.53	0.01	0.01	0.02	0.01	0.01	0.77
Monounsaturates (MUFA)[1]	39.29	47.17	0.20	43.27	43.21	0.20	43.17	43.30	0.20	42.55	43.93	0.2	42.96	43.51	43.24	0.25	0.01	0.84	0.65	0.01	0.29
Polyunsaturates (PUFA) [2]	27.86	15.30	0.25	21.57	21.58	0.25	21.24	21.92	0.25	22.68	20.48	0.25	21.61 [ab]	20.96 [a]	22.16 [b]	0.30	0.01	0.98	0.05	0.01	0.02
Saturates (SFA) [3]	32.39	36.36	0.18	34.35	34.39	0.18	34.81	33.94	0.18	34.07	34.67	0.18	34.60 [a]	34.72 [a]	33.79 [b]	0.22	0.01	0.88	0.01	0.02	0.01
MUFA/PUFA, ratio	1.49	3.17	0.04	2.34	2.32	0.04	2.36	2.30	0.04	2.16	2.50	0.04	2.28 [a]	2.45 [b]	2.26 [a]	0.05	0.01	0.77	0.27	0.01	0.01
UFA/SFA	2.09	1.73	0.02	1.92	1.91	0.02	1.88	1.95	0.02	1.94	1.89	0.02	1.89 [a]	1.89 [a]	1.96 [b]	0.02	0.01	0.82	0.01	0.03	0.01
Iodine Value[4]	83.53	68.47	0.35	76.02	75.98	0.35	75.31	76.69	0.35	77.42	74.57	0.35	75.80[ab]	75.11 [a]	77.09 [b]	0.42	0.01	0.93	0.01	0.01	0.01

[a,b,c] Means within a row with different superscripts are different ($P \leq 0.05$)

[1]MUFA: total mono-unsaturated fatty acid = C14:1 + C16:1 + C17:1 + C18:1 + C20:1 + C22:1.

[2]PUFA: total poly-unsaturated fatty acid = C18:2 + C18:3 + C20:2 + C20:3 + C20:4 + C20:3 + C22:4.

[3]SFA: total saturated fatty acid = C10:0 + C12:0 + C14:0 + C15:0 + C16:0 + C17:0 + C18:0 + C20:0 + C22:0. 10

[4]Iodine value calculated from fatty acid composition: (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 concentration (AOCS, 1998).

Table 9. Effects of dietary saturation level and RAC inclusion on fatty acid composition and iodine value of backfat fat samples

	Treatments							
Fat Source	Corn oil		Tallow					
RAC inclusion	No RAC	RAC	No RAC	RAC	SEM	*P-value*	Corn oil vs Tallow	RAC vs No RAC
Myristic acid (14:0), %	1.61 a	1.64 a	2.12 b	2.14 b	0.03	0.01	0.01	0.35
Palmitic acid (16:0), %	20.99 a	20.83 a	24.17 b	23.93 b	0.16	0.01	0.01	0.22
Palmitoleic acid (16:1 cis-9), %	1.97 a	2.01	3.10 b	3.00 b	0.04	0.01	0.01	0.41
Stearic acid (18:0), %	7.43 a	7.25 a	9.01 b	9.10 b	0.12	0.01	0.01	0.73
Elaidic acid (18:1 trans -9), %	0.17 a	0.18 a	0.75 b	0.77 b	0.02	0.01	0.01	0.51
Oleic acid (18:1 cis-9), %	33.38 a	33.3 a	41.08 b	40.71 b	0.23	0.01	0.01	0.35
Linoleic acid (18:2 cis-9, cis-12), %	30.89 a	31.0 a	15.29 b	15.82 b	0.34	0.01	0.01	0.34
α-Linolenic acid (18:3 cis-9, cis-12, cis-15)	0.85 ab	0.88 a	0.81 b	0.85 ab	0.01	0.01	0.01	0.01
Eicosenoic acid (20:1 cis-11)	0.41 a	0.41 a	0.50 b	0.51 b	0.01	0.01	0.01	0.15
Monounsaturates (MUFA)[1]	35.94 a	35.92 a	45.49 b	45.06 b	0.26	0.01	0.01	0.38
Polyunsaturates (PUFA)[2]	32.32 a	32.48 a	16.68 b	17.25 b	0.36	0.01	0.01	0.31
Saturates (SFA)[3]	31.47 a	31.16 a	36.64 b	36.52 b	0.27	0.01	0.01	0.42
MUFA/PUFA, ratio	1.14 a	1.17 a	2.78 b	2.7 b	0.04	0.01	0.01	0.50
U/S, ratio	2.20 a	2.22 a	1.71 b	1.72 b	0.02	0.01	0.01	0.51
Iodine Value[4]	88.45a	88.74 a	69.43 b	70.07 b	0.51	0.01	0.01	0.36

[a,b,c] Means within a row with different superscripts are different ($P \leq 0.05$)

[1]MUFA: total mono-unsaturated fatty acid = C14:1 + C16:1 + C17:1 + C18:1 + C20:1 + C22:1.

