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Generating equations using meta-analyses to predict iodine value of pork carcass back, belly, and jowl fat

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Generating Equations Using Meta-Analyses to Predict Iodine Value of Pork Carcass Back, Belly, and Jowl Fat[1]

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Summary

Meta-analyses used data from existing literature to generate equations to predict finishing pig back, belly, and jowl fat iodine value (IV) followed by a prospective study to validate these equations. The final database included 24, 21, and 29 papers for back, belly, and jowl fat IV, respectively. For experiments that changed dietary fatty acid composition, initial diets (INT) were defined as those fed before the change in diet composition and final diets (FIN) were those fed after. The predictor variables tested were divided into 5 groups: (1) diet fat composition (dietary % C16:1, C18:1, C18:2, C18:3, essential fatty acid [EFA], UFA, and iodine value product) for both INT and FIN diets; (2) duration of feeding the INT and FIN diets; (3) ME or NE of the INT and FIN diet; (4) performance criteria (initial BW, final BW, ADG, ADFI, and G:F); and (5) carcass criteria (HCW and backfat thickness). PROC MIXED in SAS (SAS Institute, Inc., Cary, NC) was used to develop regression equations. Evaluation of models with significant terms was then conducted based on the Bayesian Information Criterion (BIC). The optimum equations to predict back, belly, and jowl fat IV were:

backfat IV =84.83 + (6.87*INT EFA) - (3.90*FIN EFA) - (0.12*INT d) - (1.30*FIN d) - (0.11*INT EFA*FIN d) + (0.048*FIN EFA*INT d) + (0.12*FIN EFA*FIN d) - (0.0132*FIN NE) + (0.0011*FIN NE*FIN d) - (6.604*BF);

belly fat IV = 106.16 + (6.21*INT EFA) - (1.50*FIN d) - (0.11*INT EFA*FIN d) - (0.0265*INT NE) + (0.00152*INT NE*FIN d) - (0.0816*HCW) - (6.35*BF); and

jowl fat IV = 85.50 + (1.08*INT EFA) + (0.87*FIN EFA) - (0.014*INT d) - (0.050*FIN d) + (0.038*INT EFA*INT d) + (0.054*FIN EFA*FIN d) - (0.0146*INT NE) + (0.0322*INT BW) - (0.993*ADFI) - (7.366*BF),

where INT EFA = initial period dietary essential fatty acids, %; FIN EFA = final period dietary essential fatty acids, %; INT d = initial period days; FIN d=final period days; INT NE = initial period dietary net energy, kcal/lb; FIN NE = final period dietary net energy, kcal/lb; BF = backfat depth, in.; ADFI = average daily feed intake, lb; INT BW = BW at the beginning of the experiment, lb.

[1] Appreciation is expressed to the National Pork Board for providing partial financial support for this experiment.

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Dietary treatments from the validation experiment (see "Influence of Dietary Fat Source and Feeding Duration on Pig Growth Performance, Carcass Composition, and Fat Quality," p. 210) consisted of a corn-soybean meal control diet with no added fat or a 3 × 3 factorial arrangement with main effects of fat source (4% tallow, 4% soybean oil, or a blend of 2% tallow and 2% soybean oil) and feeding duration (d 0 to 42, 42 to 84, or 0 to 84). The back, belly, and jowl fat IV equations tended to overestimate IV when actual IV values were less than approximately 65 g/100 g and underestimate belly fat IV when actual IV values were greater than approximately 74 g/100 g or when the blend or soybean oil diets were fed from d 42 to 84. Overall, with the exceptions noted, the regression equations were an accurate tool for predicting carcass fat quality based on dietary and pig performance factors.

Key words: iodine value, meta-analysis, pork quality

Introduction

In the last decade, the pork industry has placed considerable importance on pork fat quality. Iodine value (IV), a measure of fatty acid unsaturation, is one method used by pork processors to assess pork fat quality. Increases in fatty acid unsaturation or IV are associated with negative effects on pork fat quality. This can lead to problems with belly slicing efficiency, fat smearing, and reduced shelf life because of oxidative rancidity (NRC, 2012[3]).

Several swine packers impose penalties on carcasses that possess carcass fat IV above certain thresholds. Carcass fat composition of monogastric animals, particularly pigs, is directly related to the fatty acid composition of the diet (Madsen et al., 1992[4]). Thus, feeding ingredients with high amounts of dietary unsaturated fatty acids will increase carcass fat IV. Examples of these ingredients include dried distillers grains with solubles (DDGS), bakery meal, or added fats such as animal-vegetable blends, choice white grease, or soybean oil. Increased use of these ingredients in swine diets has led to concerns by pork processors related to the associated negative impacts on carcass fat quality correlated with high carcass fat IV values.

Carcass fat IV varies among the three important fat depots (back, belly, and jowl), and the IV of these depots show differential responses to the fatty acid composition of dietary feedstuffs (Benz et al., 2010[5]). Although many studies have been conducted to measure carcass fat IV based on different levels of dietary fatty acid composition, accurately predicting final carcass fat IV of the various fat depots is challenging for producers and processors. Therefore, the objective of this study was to conduct a meta-analysis of existing literature to generate predictive equations for back, belly, and jowl fat IV of finishing pigs. A prospective study was also conducted to validate the developed equations.

[3] NRC. 2012. Nutrient Requirements of Swine. 11th ed. Natl. Acad. Press, Washington, DC.

[4] Madsen, A., K. Jacobsen, and H.P. Mortensen. 1992. Influence of dietary fat on carcass fat quality in pigs. A review. Acta. Agric. Scand. 42:220–225.

[5] Benz, J.M., S.K. Linneen, M.D. Tokach, S.S. Dritz, J.L. Nelssen, J.M. DeRouchey, R.D. Goodband, R.C. Sulabo, and K.J. Prusa. 2010. Effects of dried distillers grains with solubles on carcass fat quality of finishing pigs. J. Anim. Sci. 88:3666–3682.

Procedures

The term *meta-analysis* is defined as the quantitative summarization of past research. A literature review was conducted to compile studies that examined the effects of dietary fatty acids and dietary energy on variables associated with growth and carcass characteristics and back, belly, and jowl fat IV. The literature search was conducted via the Kansas State University Libraries, using the CABI search engine and the keywords "iodine value and pig" or "iodine value and swine." Data were derived from both refereed and non-refereed publications, including theses, technical memos, and university publications. The final database resulted in publication dates from 2002 to 2013.

To be included in the final database, experiments had to meet the following criteria: (1) pigs used in experiments had ad libitum access to feed and water; (2) gender of the pigs was classified as either barrows, gilts, mixed gender, or immunocastrate barrows; (3) the percentage of dietary ingredients fed throughout the experiment was adequately defined; (4) the pigs were fed diets without added conjugated linoleic acid; (5) the experiments provided information including duration of the feeding period, initial BW, final BW, ADG, ADFI, G:F, HCW, and backfat depth. The initial screen yielded 46 publications. Papers were eliminated from the analysis because pigs were not allowed ad libitum access to food and water (1 paper), dietary conjugated linoleic acid was fed (2 papers and 3 treatments from 1 paper), carcass criteria were not included (4 papers), and growth criteria were not reported (5 papers). The final database resulted in 24 papers with 169 observations for backfat IV, 21 papers with 124 observations for belly fat IV, and 29 papers with 197 observations for jowl fat IV. In all papers, back, belly, or jowl fat IV was determined by either fatty acid analysis (NRC, 2012) or near-infrared analysis (Zamora-Rojas et al., 2013[6]).

