Effects of Dietary Fat Source and Length of Fat Consumption on Degree of Unsaturation of Carcass Composite Samples

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Introduction

Soft fat in pork carcasses is an economical concern to today’s pork processor, resulting in carcass handling and fabrication difficulties, reduced bacon yields, unattractive products, reduced shelf-life, and discrimination by importers of U.S. pork. The increase in the incidence of soft fat in the United States has resulted from the adoption of leaner genetics and increased use of dietary fat sources with high levels of polyunsaturated fatty acids – especially in the South and southeastern region of the U.S. where poultry fat, restaurant grease, and animal-vegetable blends are more readily available and cost effective.

Iodine value (IV) is an indicator of the degree of saturation (fat hardness), with lower IV values indicating a harder, more saturated fat and higher IV values indicative of softer, more polyunsaturated fats. Hansen (2001), in his talk at the Carolina Swine Nutrition Conference, noted that an optimal carcass IV would be approximately 72. Most of the previous research fed specific oils/fat sources or blends of fat sources in the finishing diets and reported fatty acid profiles and IV of subcutaneous and/or intramuscular fat depots. Conversely, commercial swine producers typically incorporate fats in all diets, and little is known about whole-carcass fatty acid composition or IV. Therefore, the objective of this experiment was to test the effect of dietary fat source and length of fat consumption on the fatty acid composition of pork carcass composite samples.

Experimental Procedures

Crossbred barrows and gilts (n = 288) from the mating of EB boars to line 348 dams (Monsanto Choice Genetics, St. Louis, Mo.) were blocked by initial weight (32 pigs/block), allotted randomly to pens (eight pigs/pen), and, within blocks, pens were randomly assigned to one of four dietary treatments. Treatments included control (Ctrl) corn-soybean meal grower and finisher diets, or diets containing 5% of either beef tallow (BT), poultry fat (PF), or soybean oil (SBO). For more detail about pig management, please refer to Apple et al. (2005).

Immediately after treatment allotment, one pig from each pen was slaughtered for initial carcass dissection and sampling. Thereafter, one pig was randomly chosen from each pen for slaughter when the mean block weight was 100, 150, 200, and 250 lb. Pigs were transported from the University of Arkansas Swine Research Facility to the University of Arkansas Red Meat Research Abattoir, and were electrically-stunned and slaughtered according to industry accepted procedures. After a 48-h chill at 34°F, right sides were fabricated into primal cuts, and each primal cut was further dissected into lean, fat, bone, and skin components. After recording weights of dissected components, all lean and fat from one side were ground through a 0.375-in plate and thoroughly mixed. Then, the mixture was ground through a 0.125-in plate, and five random 1-lb samples were collected, thoroughly mixed, vacuum-packaged, and frozen at -4°F until fatty acid analysis.

Ground, composite samples were freeze-dried, and duplicate 150-mg samples were subjected to direct transesterification by incubating in 2 mL of 0.2 M methanolic potassium hydroxide at 122°F for 30 min (Murrieta et al., 2003). Tubes were then cooled to room temperature, and 1 mL of saturated salt and 2 mL hexane (containing 0.5 mg/mL methyl tridecanoic acid) were added to each tube, tubes were vortexed, and subsequently centrifuged at 1,100 x g for 5 min. Fatty acid methyl esters (FAME) were transferred to gas liquid chromatograph vials that contained 1-mm of anhydrous sodium sulfate. Separation of FAME was achieved by gas liquid chromatography with a 100-m capillary column and helium (0.5 mL/min) as the carrier gas. Chromatograph temperature was 347°F for 40 min, then ramped 50°F/min to 464°F, and injector and detector temperatures were 482°F. Identification of peaks was accomplished using purified standards obtained from Nu-Check, Prep (Elyssian, Minn.) and Matreya (Pleasant Gap, Pa.).

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The total proportion of saturated fatty acids (SFA) included capric (C10:0), lauric (C12:0), myristic (C14:0), pentadecanoic (C15:0), palmitic (C16:0), heptadecanoic (C17:0), stearic (C18:0), and arachidic (C20:0) acids, whereas the total proportion of monounsaturated fatty acids (MUFA) was calculated by summing the percentages of myristoleic (C14:1), palmitoleic (C16:1cis), palmitoleic (C16:1trans), 10-trans-heptadecenoic (C17:1trans), elaidic (C18:1trans), transvaccenic (C18:1trans), oleic (C18:1cis), vaccenic (C18:1cis), and eicosenoic (C20:1cis) acids. Lastly, iodine value (IV) was calculated using the AOCS (1998) formula: (0.95 x C16:1) + (0.86 x C18:1) + (1.732 x C18:2) + (2.616 x C18:3) + (0.785 x C20:1).