[2]PUFA: total poly-unsaturated fatty acid = C18:2 + C18:3 + C20:2 + C20:3 + C20:4 + C20:3 + C22:4.

[3]SFA: total saturated fatty acid = C10:0 + C12:0 + C14:0 + C15:0 + C16:0 + C17:0 + C18:0 + C20:0 + C22:0. 10

[4]Iodine value calculated from fatty acid composition: (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 concentration (AOCS, 1998).

Table 10. Effects of dietary saturation level and RAC inclusion on fatty acid composition and iodine value of belly fat samples

Fat Source	Corn oil		Tallow				Corn oil vs Tallow	RAC vs No RAC
RAC inclusion	No RAC	RAC	No RAC	RAC	SEM	*P-value*		
Myristic acid (14:0), %	1.71[a]	1.78[a]	2.12[b]	2.14[b]	0.03	0.01	0.01	0.16
Palmitic acid (16:0), %	21.45[a]	21.64[a]	24.19[b]	23.86[b]	0.16	0.01	0.01	0.68
Palmitoleic acid (16:1 cis-9), %	2.48[a]	2.5[a]	3.78[b]	3.4[b]	0.05	0.01	0.01	0.54
Stearic acid (18:0), %	7.62[a]	7.67[a]	8.9[b]	8.83[b]	0.14	0.01	0.01	0.96
Elaidic acid (18:1 trans -9), %	0.15[a]	0.15[a]	0.58[b]	0.59[b]	0.02	0.01	0.01	0.85
Oleic acid (18:1 cis-9), %	35.98[a]	36.3[a]	42.78[b]	42.3[b]	0.27	0.01	0.01	0.78
Linoleic acid (18:2 cis-9, cis-12), %	26.88[a]	26.07[a]	13.5[b]	14.39	0.34	0.01	0.01	0.91
α-Linolenic acid (18:3 cis-9, cis-12, cis-15)	0.75	0.74	0.71	0.76	0.01	0.02	0.44	0.28
Eicosenoic acid (20:1 cis-11)	0.48[a]	0.51[ab]	0.54[bc]	0.58[c]	0.01	0.01	0.01	0.03
Monounsaturates (MUFA)[1]	39.11[a]	39.48[a]	47.45[b]	46.92[b]	0.3	0.01	0.01	0.79
Polyunsaturates (PUFA)[2]	28.26[a]	27.42	14.8[b]	15.78	0.37	0.01	0.01	0.85
Saturates (SFA)[3]	31.2[a]	32.61	36.57[b]	36.16[b]	0.26	0.01	0.01	0.99
MUFA/PUFA, ratio	1.42[a]	1.57	3.27[b]	3.07[b]	0.05	0.01	0.01	0.66
U/S, ratio	2.11[a]	2.07[a]	1.72[b]	1.75[b]	0.02	0.01	0.01	0.93
Iodine Value[4]	84.09[a]	82.91[a]	67.81[b]	69.1	0.51	0.01	0.01	0.91

[a,b,c] Means within a row with different superscripts are different ($P \leq 0.05$)

[1]MUFA: total mono-unsaturated fatty acid = C14:1 + C16:1 + C17:1 + C18:1 + C20:1 + C22:1.

[2]PUFA: total poly-unsaturated fatty acid = C18:2 + C18:3 + C20:2 + C20:3 + C20:4 + C20:3 + C22:4.

[3]SFA: total saturated fatty acid = C10:0 + C12:0 + C14:0 + C15:0 + C16:0 + C17:0 + C18:0 + C20:0 + C22:0. 10

[4]Iodine value calculated from fatty acid composition: (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 concentration (AOCS, 1998).