The dietary composition of experimental diets was used to calculate percentage dietary C16:1, C18:1, C18:2, and C18:3 fatty acids, essential fatty acid (EFA; sum of C18:2 and C18:3), total UFA), dietary iodine value product (IVP), and dietary ME (kcal/lb) and NE (kcal/lb) concentrations. Reported individual fatty acid percentages from analyzed ingredients or complete diets were calculated as a percentage of total fatty acids. When analyzed values were not reported, fatty acids, as a percentage of total fatty acids, were obtained from Sauvant et al. (2004[7]) or from the U.S. Department of Agriculture (2010[8]). The fatty acid profile of corn oil from Sauvant et al. (2004) was used for DDGS. Dietary fatty acid concentrations were calculated by multiplying the percentage of each fatty acid by the reported analyzed ether extract of the ingredient or diet. If ether extract was not reported, it was derived from the NRC (2012). Iodine value was calculated using the following equation (NRC, 2012): Total IV = % C16:1 (0.9502) + % C18:1 (0.8598) + % C18:2 (1.7315) + % C18:3 (2.6152) + % C20:4 (3.2008) + % C20:5 (4.0265) + % C22:1 (0.7225) + % C22:5 (3.6974) + % C22:6 (4.4632). In the equation, % is the percentage that each fatty acid methyl ester represents of the

[6] Zamora-Rojas, E., A. Garrido-Varo, E. De Pedro-Sanz, J.E. Guerrero-Ginel, D. Perez-Marin. 2013. Prediction of fatty acids content in pig adipose tissue by near infrared spectroscopy: At-line versus in-situ analysis. Meat Sci. 95:503–511.

[7] Sauvant, D., J.M. Perez, and G. Tran. 2004. Tables of composition and nutritional value of feed materials: pigs, poultry, sheep, goats, rabbits, horses, fish. The Netherlands: Wageningen Academic.

[8] USDA Agricultural Research Service. 2010. USDA National Nutrient Database for Standard Reference, Release 26. Nutrient Data Laboratory Home Page. Available online at http://www.ars.usda.gov/Services/docs.htm?docid=8964. Accessed November 11, 2013.

sum total of all fatty acid methyl esters in the gas chromatographic analysis. The dietary IVP was calculated for all dietary treatments using the following equation (NRC, 2012): IVP = (IV of ingredient fat) × (% fat in the ingredient) × (0.1). The ME and NE content of every diet was determined by using the ingredient ME and NE values provided in the NRC (2012). The ME and NE values for glycerol was obtained from Lammers et al. (2008[9]) and Hinson (2009[10]), respectively.

Some observations (back [n = 36], belly [n = 37], and jowl [n = 45]) changed diet composition during the experiment, which resulted in changes in dietary fatty acid composition. Therefore, dietary variables were determined for initial (INT) and final (FIN) diets. Initial diets are defined as diets fed prior to the change in ingredient composition, and final diets are defined as diets fed after the change in diet composition. Feeding duration of both the INT and FIN diets were used in the meta-analyses. In the database, observations that did not change dietary fatty acid composition had equal INT and FIN dietary variables, the initial duration was defined as the total duration of the experiment, and final duration equaled 0 days. For INT or FIN diets applied during more than one dietary phase, a weighted average of each variable, based on feeding duration within the INT or FIN period, was calculated to describe the treatment applied within that period.

Statistical analysis

Descriptive statistics of candidate variables were evaluated using PROC UNIVARIATE in SAS (SAS institute, Inc., Cary, NC). All candidate variables were then evaluated for correlation using PROC CORR in SAS to determine relationships between variables and prevent multicolinearity. Based on descriptive statistics and correlations, the predictor variables tested were divided into the following groups: (1) diet fat composition (C16:1, C18:1, C18:2, C18:3, EFA, UFA, and IVP); (2) duration of feeding for initial and final diets; (3) energy content of the diet (ME or NE); (4) performance criteria (initial BW, final BW, ADG, ADFI, and G:F); (5) carcass criteria (HCW and backfat thickness). PROC MIXED in SAS was then used to develop regression equations to separately predict back, belly, and jowl fat IV. The method of maximum likelihood (ML) was used in the model selection. The treatment applied within each experiment was the experimental unit for modeling of the equations, and experiment within paper was included as a random effect. The statistical significance for inclusion of terms in the models was determined at $P < 0.10$. Further evaluation of models with significant terms was then conducted based on the Bayesian Information Criterion (BIC). A model comparison with a reduction in BIC of more than 2 was considered improved (Kass and Raftery, 1995[11]). Throughout the selection process, studentized residual plots were observed to determine if quadratic terms or interaction terms needed to be tested in the model. The model was determined using a manual forward selection procedure while progressing through the groups of the predictor variables. First, the best single predictor for back, belly, or jowl fat IV was determined. Variables from the dietary fat composition group had the lowest BIC value. Next, the

[9] Lammers, P.J., B.J. Kerr, T.E. Weber, W.A. Dozier III, M.T. Kidds, K. Bregendahl, and M.S. Honeyman. 2008. Digestible and metabolizable energy of crude glycerol for growing pigs. J. Anim. Sci. 86:602–608.

[10] Hinson, R.B. 2009. Net energy content of soybean meal and glycerol for growing and finishing pigs. PhD Diss. Univ. of Missouri, Columbia.

[11] Kass, R.E., and A.E. Raftery. 1995. Bayes Factors. J. Am. Statist. 90:773–795.

chosen initial and final dietary fat composition variables and the initial and final duration and their interactions were added to the model. Once the best dietary fat composition × duration model was determined, dietary energy content (ME or NE) was added to the model to determine if either were significant and improved the precision of the model. The model was then evaluated for improvement by adding the significant growth performance and carcass criteria parameters.

The method of residual maximum likelihood (REML) was then used to obtain the estimate of the parameters for the candidate models. The adequacies of candidate models were also examined by evaluating a histogram of residuals for evidence of normality and plotting residuals against predicted values of Y (back, belly, or jowl IV; Kuehl, 2000[12]; St-Pierre, 2003[13]). Actual IV was plotted against predicted IV and was evaluated using the line of equality to determine if there was bias in estimation (Altman and Bland, 1983[14]). Residual plots were also used to investigate outliers. Any residual greater or less than 3 standard deviations from the mean were deemed outliers under review. Outliers were reviewed to determine if they were biologically significant. As a result, one observation for back and belly fat IV was removed.

