INFLUENCE OF SWINE BREED ON FATTY ACID COMPOSITION OF PHOSPHOLIPIDS IN LONGISSIMUS MUSCLE.

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SUMMARY

The objective of this study was to determine whether there is a genetic difference in fatty acid composition of phospholipids. Forty five pigs, 15 each of Hampshire X Yorkshire-Landrace (YL), Duroc x YL and Danbred x YL, were used. Animals were of similar age and fed identical diets. Across all three breeds, saturated fatty acids (SFA, 16:0 and 18:0) comprised 31.5% of the total fatty acids, unsaturated fatty acid (18:1) 16.7% and poly-unsaturated fatty acids (PUFA, mainly 18:2 and 20:4) accounted for 51.8% of the total fatty acids. Fatty acid composition of muscle phospholipids from Duroc and Hampshire crosses was identical. Muscle phospholipids from Danbred crossbreds contained more PUFA (about 3%, $p<0.05$) and less SFA (about 2%, $p<0.05$) than phospholipids from the two other crossbreds.

INTRODUCTION

Waterholding capacity (WHC), often expressed as drip loss, is an important meat quality characteristic. Drip loss not only affects the final weight of the product, but also the juiciness and texture of the meat. Research on WHC has focusses on factors that influence the amount of drip loss, yet the exact mechanism(s) of drip loss formation remains unknown.

Drip is an aqueous solution of intra-cellular proteins. It has been established that the primary cause for expulsion of water from the muscle is a reduction in myofilament spacing resulting from myosin denaturation and associated shrinkage. However, the mechanism(s) involved in the subsequent expulsion/transport of the fluid from the fiber into the extracellular space is less clear.

Offer and Knight (1988) suggested that membrane permeability may affect the rate of water loss from muscle. The observation by Asghar et al. (1991) that vitamin E supplementation led to increased membrane stability as well as a reduction in drip loss lends some support to this hypothesis. Cheah et al. (1995) confirmed that vitamin E supplementation leads to a reduction in drip loss. However, Cannon et al. (1996) and Warner (1994) were unable to reproduce these results; they reported no effect of vitamin E supplementation on drip loss from pork.

One of the unknown variables in the studies on the effect of vitamin E, is the hog population studied. It may be suggested that variability in results is related to an inherent difference in membrane composition (and associated stability) of the muscle derived from different pigs.

Phospholipids, in particular the fatty acid composition of phospholipids, influence sensitivity to oxidation and, thus, the stability of the membrane. Consequently, the effect of vitamin E on membrane stability (and possibly drip loss) will depend on the fatty acid composition of the phospholipids.

The objectives of the present study were 1) to establish the fatty acid composition of phospholipids in pork muscle and 2) to determine whether there is a genetic variation in the fatty acid composition.

MATERIALS AND METHODS

Forty-five pigs, 15 each of Hampshire X Yorkshire-Landrace (YL), Duroc X YL, and Danbred X YL, were used. Animals were of similar age, reared under the same conditions and fed identical diets.

One day after slaughter, a sample of the longissimus muscle was excised, packaged and frozen at -20°C until analyzed. Frozen samples were powdered with liquid nitrogen. Phospholipids were extracted and separated from the triglycerides using procedures described by Melton et al. (1979). Fatty acid composition of the phospholipids was determined by preparing fatty acid methyl esters (FAME; AOCS 1993: Official Method Ce 2-66). FAME were analyzed using a gas chromatograph. Identification of the peaks was based on retention times of reference compounds. Peak areas of identified fatty acids were used to determine the relative percentage fatty acid composition of the total fatty acids.

Analysis of variance for the Randomized Complete Block Design was computed using the GLM procedure of SAS (1996).

RESULTS AND DISCUSSION

Results are presented in Table 1. The main fatty acids (>10%) were 16:0, 18:0, 18:1 and 20:4. In all three crossbreds, the fatty acid 18:2 predominated. When comparing concentrations of individual fatty acids, none of the differences between crossbreds was significant. However, when comparing the total amounts of saturated fatty acids (SFA), unsaturated fatty acids (UFA) and poly-unsaturated fatty acids (PUFA), there was a significant difference. In muscle from Danbred pigs, the concentration of SFA was 2% lower and the concentration of PUFA was 3% higher than in muscle from Duroc and Hampshire. It is not known if these differences will affect membrane stability to such an extent as to influence drip loss from the muscle. Studies to determine the fatty acid composition of a larger variety of crossbreds are underway. The present results suggest that there may be a difference in fatty acid composition which

is dependent on the pig population studied. This difference may explain the variation in results of vitamin E supplementation studies. It is well-known that diet influences the fatty acid composition, as well. Thus, in future studies, researchers would be well-advised to consider and determine the fatty acid composition of the phospholipids in the material used.

Compared to beef (Larick et al. 1989), phospholipids in pork contain more PUFA (18:2 and 20:4) and less SFA (16:0 and 18:0). Although influenced by diet, the fatty acid composition of chicken phospholipids (Lin et al. 1989) is similar to that of pork.

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Table 1: Percent fatty acid composition of phospholipids from longissimus muscle of different pig crossbreds.

	Danbred	Duroc	Hampshire	Total*
16:0	17.2	19.1	18.9	18.4
16:1	.77	.68	.62	.69
18:0	12.7	13.4	13.1	13.1
18:1	15.6	15.6	16.0	15.8
18:2	34.9	33.6	34.0	34.2
$18:3^{w6}$	.38	.33	.38	.36
$18:3^{w3}$	.45	.42	.43	.43
20:1	.31	.33	.26	.30
20:2	.51	.50	.51	.51
20:3	1.4	1.4	1.2	1.3
20:4	12.2	11.5	11.3	11.7
$20:5^{w6}$	.36	.41	.33	.37
$20:5^{w3}$	1.7	1.6	1.6	1.6
22:5	.97	.95	.79	.91
22:6	.42	.45	.35	.41
SFA**	**29.9^{a}**	**32.4^{b}**	**32.1^{b}**	**31.5**
UFA**	**16.3**	**16.9**	**16.9**	**16.7**
PUFA**	**53.8^{a}**	**50.7^{b}**	**50.8^{b}**	**51.8**

* Total is average across all three breeds.

**SFA = saturated fatty acids, UFA = unsaturated fatty acids, PUFA = poly-unsaturated fatty acids

Means bearing different superscripts on the same line differ significantly ($p < 0.05$).