Data were analyzed as a randomized complete block design with blocks based on initial live weight and pen as the experimental unit. Fatty acid data were analyzed as repeated measures using PROC MIXED (SAS Inst., Inc., Cary, N.C.), with slaughter weight as the repeated variable and pen as the subject. Dietary fat source and slaughter weight, as well as the two-way interaction, were included in the model as fixed effects, and block included in the model as a random effect. Least squares means were computed for main and interactive effects, and separated statistically using the PDIFF option when a significant F-test (P < 0.05) was detected.

Results and Discussion

Composite samples from pigs slaughtered immediately after treatment allotment had similar (P > 0.05) percentages of SFA; however, samples from pigs fed BT or Ctrl had higher (P < 0.05) proportions of SFA than samples from pigs fed PF and SBO when slaughtered at 100, 150, and 200 lb (fat source x slaughter weight, P < 0.001; Figure 1). For pigs slaughtered at 250 lb, composite samples from Ctrl-fed pigs had a higher (P < 0.05) percentage of SFA than samples from SBO-fed pigs, and, with the exception of samples from pigs slaughtered at 100 lb, the proportion of SFA in samples from SBO-fed pigs did not change as slaughter weight increased from 50 to 250 lb. It is not surprising that feeding BT, a highly saturated fat source, would result in increased deposition of SFA, and it is generally accepted that feeding a highly polyunsaturated fat source like SBO would reduce the deposition of SFA. Interestingly, Engel et al. (2001) reported that the optimal carcass IV was approximately 72. Composition samples from pigs fed SBO-diets had greater (P < 0.05) IV than all other dietary treatments at slaughter weights of 100, 150, 200, and 250 (fat source x slaughter weight, P < 0.001), and exceeded the recommended value of 72 (Figure 4). Moreover, the IV of samples from SBO-fed pigs increased rapidly from 50 to 100 lb, and remained constant thereafter. The IV for samples from pigs fed AT- and BT-diets was lower (P < 0.05) at 100, 150, 200, and 250 lb than samples from PF-fed pigs. As indicated earlier, feeding polyunsaturated fat sources invariably increases the level of PUFA, and would, therefore, increase the IV. Recently, Gatlin et al. (2002) reported that IV decreased linearly in fat samples as the level of BT was increased in swine finishing diets.

Implications

Results of this study indicate that feeding typical corn-soybean meal diets, as well as diets containing 5% beef tallow to growing-finisher pigs will elevate total carcass SFA content, resulting in pork with iodine values well below the recommended value for exportation of 72. Conversely, feeding pigs diets containing 5% soybean oil caused a rapid and sustained elevation in total carcass iodine value, which may impact marketability to U.S. and foreign consumers. Interestingly, feeding growing-finisher pigs a diet containing 5% poultry fat resulted in a fatty acid composition and iodine values intermediate to either beef tallow or soybean oil, and may be a desirable dietary fat source to impart the health benefits associated with increased consumption of PUFA without the detrimental effects associated with feeding a polyunsaturated fat source.

Literature Cited


Fig. 1. The fat source × length of fat consumption interactive effect (P < 0.001) on the proportion of total saturated fatty acids (SFA) in the carcass composite samples. Datum points lacking a common letter differ (P < 0.05).

Fig. 2. The fat source × length of fat consumption interactive effect (P < 0.001) on the proportion of total monounsaturated fatty acids (MUFA) in the carcass composite samples. Datum points lacking a common letter differ (P < 0.05).
Fig. 3. The fat source × length of fat consumption interactive effect (P < 0.001) on the proportion of total polyunsaturated fatty acids (PUFA) in the carcass composite samples. Datum points lacking a common letter differ (P < 0.05).

Fig. 4. The fat source × length of fat consumption interactive effect (P < 0.001) on the iodine value (IV) of carcass composite samples. Datum points lacking a common letter differ (P < 0.05).