Validation experiment

A prospective study was conducted to validate the regression equations used to estimate back, belly, and jowl fat IV. Data from this experiment were not included in the meta-analysis dataset. The procedures of the validation experiment are in Influence of Dietary Fat Source and Feeding Duration on Pig Growth Performance, Carcass Composition, and Fat Quality” (p. 210). Dietary treatments consisted of: a corn-soybean meal control diet with no added fat fed from d 0 to 84 (C); 4% tallow from d 0 to 84 (T); 4% tallow from d 0 to 42 and the control from d 42 to 84 (T-C); control from d 0 to 42 and 4% tallow from d 42 to 84 (C-T); blend of 2% tallow and 2% soybean oil from d 0 to 84 (B); blend of 2% tallow and 2% soybean oil from d 0 to 42 and the control from d 42 to 84 (B-C); control from d 0 to 42 and blend of 2% tallow and 2% soybean oil from d 42 to 84 (C-B); 4% soybean oil from d 0 to 84 (SBO); 4% soybean oil from d 0 to 42 and the control from d 42 to 84 (SBO-C); and control from d 0 to 42 and 4% soybean oil from d 42 to 84 (C-SBO). Soy oil, tallow, and a blend of the two were added to create treatments of high levels of dietary unsaturated fatty acids, high levels of saturated fatty acids, and a blend of the two, respectively. Back, belly, and jowl fat IV means and the 95% confidence interval determined in the experiment were used to validate the estimated means derived from the equations.

Results

The backfat IV database included INT diets that were fed from 21 to 125 d and were analyzed to contain an IVP range of 21.3 to 107.2 g/100 g, an EFA range of 0.80 to 4.88%, and an NE range of 1,026 to 1,264 kcal/lb (Table 1). The FIN diets were fed up to 66 d prior to market and were analyzed to consist of an IVP range of 21.3 to 107.2 g/100 g, an EFA range of 0.80 to 4.90%, and NE range of 1,026 to 1,264 kcal/lb. Before

[12] Kuehl, R.O. 2000. Design of experiments: Statistical principles of research design and analysis. 2nd ed. Duxbury Press. New York. NY.

[13] St-Pierre, N.R. 2003. Reassessment of biases in predicted nitrogen flows to the duodenum by NRC 2001. J. Dairy Sci. 86:344–350.

[14] Altman, D.G., and J.M. Bland. 1983. Measurement in Medicine: the Analysis of Method Comparison Studies. The Statistician 32: 307–317.

beginning the INT period diet, pigs had an average BW range of 48.3 to 207.9 lb. These pigs' ADFI intake ranged from 3.44 to 8.02 lb/d, and they produced carcasses with HCW from 61.9 to 221.6 lb and backfat thicknesses from 0.41 to 1.16 in. Backfat IV values were from 58.3 to 86.1 g/100 g.

The belly fat IV database included INT diets that were fed from 21 to 125 d and were analyzed to contain an IVP range of 33.8 to 96.2 g/100 g, an EFA range of 1.51 to 4.09%, and an NE range of 1,026 to 1,264 kcal/lb. The FIN diets were fed up to 66 d prior to market and were analyzed to consist of an IVP range of 33.8 to 88.1 g/100 g, an EFA range of 1.50 to 3.60%, and an NE range of 1,026 to 1,264 kcal/lb. These pigs' ADFI ranged from 4.50 to 7.30 lb/d, and they produced carcasses with HCW from 175.3 to 221.6 lb and backfat thickness from 0.55 to 1.15 in. Belly fat IV values were from 58.9 to 87.3 g/100 g.

The jowl fat IV database included INT diets fed from 21 to 125 d and were analyzed to contain an IVP range of 22.1 to 101.1 g/100 g, an EFA range of 1.08 to 4.63%, and an NE range of 1,026 to 1,264 kcal/lb. The FIN diets were fed up to 66 d prior to market and were analyzed to contain an IVP range of 22.1 to 101.1 g/100 g, an EFA range of 1.10 to 4.60%, and an NE range of 1,026 to 1,264 kcal/lb. These pigs' ADFI ranged from 4.48 to 7.39 lb/d, and they produced carcasses with HCW from 162.0 to 221.6 lb and backfat thickness from 0.41 to 1.02 in. The jowl fat IV ranged from 61.4 to 86.2 g/100 g.

Correlations between predictor variables were determined, and as expected, some of the variables within each category were highly correlated. For variables determining dietary fat composition in all 3 datasets, IVP was positively correlated ($R^2 > 0.83$; $P < 0.001$) with C18:2, EFA, and UFA for both INT and FIN diets (Table 2). It was also determined that C18:2 was positively correlated ($R^2 = 1.00$; $P < 0.001$) with EFA for INT and FIN diet in all 3 datasets. The ME content of the diet was positively correlated ($R^2 > 0.86$; $P < 0.001$) with the NE content. For growth and carcass characteristics in all 3 datasets, FIN BW was positively correlated ($R^2 > 0.64$; $P < 0.001$) with HCW (Table 3).

Significant single-variable models used to predict back, belly, and jowl fat IV for the dietary fat composition category included the INT and FIN diet IVP, C18:1, C18:2, C18:3, EFA, and UFA ($P < 0.01$; Table 4). Also, INT C16:1 ($P < 0.07$) was a significant predictor of backfat IV. For the dietary energy content category, the INT and FIN ME were significant predictors for backfat IV ($P < 0.001$). For belly and jowl fat IV, the INT and FIN dietary NE were significant predictors ($P < 0.01$). Common significant single-variable models used to predict back, belly, and jowl fat IV for the growth and carcass characteristic category included ADG, ADFI, HCW, and BF ($P < 0.05$; Table 5). In addition, FIN BW and G:F were significant predictors of backfat IV($P < 0.07$), FIN BW for belly fat IV($P < 0.04$), and INT BW for jowl fat IV($P < 0.06$). Predictors C18:2 and EFA had the lowest BIC values within INT (back BIC = 870.6 and 871.6, belly BIC = 624.5 and 622.6, jowl BIC = 853.7 and 962.1, respectively) and FIN (back BIC = 886.6 and 888.1, belly = 629.1 and 627.3, jowl BIC = 961.4 and 962.1, respectively) diets.

For backfat IV, using variables from the dietary fat composition and duration of feeding categories, INT EFA, FIN EFA, INT d, FIN d, INT EFA*FIN d, FIN EFA*INT d, and FIN EFA*FIN d had the lowest BIC (755.2) for all models tested (Table 6). Next, variables from the dietary energy category were tested and the prediction equation developed was improved (BIC = 744.9) by adding FIN NE and FIN NE*FIN d to the model. Lastly, pig growth and carcass characteristics were investigated for inclusion in the model. Adding backfat depth resulted in the best final model (BIC = 734.5).

Utilizing variables from the dietary fat composition and duration of feeding categories for belly fat IV, INT EFA, FIN d, and INT EFA*FIN d resulted in the lowest BIC (586.0) compared with all models tested. Next, dietary energy was tested with the addition of INT NE and INT NE*FIN d improving the model (BIC = 566.9). Lastly, pig growth and carcass characteristics were tested, and the model was further improved by adding HCW and backfat thickness (BIC = 557.9).

For jowl fat IV, dietary fat composition and duration of feeding variables including INT EFA, FIN EFA, INT d, FIN d, INT EFA*INT d, and FIN EFA*FIN d were determined to be components of the best model (BIC = 814.6). Next, the inclusion of diet energy content was tested, with the model further improved by adding INT NE (BIC = 792.6). The final step determined the growth and carcass characteristics that should be included. Adding INT BW, ADFI, and backfat thickness improved (BIC = 756.2) the final model.