Table 11. Effects of dietary saturation level and sex on fatty acid composition and iodine value of backfat fat samples

	Treatments							
Saturation Level	Corn oil		Beef Tallow			*P-values*		
Sex	Barrow	Gilt	Barrow	Gilt	SEM	Sat level	Sex	Sat x Sex
Myristic acid (14:0), %	1.67 [a]	1.58 [a]	2.16 [b]	2.11 [b]	0.02	0.01	0.01	0.4
Palmitic acid (16:0), %	21.53 [a]	20.28 [b]	24.26 [c]	23.83 [c]	0.16	0.01	0.01	0.01
Palmitoleic acid (16:1 cis-9), %	2.02 [a]	1.94 [a]	3.08 [b]	3.01 [b]	0.04	0.01	0.05	0.87
Stearic acid (18:0), %	7.66 [a]	7.03 [b]	9.08 [c]	9.05 [c]	0.12	0.01	0.01	0.01
Elaidic acid (18:1 trans -9), %	0.16 [a]	0.2 [a]	0.74 [b]	0.77 [b]	0.02	0.01	0.15	0.97
Oleic acid (18:1 cis-9), %	33.71 [a]	32.95 [b]	41.05 [c]	40.72 [c]	0.23	0.01	0.02	0.49
Linoleic acid (18:2 cis-9, cis-12), %	29.72 [a]	32.18 [b]	15.16 [c]	16.01 [c]	0.32	0.1	0.01	0.01
α-Linolenic acid (18:3 cis-9, cis-12, cis-15)	0.82 [a]	0.9 [b]	0.81 [c]	0.86 [bc]	0.01	0.01	0.01	0.15
Eicosenoic acid (20:1 cis-11)	0.43 [a]	0.39 [b]	0.53 [c]	0.49 [d]	0.01	0.01	0.01	0.99
Monounsaturates (MUFA)[1]	36.31 [a]	35.53 [b]	45.46 [c]	45.01 [c]	0.25	0.01	0.01	0.5
Polyunsaturates (PUFA) [2]	31.12 [a]	33.71 [a]	16.54 [c]	17.44 [c]	0.34	0.01	0.01	0.01
Saturates (SFA) [3]	32.31 [a]	30.31 [b]	36.83 [c]	36.34 [c]	0.25	0.01	0.01	0.01
MUFA/PUFA, ratio	1.2 [a]	1.1 [a]	2.82 [b]	2.64 [c]	0.04	0.01	0.01	0.29
U/S, ratio	2.11 [a]	2.31 [b]	1.70 [c]	1.73 [c]	0.02	0.01	0.01	0.01
Iodine Value[4]	86.63[a]	90.58 [b]	69.15 [c]	70.4 [c]	0.49	0.01	0.01	0.01

[a,b,c] Means within a row with different superscripts are different ($P \leq 0.05$)

[1]MUFA: total mono-unsaturated fatty acid = C14:1 + C16:1 + C17:1 + C18:1 + C20:1 + C22:1.

[2]PUFA: total poly-unsaturated fatty acid = C18:2 + C18:3 + C20:2 + C20:3 + C20:4 + C20:3 + C22:4.

[3]SFA: total saturated fatty acid = C10:0 + C12:0 + C14:0 + C15:0 + C16:0 + C17:0 + C18:0 + C20:0 + C22:0. 10

[4]Iodine value calculated from fatty acid composition: (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 concentration (AOCS, 1998).

Table 12. Effects of dietary saturation level and sex on fatty acid composition and iodine value of belly fat samples

	Treatments							
Saturation Level	Corn oil		Beef Tallow			*P-values*		
Sex	Barrow	Gilt	Barrow	Gilt	SEM	Sat. level	Sex	Sat x Sex
Myristic acid (14:0), %	1.79 [a]	1.69 [a]	2.16 [b]	2.10 [b]	0.03	0.01	0.01	0.55
Palmitic acid (16:0), %	21.81 [a]	21.26 [a]	24.36 [b]	23.65[c]	0.16	0.01	0.01	0.62
Palmitoleic acid (16:1 cis-9), %	2.52 [a]	2.46 [a]	3.44 [b]	3.43 [b]	0.05	0.01	0.48	0.65
Stearic acid (18:0), %	7.75 [a]	7.53 [a]	8.9 [b]	8.83 [b]	0.14	0.01	0.33	0.58
Elaidic acid (18:1 trans -9), %	0.15 [a]	0.15 [a]	0.57 [b]	0.61 [b]	0.02	0.01	0.39	0.51
Oleic acid (18:1 cis-9), %	35.97 [a]	36.3 [a]	42.48 [b]	42.6 [b]	0.27	0.01	0.41	0.71
Linoleic acid (18:2 cis-9, cis-12), %	26.26 [a]	26.74 [a]	13.67 [b]	14.24 [b]	0.35	0.01	0.14	0.9
α-Linolenic acid (18:3 cis-9, cis-12, cis-15)	0.75 [ab]	0.74 [ab]	0.71 [a]	0.76 [b]	0.01	0.48	0.13	0.06
Eicosenoic acid (20:1 cis-11)	0.51 [ac]	0.48 [b]	0.58 [c]	0.54 [bc]	0.01	0.01	0.01	0.52
Monounsaturates (MUFA)[1]	39.17 [a]	39.42 [a]	47.14 [b]	47.24 [b]	0.3	0.01	0.56	0.8
Polyunsaturates (PUFA) [2]	27.59 [a]	28.13 [a]	14.98 [b]	15.64 [b]	0.37	0.01	0.11	0.86
Saturates (SFA) [3]	32.82 [a]	31.96 [a]	36.75 [b]	35.93 [b]	0.26	0.01	0.01	0.93
MUFA/PUFA, ratio	1.46 [a]	1.53 [a]	3.25 [b]	3.09 [c]	0.05	0.01	0.42	0.04
U/S, ratio	2.05 [a]	2.14 [a]	1.71 [b]	1.76 [b]	0.02	0.01	0.01	0.51
Iodine Value[4]	82.92 [a]	84.15 [a]	67.84 [b]	69.14 [b]	0.51	0.01	0.01	0.92

