The Impact of Divergent Selection for Residual Feed Intake on Meat Quality Traits of Loins from Pigs on High or Low Energy Diets

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Summary and Implications

The goal of this experiment was to determine the impact of low and high energy diets on the meat quality of animals selected for divergent residual feed intake (RFI). Low RFI (efficient) and high RFI (less efficient) pigs were fed either a high energy, low fiber (HELF) or low energy, high fiber (LEHF) diet. Diet had little impact on meat quality. Selection for low RFI animals resulted in loins with greater water holding capacity and sensory juiciness. High RFI animals have loins with greater percent lipid, color and marbling scores, and a* values (are more red in color). It is unlikely that marbling and color differences are large enough to be detected by the consumer.

Introduction

RFI is the difference in an animal's observed feed intake from its expected feed intake based on its average daily gain and back fat. Low RFI (LRFI) pigs are more efficient than high RFI (HRFI) animals. Generation five of the ISU RFI selection project compared a LRFI line to a randomly selected control line. LRFI animals had less lipid and greater percent moisture. No difference in 48 hour pH, drip loss, or Hunter L* and a* values were detected between the LRFI line and control. Divergent selection for RFI at the Institut National de la Recherche Agronomique (INRA, France) suggests loins from LRFI animals had lower pH at 24 hours postmortem, paler color, and poorer water holding capacity after four generations of selection. Results of generation six of these lines found similar results. Thus, the goal of this study was to determine the effects of divergent selection for RFI on the meat quality of pigs fed a LEHF or HELF diet.

Materials and Methods

Pigs of generations 8 and 9 of the ISU RFI selection project were used [n=155 LRFI (82 HELF, 73 LEHF), n=153 HRFI (79 HELF, 74 LEHF)]. LRFI animals have been selected since generation one, and divergent selection for a HRFI line was initiated in generation five. For each generation six pens were placed on the HELF diet (3.32 Mcal/Kg ME; 9.5% NDF) and six on the LEHF diet (2.87 Mcal/Kg ME; 24.6% NDF). Pigs were put on-test at 89.2 ± 3.9 days (35.9 ± 4.8 kg) and 107.2 ± 8.3 days (42.6 ± 7.0 kg) for generations eight and nine, respectively. Pigs were slaughtered in a commercial slaughter facility. In generation eight slaughter occurred in three groups over an eight week period (February – April) and in generation nine occurred in two groups over at five week period (June – July). Mean off-test ages were 239.5 ± 19.8 days (122.2 ± 7.7 kg) and 227.0 ± 14.5 days (128.4 ± 8.0 kg) for generations eight and nine, respectively. Pigs were rendered insensible by the use of carbon dioxide stunning, and carcasses were chilled using a spray-chill scenario. Loins were removed from the carcass 24 hours postmortem, de-boned, and trimmed. Loins were cut into 2.54 cm chops for quality analyses at the ISU Meat Laboratory 48 hours after slaughter. In order to minimize location effects chops were cut in the same order every time. Ultimate pH of each loin was determined by the average of three measurements on one chop 48 h postmortem (Hanna 9025 pH/ORP meter (Hanna Instruments, Woonsocket, RI). To determine protein, moisture, and intramuscular lipid content, chops were trimmed of subcutaneous adipose tissue and homogenized. Lean color was determined on two chops by CIE L* (0=black, 100=white), a* (greater values are more red, lower values are more green), b*(greater values are more yellow, lower values are more blue) using a calibrated Hunter Labscan XE colorimeter (Hunter Association Laboratories Inc., Reston, VA). A D75 light source with a 10º observer was used with a 1.27-cm aperture. Subjective scores for marbling (National Pork Board standards 10-point scale, 1 = 1.0% IMF; 10 = 10.0% IMF), color (National Pork Board Standards 6-point scale, 1 = pale pinkish gray to white; 6 = dark purplish red), and firmness (National Pork Board Standards 3-point scale, 1 = soft; 3 = very firm) were assigned. Drip loss was determined on two chops per animal three days postmortem.

Data were analyzed using the MIXED procedure in SAS (v. 9.3, SAS Institute Inc., Cary, NC). The model included fixed effects of line, diet, sex, generation, line*diet, significant interactions of line*sex, sex*diet, and line*sex*diet were tested and left in the model if $P \leq 0.10$;

random effects included slaughter group, pen, litter, and sire, and covariate of off-test live weight.