For back, belly, and jowl fat IV, the residual plots showed no evidence of prediction bias (Figure 1). The residual plots portray improved precision for the estimation of back and jowl fat IV compared with precision when predicting belly fat IV. When evaluating bias for all 3 fat depots, the final equations tended to overestimate carcass fat IV when the actual fat IVs were at the lower end of the range (Figure 2). The final equation for belly fat IV tended to underestimate IV when the actual IV values were at the upper end of the range.

Validation experiment

Regression equation input variables derived from the validation experiment are presented in Table 7. Back, belly, and jowl fat IV means determined in the experiment and estimated IV are presented in Table 8. For backfat IV, the means estimated using the regression equations fell within 3.77 g/100 g of the actual IV for all dietary treatments except C-T, which was 7.47 g/100 g greater than the actual value. For belly fat IV, the means estimated using the regression equations fell within 9.22 g/100 g of the actual IV for all dietary treatments. However, estimated IV for the C, T, T-C, C-T, B-C, and SBO-C treatments were within 3.77 g/100 g of the actual IV. For jowl fat IV, the means estimated using the regression equations fell within 3.43 g/100 g of the actual IV for all dietary treatments.

Discussion

Prediction equations are tools that can become an integral part of a pork enterprise; however, it is essential that they are used correctly to prevent the generation of faulty information. It is important to realize that the equations are valid only as long as the input variables consist of values within the ranges used to generate the predictive equa-

tion. For example, backfat IV is estimated to be reduced from 73.4 to 68.7 g/100 g by lowering the INT EFA from 4 to 2.7% when the INT diet is fed for 90 d followed by a final diet containing 2.7% EFA fed for 30 d (FIN NE of 2,580, backfat depth of 0.79 in.). However, if FIN d is increased to a value outside of the range used in generating the equations (d 0 to 66), the equation does not behave appropriately and will generate inaccurate predictions; for example, when INT d equals 30 and FIN d equals 90, with all other variables remaining constant, the estimated backfat IV increases from 60.0 to 64.0 g/100 g. Previous research has documented that reducing the INT EFA will result in decreased carcass backfat IV (Xu et al., 2010[15]; Benz et al., 2011[16]). Therefore, in the example, the increase in backfat IV results from using values outside of the range of the predictor variables.

Many factors, both dietary and biological, affect the fatty acid composition of adipose tissue in pigs. Iodine value is a measure of fatty acid unsaturation and is commonly used to assess pork fat quality. Equations incorporating the appropriate factors to estimate carcass fat IV will allow producers to feed their pigs appropriately to avoid monetary discounts associated with IV that are higher than acceptable at harvest. Although a number of different factors were evaluated, we found that dietary EFA, NE content, and backfat thickness exhibited the greatest influence on predicting IV of 3 distinct fat depots. Regression equations from this paper can be used to predict back, belly, and jowl fat IV.

[15] Xu, G., S.K. Baidoo, L.J. Johnston, D. Bibus, J.E. Cannon, and G.C. Shurson. 2010. Effects of feeding diets containing increasing content of corn distillers dried grains with solubles to grower-finisher pigs on growth performance, carcass composition, and pork fat quality. J. Anim. Sci. 88:1394–1410.

[16] Benz, J.M., M.D. Tokach, S.S. Dritz, J.L. Nelssen, J.M. DeRouchey, R.C. Sulabo, and R.D. Goodband. 2011a. Effects of choice white grease and soybean oil on growth performance, carcass characteristics, and carcass fat quality of growing-finishing pigs. J. Anim. Sci. 89:404–413.

Table 1. Descriptive statistics for data included in the evaluation

	Initial period[1]				Final period[2]										
Item	IVP,[3] g/100 g	EFA,[4] %	NE, kcal/lb	Days	IVP,[3] g/100 g	EFA,%	NE, kcal/lb	Days	INT-BW,[5] lb	FIN-BW,[6] lb	ADG, lb	ADFI, lb	HCW, lb	Backfat depth, in.	Fat IV, g/100 g
Backfat IV[7]															
Mean	60.9	2.48	1,170	69	55.3	2.23	1,171	8	106.3	261.7	2.07	5.80	194.0	0.79	70.5
SD	21.0	0.99	58	27	18.7	0.82	52	17	44.5	37.0	0.18	0.84	29.3	0.15	6.0
Minimum	21.3	0.80	1,026	21	21.3	0.80	1,026	0	48.3	100.3	1.61	3.44	61.9	0.41	58.3
Maximum	107.2	4.88	1,264	125	107.2	4.90	1,264	66	207.9	305.6	2.43	8.02	221.6	1.16	86.1
Belly fat IV[8]															
Mean	57.3	2.33	1,145	76	51.9	2.10	1,156	9	101.6	273.1	2.09	5.75	203.0	0.81	69.3
SD	13.7	0.56	50	27	13.5	0.49	44	17	52.9	13.7	0.15	0.62	9.3	0.15	5.4
Minimum	33.8	1.51	1,026	21	33.8	1.50	1026	0	48.3	233.7	1.83	4.50	175.3	0.55	58.9
Maximum	96.2	4.09	1,257	125	88.1	3.60	1,257	66	221.8	305.6	2.71	7.30	221.6	1.15	87.3
Jowl fat IV[9]															
Mean	59.1	2.49	1,134	75	54.0	2.25	1,143	7	109.6	274.7	2.07	5.95	201.5	0.74	72.1
SD	16.8	0.75	49	21	16.0	0.65	42	14	41.2	14.6	0.18	0.66	9.9	0.10	4.3
Minimum	22.1	1.08	1,026	21	22.1	1.10	1,026	0	52.9	214.7	1.70	4.48	162.0	0.41	61.4
Maximum	101.1	4.63	1264	125	101.1	4.60	1,264	66	221.8	305.6	2.71	7.39	221.6	1.02	86.2

[1] Characteristics of initial diets fed during the experiment.
[2] Characteristics of final diets fed during the experiment.
[3] Iodine value product (IVP = [iodine value of the dietary lipids] × [percentage dietary lipid] × 0.10); and IV = iodine value (IV = [C16:1] × 0.95 + [C18:1] × 0.86 + [C18:2] × 1.732 + [C18:3] × 2.616 + [C20:1] × 0.785 + [C20:4] × 3.2008 + [C20:5] × 4.0265 + [C22:1] × 0.7225 + [C22:5] × 3.6974 + [C22:6] × 4.4632; NRC, 2012).
[4] Essential fatty acids, %.
[5] Refers to BW of pigs at the beginning of the experiment.
[6] Refers to BW of pigs at the end of the experiment.
[7] The final database resulted in 24 papers with 169 observations for backfat IV.
[8] The final database resulted in 21 papers with 124 observations for belly fat IV.
[9] The final database resulted in 29 papers with 197 observations for jowl fat IV.