[a,b,c,d] Means within a row with different superscripts are different ($P \leq 0.05$)

1MUFA: total mono-unsaturated fatty acid = C14:1 + C16:1 + C17:1 + C18:1 + C20:1 + C22:1.

2PUFA: total poly-unsaturated fatty acid = C18:2 + C18:3 + C20:2 + C20:3 + C20:4 + C20:3 + C22:4.

3SFA: total saturated fatty acid = C10:0 + C12:0 + C14:0 + C15:0 + C16:0 + C17:0 + C18:0 + C20:0 + C22:0. 10

4Iodine value calculated from fatty acid composition: (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 concentration (AOCS, 1998).

Table 13. Backfat-IV Prediction

Individual		R^2	Adj R^2	RMSE
IVP	= 47.71 + (0.39 x Diet IVP)	0.74	0.74	5.51
C18:2	= 60.62 (6.21 x Diet Linoleic)	0.75	0.75	5.48
IVP RAC Sex Season Pull	= 44.58 + (0.39 x Diet IVP) + (1.58 x RAC) – (2.69 x Sex) + (.865 x Season) + (1.58 x Pull)	0.78	0.78	5.13
IVP RAC Pull BF	= 52.74 + (0.39 x IVP) + (1.37 x RAC) + (1.49 + Pull) – (10.37 x BF)	0.80	0.80	4.87
Pen				
IVP	= 47.78 + (0.38 x Diet IVP)	0.90	0.90	3.19
C18:2	= 60.68 + (6.20 x Diet Linoleic)	0.90	0.90	3.14
IVP RAC Sex Season Pull	= 44.52 + (0.39 x Diet IVP) + (1.61 x RAC) – (2.77 x Sex) + (1.03 x Season) + (1.63 x Pull)	0.94	0.94	2.40
IVP RAC Sex Pull BF	= 50.36 + (0.39 x IVP) + (1.50 x RAC) – (1.41 x Sex) + (1.54 + Pull) – (6.92 x BF)	0.95	0.94	2.48

Table 14. Belly-IV Prediction

Individual		R^2	Adj R^2	RMSE
IVP	= 50.79 + (0.31 x Diet IVP)	0.66	0.66	5.41
C18:2	= 61.14 + (4.97 x Diet Linoleic)	0.66	0.66	5.40
IVP RAC Sex Season Pull	= 48.14 + (0.31 x IVP) – (1.34 x Sex) + (0.94*RAC) + (2.88 x Season) + (0.66 x Pull)	0.70	0.69	5.14
IVP FFLP ADG	= 38.45 + (0.31 x IVP) + (0.45 x FFLP) – (2.97 x ADG)	0.72	0.72	4.90
Pen				
IVP	= 50.84 +(0.31 x Diet IVP)	0.86	0.86	3.06
C18:2	= 61.18 + (4.97 x Diet Linoleic)	0.86	0.86	3.04
IVP RAC Sex Season Pull	= 48.31+ (0.31 x IVP) + (0.98 x RAC) – (1.31 x Sex) + (2.70 x Season) + (0.61 x Pull)	0.90	0.90	2.61
IVP RAC FFLP ADG	= 35.90 + (0.31 x IVP) + (1.03 x RAC) + (0.48 x FFLP) – (3.74 x ADG)	0.92	0.92	2.35

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