Results and Discussion

Results are reported in table 1. No difference in pH or LM L* values was found between chops of differing lines (P>0.05), yet greater loin a* and b* values were found in the loins of HRFI animals. This means chops from HRFI animals were more red than green and more yellow than blue in color, contributing to a greater (P<0.01) color score in loins from pigs of the HRFI line. Marbling scores were greater (P<0.01) and percent lipid proximate analysis values were greater (P<0.01) in loins from the HRFI line. Loin moisture content was greater in loins of the LRFI line (P<0.01). Loins from pigs of the HRFI line had increased drip loss compared to loins from the LRFI line (P<0.01).

Chops from animals fed the HELF diet had greater LM L* values (P<0.05), or were more pale in color than chops from animals fed the LEHF diet. Loins from animals fed the LEHF diet had greater percent moisture (P<0.01). Chops from LRFI animals on the LEHF diet had less firm chops than all other line by diet combinations (P<0.05).

Chops from barrows had a greater proximate analysis percent lipid (P<0.01) and lower proximate analysis percent protein (p<0.01) color score (p<0.05) and loin a* values (P<0.05). Within the LRFI line loins from gilts had lower loin b* values (P<0.01), and tended to have greater loin a* values (P=0.06) and percent protein values (P=0.10) than loins from barrows of the LRFI line.

Divergent selection for RFI did have an effect on meat quality. LRFI animals had loins with poorer color and less lipid (both less percent lipid and lower marbling score) than loins from HRFI animals. Chops from HRFI pigs exhibited greater drip loss than those from LRFI pigs.

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Table 1. Effect of selection of divergent residual feed intake (RFI), diets differing in fiber and energy content and sex on technical meat quality.

Trait	LRFI	HRFI	P-value	HELF	LEHF	P-value	Barrow	Gilt	P-value
pH, 48 hours	5.64[1] *(5.60, 5.69)*[2]	5.64 *(5.59, 5.68)*	0.61	5.64 *(5.60, 5.68)*	5.64 *(5.62, 5.66)*	1.00	5.65 *(5.61, 5.69)*	5.63 *(5.59, 5.68)*	0.11
Drip loss, %	1.34 *(1.18, 1.51)*	1.60 *(1.42, 1.80)*	**<0.01**	1.57 *(1.39, 1.78)*	1.36 *(1.19, 1.56)*	*0.09*	1.44 *(1.28, 1.62)*	1.49 *(1.31, 1.68)*	0.61
Color	2.0 (0.2)	2.3 (0.2)	**<0.0001**	2.1 (0.2)	2.2 (0.2)	0.70	2.2 (0.2)	2.1 (0.2)	**<0.05**
Marbling	1.26 *(1.15, 1.39)*	1.44 *(1.31, 1.58)*	**<0.05**	1.41 *(1.28, 1.55)*	1.29 *(1.17, 1.43)*	*0.10*	1.41 *(1.28, 1.54)*	1.29 *(1.18, 1.42)*	**<0.05**
Firmness	1.36 *(1.19, 1.56)*	1.45 *(1.26, 1.66)*	0.23	1.46 *(1.28, 1.68)*	1.34 *(1.16, 1.54)*	*0.07*	1.43 *(1.25, 1.64)*	1.36 *(1.19, 1.56)*	0.13
LM L*	51.41 (0.45)	50.89 (0.45)	0.12	51.53 (0.44)	50.78 (0.46)	**<0.05**	51.08 (0.44)	51.23 (0.45)	0.56
LM a*	2.64 (0.40)	3.46 (0.39)	**<0.0001**	2.98 (0.40)	3.12 (0.41)	0.50	3.20 (0.39)	2.89 (0.40)	**<0.05**
LM b*	10.73 (0.28)	11.28 (0.28)	**<0.01**	11.01 (0.28)	10.99 (0.29)	0.90	11.06 (0.28)	10.95 (0.28)	0.37
% Moisture	73.68 (0.07)	73.26 (0.07)	**<0.0001**	73.27 (0.8)	73.67 (0.08)	**<0.01**	73.40 (0.07)	73.54 (0.07)	*0.06*
% Lipid	1.30 *(1.01, 1.68)*	1.70 *(1.32, 2.20)*	**<0.01**	1.60 *(1.25, 2.05)*	1.38 *(1.07, 1.79)*	*0.07*	1.62 *(1.27, 2.08)*	1.36 *(1.06, 1.75)*	**<0.01**
% Protein	23.93 (0.10)	23.97 (0.10)	0.63	23.96 (0.10)	23.94 (0.11)	0.83	23.83 (0.10)	24.06 (0.10)	**<0.01**

[1] Least square mean reported for each trait.

[2](SE) or *(95% Confidence Interval)* reported for each trait.