Table 2. Pearson's correlation coefficients between dependent dietary variables used to predict back, belly, and jowl fat iodine value (IV)[1]

	Initial period[2]								Final period[3]							
	Fatty acids, %						Energy, kcal/lb		Fatty acids, %						Energy, kcal/lb	
Item	C16:1	C18:1	C18:2	C18:3	EFA[4]	UFA	ME	NE	C16:1	C18:1	C18:2	C18:3	EFA	UFA	ME	NE
IVP, [5] g/100 g	0.13	0.57	0.93	0.82	0.94	0.97	0.68	0.58	0.33	0.68	0.91	0.71	0.92	0.97	0.65	0.55
	0.48	0.73	0.83	0.47	0.83	0.97	0.47	0.17	0.59	0.81	0.82	0.28	0.83	0.97	0.54	0.34
	0.30	0.71	0.90	0.59	0.91	0.98	0.40	0.12	0.43	0.79	0.89	0.43	0.90	0.98	0.46	0.14
C16:1, %	1.00	0.71	-0.17	-0.12	-0.17	0.33	0.43	0.36	1.00	0.71	0.01	-0.08	0.01	0.49	0.43	0.38
	1.00	0.83	-0.02	0.33	-0.01	0.64	0.70	0.57	1.00	0.79	0.12	0.09	0.14	0.69	0.57	0.49
	1.00	0.86	-0.12	0.11	-0.11	0.50	0.73	0.70	1.00	0.84	0.01	0.13	0.02	0.58	0.65	0.67
C18:1, %		1.00	0.25	0.17	0.24	0.76	0.79	0.70		1.00	0.34	0.16	0.34	0.84	0.71	0.65
		1.00	0.24	0.26	0.24	0.88	0.84	0.66		1.00	0.34	0.14	0.36	0.92	0.78	0.67
		1.00	0.35	0.31	0.35	0.85	0.75	0.59		1.00	0.44	0.28	0.46	0.90	0.72	0.56
C18:2, %			1.00	0.84	1.00	0.82	0.45	0.36			1.00	0.78	1.00	0.80	0.42	0.32
			1.00	0.38	1.00	0.67	-0.01	-0.29			1.00	0.24	1.00	0.68	0.11	-0.11
			1.00	0.53	1.00	0.79	0.06	-0.23			1.00	0.40	1.00	0.79	0.14	-0.22
C18:3, %				1.00	0.88	0.69	0.53	0.51				1.00	0.81	0.57	0.46	0.44
				1.00	0.41	0.42	0.29	0.10				1.00	0.28	0.22	0.23	0.10
				1.00	0.58	0.53	0.41	0.32				1.00	0.42	0.39	0.27	0.18
EFA, %					1.00	0.82	0.46	0.38					1.00	0.80	0.44	0.35
					1.00	0.67	-0.01	-0.28					1.00	0.69	0.14	-0.09
					1.00	0.80	0.09	-0.20					1.00	0.80	0.16	-0.19
UFA, %						1.00	0.78	0.67						1.00	0.71	0.61
						1.00	0.63	0.36						1.00	0.65	0.47
						1.00	0.53	0.26						1.00	0.56	0.28
ME, kcal/lb							1.00	0.94							1.00	0.94
							1.00	0.91							1.00	0.93
							1.00	0.89							1.00	0.86

[1] The 1st, 2nd, and 3rd row within each variable represents Pearson's correlation coefficients for back, belly, and jowl fat IV datasets, respectively.
[2] Correlations between characteristics of initial diets fed during the experiment.
[3] Correlations between characteristics of final diets fed during the experiment.
[4] Essential fatty acids.
[5] Iodine value product (IVP = [iodine value of the dietary lipids] × [percentage dietary lipid] × 0.10); and IV = iodine value (IV = [C16:1] × 0.95 + [C18:1] × 0.86 + [C18:2] × 1.732 + [C18:3] × 2.616 + [C20:1] × 0.785 + [C20:4] × 3.2008 + [C20:5] × 4.0265 + [C22:1] × 0.7225 + [C22:5] × 3.6974 + [C22:6] × 4.4632; NRC, 2012).

Table 3. Pearson's correlation coefficients between dependent growth performance and carcass characteristic variables used to predict back, belly, and jowl fat iodine value (IV)[1]

	FIN-BW, [7] lb	ADG, lb	ADFI, lb	GF	HCW, lb	Backfat depth, in.
INT BW,[2] lb	0.25	0.27	0.57	-0.62	0.21	0.05
	0.14	0.49	0.62	-0.43	0.01	-0.05
	0.03	0.03	0.47	-0.57	-0.03	-0.02
FIN BW,[3] lb	1.00	0.70	0.63	-0.44	0.96	0.41
	1.00	0.53	0.32	0.08	0.64	0.24
	1.00	0.47	0.45	-0.13	0.89	0.36
ADG, lb		1.00	0.72	-0.24	0.64	0.25
		1.00	0.66	0.02	0.45	0.15
		1.00	0.54	0.29	0.50	0.39
ADFI, lb			1.00	-0.79	0.59	0.35
			1.00	-0.70	0.19	0.31
			1.00	-0.59	0.30	0.19
G:F				1.00	-0.46	-0.38
				1.00	0.20	-0.26
				1.00	0.04	0.04
HCW, lb					1.00	0.47
					1.00	0.47
					1.00	0.40

[1]The 1st, 2nd, and 3rd row within each variable represents Pearson's correlation coefficients for back, belly, and jowl fat IV datasets, respectively.
[2]Refers to BW of pigs at the beginning of the experiment.
[3]Refers to BW of pigs at the end of the experiment.

Table 4. Dietary characteristic single-variable models used to predict back, belly, and jowl fat iodine value (IV)

Item	IVP,[1] g/100 g	C16:1, %	C18:1, %	C18:2, %	C18:3, %	EFA,[2] %	UFA, %	ME, kcal/lb	NE, kcal/lb
Initial period[3]									
Backfat IV									
Probability, $P <$	0.001	0.07	0.01	0.001	0.001	0.001	0.001	0.001	0.16
BIC[4]	897.9	1,040.9	1,034.6	870.6	959.6	871.7	942.1	1,032.7	1,042.3
Belly fat IV									
Probability, $P <$	0.001	0.29	0.001	0.001	0.001	0.001	0.001	0.34	0.01
BIC[4]	632.5	716.1	695.5	624.5	695.9	622.6	648.4	716.3	705.2
Jowl fat IV									
Probability, $P <$	0.001	0.92	0.001	0.001	0.001	0.001	0.001	0.83	0.001
BIC[4]	896.8	1,104.5	1,065.4	853.7	1,066.7	858.9	940.7	1,104.4	1,078.8
Final period[5]									
Backfat IV									
Probability, $P <$	0.001	0.17	0.001	0.001	0.001	0.001	0.001	0.001	0.12
BIC[4]	918.2	1,042.3	1031	886.6	986.7	888.1	951.1	1,031.3	1,041.8
Belly fat IV									
Probability, $P <$	0.001	0.67	0.001	0.001	0.46	0.001	0.001	0.42	0.001
BIC[4]	644.2	717	702	629.1	716.7	627.3	659.4	716.6	707
Jowl fat IV									
Probability, $P <$	0.001	0.77	0.001	0.001	0.2	0.001	0.001	0.56	0.01
BIC[4]	992	1,104.4	1,075.1	961.4	1,102.8	962.1	1,013.1	1,104.2	1,090.5

[1] IVP = iodine value product (IVP = [iodine value of the dietary lipids] × [percentage dietary lipid] × 0.10); and IV = iodine value (IV = [C16:1] × 0.95 + [C18:1] × 0.86 + [C18:2] × 1.732 + [C18:3] × 2.616 + [C20:1] × 0.785 + [C20:4] × 3.2008 + [C20:5] × 4.0265 + [C22:1] × 0.7225 + [C22:5] × 3.6974 + [C22:6] × 4.4632; NRC, 2012).

[2] Dietary essential fatty acids.

[3] Characteristics of initial diets fed during the experiment.

[4] Bayesian Information Criterion (BIC) values were used to compare the precision of the model. Models that minimized BIC variables within fat depot were used to select variables for initial model building.

[5] Characteristics of final diets fed during the experiment.

Table 5. Pig growth and carcass characteristic single-variable models used to predict back, belly, and jowl fat iodine value (IV)

Item	INT BW,[1] lb	FIN BW,[2] lb	ADG, lb	ADFI, lb	G:F	HCW, lb	Backfat depth, in.
Backfat IV							
Probability, *P* <	0.19	0.02	0.05	0.03	0.07	0.02	0.01
BIC[3]	1,042.5	1,038.3	1,040.4	1,039.5	1,041.1	1,038.3	1,036.5
Belly fat IV							
Probability, *P* <	0.97	0.04	0.01	0.01	0.77	0.001	0.001
BIC[3]	717.2	713.2	710.1	709.8	717.1	704.8	705.5
Jowl fat IV							
Probability, *P* <	0.06	0.15	0.01	0.05	0.76	0.01	0.001
BIC[3]	1,101.1	1,102.4	1,097.8	1,100.5	1,104.4	1,094.7	1,082.0

[1] Refers to BW of pigs at the beginning of the experiment.
[2] Refers to BW of pigs at the end of the experiment.
[3] Bayesian Information Criterion (BIC) values were used to compare the precision of the model. BIC variables within fat depot were used to select variables for initial model building.

Table 6. Regression equations generated from meta-analyses of existing data for prediction of back, belly, and jowl fat iodine value (IV)[1]

Dependent Variable	Models	BIC[2]
Backfat IV	= 60.30 + (3.70*INT EFA) + (2.37*FIN EFA) - (0.051*INT d) - (0.086*FIN d)	817.0
	= 69.40 + (0.55*INT EFA) + (2.06*FIN EFA) - (0.18*INT d) - (0.088*FIN d) + (0.053*INT EFA*INT d)	782.4
	= 70.66 + (1.22*INT EFA) + (0.86*FIN EFA) - (0.20*INT d) - (0.20*FIN d) + (0.058*INT EFA*INT d) + (0.047*FIN EFA*FIN d)	775.8
	= 69.00 + (6.66*INT EFA) - (4.31*FIN EFA) - (0.18*INT d) - (0.13*FIN d) - (0.095*INT EFA*FIN d) + (0.055*FIN EFA*INT d) + (0.13*FIN EFA*FIN d)	755.2
	= 86.93 + (6.67*INT EFA) - (3.91*FIN EFA) - (0.17*INT d) - (0.14*FIN d) - (0.90*INT EFA*FIN d) + (0.051*FIN EFA*INT d) + (0.13*FIN EFA*FIN d) - (0.0161*INT NE)	746.9
	=87.76 + (7.03*INT EFA) - (3.96*FIN EFA) - (0.17*INT d) - (1.34*FIN d) - (0.11*INT EFA*FIN d) + (0.047*FIN EFA*INT d) + (0.12*FIN EFA*FIN d) - (0.0174*FIN NE) + (0.0011*FIN NE*FIN d)	744.9
	=84.83 + (6.87*INT EFA) - (3.90*FIN EFA) - (0.12*INT d) - (1.30*FIN d) - (0.11*INT EFA*FIN d) + (0.048*FIN EFA*INT d) + (0.12*FIN EFA*FIN d) - (0.0132*FIN NE) + (0.0011*FIN NE*FIN d) - (6.604*BF)	734.5
Belly fat IV	= 54.59 + (6.73*INT EFA) + (0.31*FIN d) - (0.14*INT EFA*FIN d)	586.0
	= 82.77 + (6.37*INT EFA) + (0.28*FIN d) - (0.13*INT EFA*FIN d) - (0.022*INT NE)	580.1
	= 93.05 + (6.45*INT EFA) - (1.43*FIN d) - (0.12*INT EFA*FIN d) - (0.033*INT NE) + (0.00148*INT NE*FIN d)	566.9
	= 111.08 + (6.20*INT EFA) - (1.42*FIN d) - (0.11*INT EFA*FIN d) - (0.032*INT NE) + (0.00146*INT NE*FIN d) - (0.0953*HCW)	561.3
	=90.53 + (6.41*INT EFA) - (1.53*FIN d) - (0.12*INT EFA*FIN d) - (0.0265*INT NE) + (0.00157*INT NE*FIN d) - (6.35*BF)	560.7
	= 106.16 + (6.21*INT EFA) - (1.50*FIN d) - (0.11*INT EFA*FIN d) - (0.0265*INT NE) + (0.00152*INT NE*FIN d) - (0.0816*HCW) - (6.35*BF)	557.9
Jowl fat IV	= 58.11 + (3.86*INT EFA) + (1.54*FIN EFA) + (0.013*INT d)	831.1
	= 65.14 + (0.87*INT EFA) + (0.85*FIN EFA) - (0.073*INT d) - (0.078*FIN d) + (0.045*INT EFA*INT d) + (0.051*FIN EFA*FIN d)	814.6
	= 85.28 + (1.18*INT EFA) + (0.95*FIN EFA) - (0.058*INT d) - (0.087*FIN d) + (0.038*INT EFA*INT d) + (0.051*FIN EFA*FIN d) - (0.0183*INT NE)	792.6
	= 86.17 + (0.64*INT EFA) + (0.91*FIN EFA) - (0.065*INT d) - (0.080*FIN d) + (0.043*INT EFA*INT d) + (0.053*FIN EFA*FIN d) - (0.0126*INT NE) - (8.89*BF)	767.7
	= 77.88 + (1.04*INT EFA) + (1.01*FIN EFA) - (0.0063*INT d) - (0.041*FIN d) + (0.038*INT EFA*INT d) + (0.053*FIN EFA*FIN d) - (0.0123*INT NE) + (0.0299*INT BW) - (9.144*BF)	759.3
	= 85.50 + (1.08*INT EFA) + (0.87*FIN EFA) - (0.014*INT d) - (0.050*FIN d) + (0.038*INT EFA*INT d) + (0.054*FIN EFA*FIN d) - (0.0146*INT NE) + (0.0322*INT BW) - (0.993*ADFI) - (7.366*BF)	756.2

[1] INT EFA = initial period dietary essential fatty acids, %; FIN EFA = final period dietary essential fatty acids, %; INT d = initial period days; FIN d = final period days; INT NE = initial period dietary net energy, kcal/lb; FIN NE = final period dietary net energy, kcal/lb; BF = backfat depth, in.; INT BW = BW at the beginning of the experiment, lb.

[2] Bayesian Information Criterion (BIC) values were used to compare the precision of the model. Models that minimized BIC were preferred candidate models, with a reduction of more than 2 considered improved (Kass and Raftery, 1995).

Table 7. Inputs from validation experiment used in the regression equations to predict back, belly, and jowl fat iodine value (IV)[1]

Treatment[2]:	A	B	C	D	E	F	G	H	I	J
d 0 to 42:	Control	Tallow	Tallow	Control	Blend	Blend	Control	Soy	Soy	Control
d 42 to 84:	Control	Tallow	Control	Tallow	Blend	Control	Blend	Soy	Control	Soy
Initial diet essential fatty acid, %	1.47	1.87	1.87	1.47	2.65	2.65	1.47	3.44	3.44	1.47
Initial diet NE, kcal/lb	1,134	1,204	1,204	1,134	1,210	1,210	1,134	1,216	1,216	1,134
Initial diet days	42	42	42	42	42	42	42	42	42	42
Final diet essential fatty acids, %	1.52	1.94	1.52	1.94	2.41	1.52	2.41	3.45	1.52	3.45
Final diet NE, kcal/lb	1,150	1,221	1,150	1,221	1,227	1,150	1,227	1,232	1,150	1,232
Final diet days	42	42	42	42	42	42	42	42	42	42
Backfat, in.	0.67	0.76	0.77	0.73	0.88	0.82	0.77	0.86	0.71	0.76
HCW, lb	214.40	218.60	217.20	212.80	213.00	212.90	216.10	216.40	215.50	213.10
ADFI, lb	6.08	5.97	6.15	6.15	6.13	5.95	5.84	6.09	5.97	5.78
Initial BW, lb	100.60	100.70	100.50	100.50	101.10	100.00	100.90	100.50	100.30	100.20

[1]Inputs were obtained from the experiment conducted for validation of regression equations (see "Influence of Dietary Fat Source and Feeding Duration on Pig Growth Performance, Carcass Composition, and Fat Quality," p. 210).
[2] Control = no added fat; Tallow = 4% beef tallow; Soy = 4% soybean oil; Blend = 2% tallow and 2% soybean oil

Table 8. Validation of regression equations used to predict back, belly, and jowl fat iodine value (IV)

Treatment[1]:	A	B	C	D	E	F	G	H	I	J	
d 0 to 42:	Control	Tallow	Tallow	Control	Blend	Blend	Control	Soy	Soy	Control	
d 42 to 84:	Control	Tallow	Control	Tallow	Blend	Control	Blend	Soy	Control	Soy	SEM
Backfat IV											
Actual[2]	63.29	64.03	63.83	62.72	71.17	66.92	67.83	79.43	67.87	73.86	1.16
Predicted[3]	65.61	66.92	67.16	70.19	70.42	68.59	71.60	76.93	71.09	75.13	
Belly fat IV											
Actual	66.23	67.25	67.50	66.15	72.42	69.91	70.39	79.45	72.44	74.96	0.94
Predicted[4]	63.70	63.48	68.57	65.95	66.89	70.07	65.43	72.29	72.03	65.74	
Jowl fat IV											
Actual	64.68	65.10	65.43	64.66	69.96	67.56	67.84	75.94	71.07	70.90	0.96
Predicted[5]	67.79	68.32	66.54	68.09	70.42	68.36	69.59	75.23	71.18	72.96	

[1] Control = no added fat; Tallow = 4% beef tallow; Soy = 4% soybean oil; Blend = 2% tallow and 2% soybean oil.

[2] Means were obtained from the experiment conducted for validation of regression equations (see Stephenson et al., "Influence of Dietary Fat Source and Feeding Duration on Pig Growth Performance, Carcass Composition, and Fat Quality," p. 210).

[3] Backfat IV = 84.83 + (6.87*INT EFA) - (3.90*FIN EFA) - (0.12*INT d) - (1.30*FIN d) - (0.11*INT EFA*FIN d) + (0.048*FIN EFA*INT d) + (0.12*FIN EFA*FIN d) - (0.0060*FIN NE) + (0.0005*FIN NE*FIN d) - (0.26*BF) where INT EFA = initial period dietary essential fatty acids, %; FIN EFA = final period dietary essential fatty acids, %; INT d = initial period days; FIN d = final period days; FIN NE = final period dietary net energy, kcal/kg; BF= backfat depth, in.

[4] Belly fat IV = 106.16 + (6.21*INT EFA) - (1.50*FIN d) - (0.11*INT EFA*FIN d) - (0.012*INT NE) + (0.00069*INT NE*FIN d) - (0.18*HCW) - (0.25*BF) where INT NE = initial period dietary NE, kcal/kg.

[5] Jowl fat IV = 85.50 + (1.08*INT EFA) + (0.87*FIN EFA) - (0.014*INT d) - (0.050*FIN d) + (0.038*INT EFA*INT d) + (0.054*FIN EFA*FIN d) - (0.0066*INT NE) + (0.071*INT BW) - (2.19*ADFI) - (0.29*BF) where INT BW = BW at the beginning of the experiment, kg.

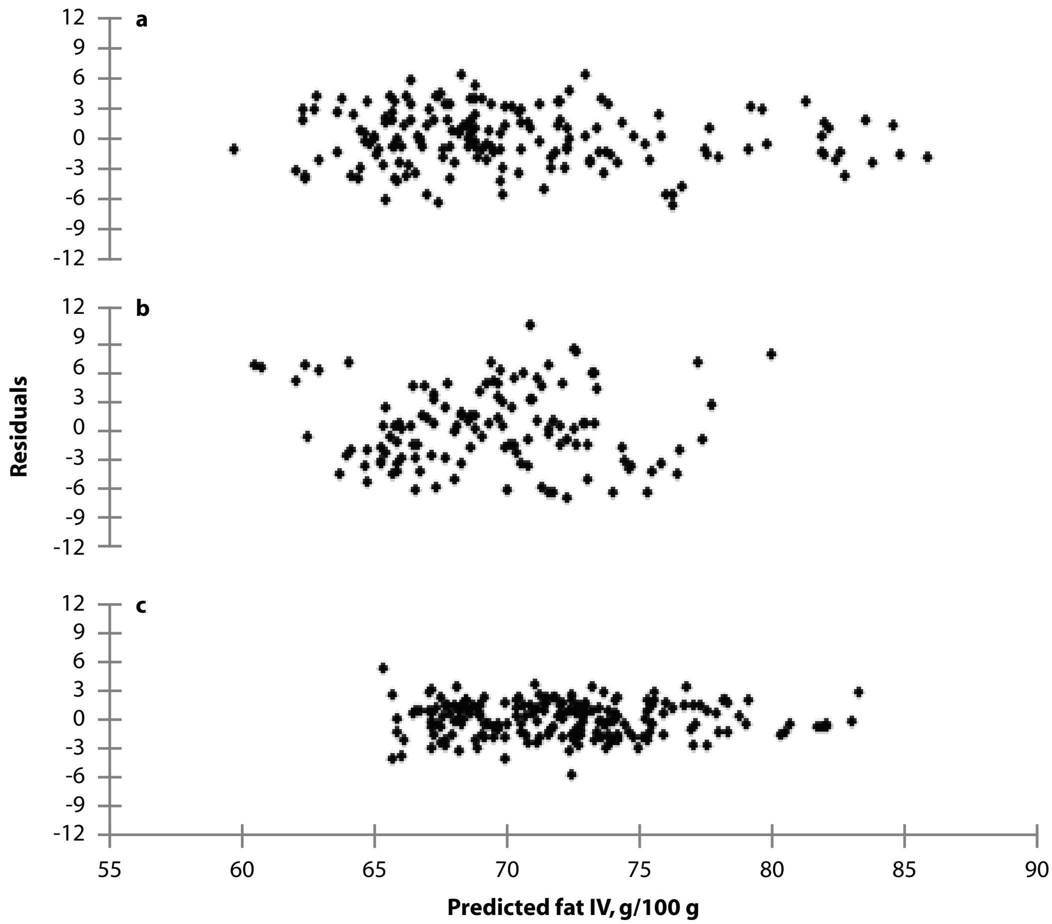

Figure 1. Plot of residuals against predicted (A) back, (B) belly, and (C) jowl fat iodine value (IV) from each mixed model analysis. The following equations were used:

(A) backfat IV = 84.83 + (6.87*INT EFA) - (3.90*FIN EFA) - (0.12*INT d) - (1.30*FIN d) - (0.11*INT EFA*FIN d) + (0.048*FIN EFA*INT d) + (0.12*FIN EFA*FIN d) - (0.0132*FIN NE) + (0.0011*FIN NE*FIN d) - (6.604*BF);

(B) belly fat IV = 106.16 + (6.21*INT EFA) - (1.50*FIN d) - (0.11*INT EFA*FIN d) - (0.0265*INT NE) + (0.00152*INT NE*FIN d) - (0.0816*HCW) - (6.35*BF);

(C) jowl fat IV = 85.50 + (1.08*INT EFA) + (0.87*FIN EFA) - (0.014*INT d) - (0.050*FIN d) + (0.038*INT EFA*INT d) + (0.054*FIN EFA*FIN d) - (0.0146*INT NE) + (0.0322*INT BW) - (0.993*ADFI) - (7.366*BF),

where INT EFA = initial period dietary essential fatty acids, %; FIN EFA = final period dietary essential fatty acid, %; INT d = initial period days; FIN d = final period days; INT NE= initial period dietary net energy, kcal/lb; FIN NE = final period dietary net energy, kcal/lb; BF = backfat depth, in.; ADFI = average daily feed intake, lb; and INT BW = BW at the beginning of the experiment, lb.

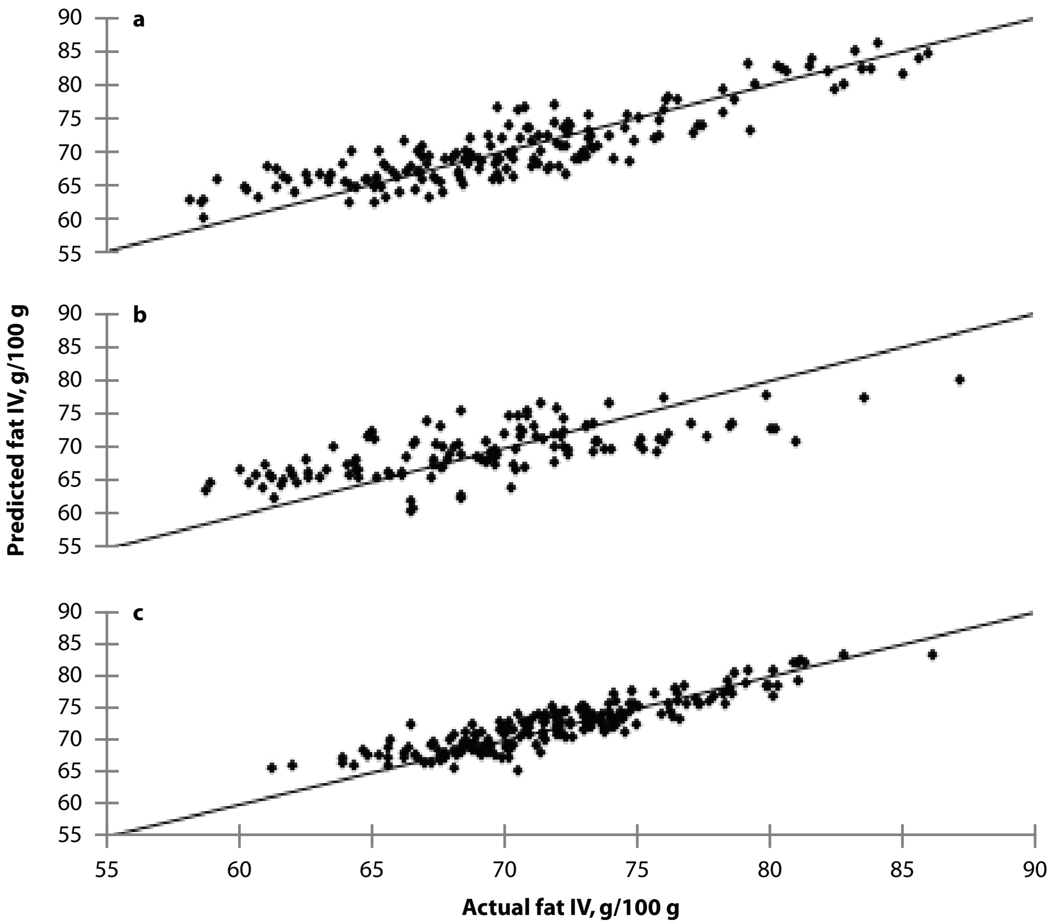

Figure 2. Plot of actual iodine value (IV) vs. predicted IV relative to the line of equality for (A) back, (B) belly, and (C) jowl fat IV from each mixed model analysis. The following equations were used:

(A) backfat IV =84.83 + (6.87*INT EFA) - (3.90*FIN EFA) - (0.12*INT d) - (1.30*FIN d) - (0.11*INT EFA*FIN d) + (0.048*FIN EFA*INT d) + (0.12*FIN EFA*FIN d) - (0.0132*FIN NE) + (0.0011*FIN NE*FIN d) - (6.604*BF);

(B) belly fat IV = 106.16 + (6.21*INT EFA) - (1.50*FIN d) - (0.11*INT EFA*FIN d) - (0.0265*INT NE) + (0.00152*INT NE*FIN d) - (0.0816*HCW) - (6.35*BF); and

(C) jowl fat IV = 85.50 + (1.08*INT EFA) + (0.87*FIN EFA) - (0.014*INT d) - (0.050*FIN d) + (0.038*INT EFA*INT d) + (0.054*FIN EFA*FIN d) - (0.0146*INT NE) + (0.0322*INT BW) - (0.993*ADFI) - (7.366*BF),

where INT EFA = initial period dietary essential fatty acids, %; FIN EFA = final period dietary essential fatty acids, %; INT d = initial period days; FIN d = final period days; INT NE = initial period dietary net energy, kcal/lb; FIN NE = final period dietary net energy, kcal/lb; BF = backfat depth, in.; ADFI = average daily feed intake, lb; and INT BW = BW at the beginning of the experiment, lb.