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EFFECT OF SLAUGHTER WEIGHT ON THE INTRAMUSCULAR FAT COMPOSITION OF PIGS

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Background:

The content and condition of fat is an important technological property of meat and make a significant contribution to meat quality as a whole. Fat composition of pork can be influenced by season of the year, growth rate, age, sex, breed, diet and carcass fatness (Honkavaara, 1989). For many years pigs with higher lean meat content and lower feed conversion ratio were selected. The reduction of fat content in carcasses led to an inferior consistency and an increasing susceptibility for deterioration of fat. Intramuscular fat content seems to have an important influence on tenderness, juiciness and flavour of pig meat. Meat with a low intramuscular fat content is insipid, strawy and dry. Therefore an increase of intramuscular fat content is preferred. The present pig market in Europe rejects insufficient subcutaneous fat quality and low intramuscular fat content (Affentranger et al., 1996). Therefore, with regard to quality in lean pork, an intramuscular fat content of at least 2 % is desired (Arneth, 1998). According to Prabucki (1991), lean meat must contain at least 2.5 % total fat in the *M. Longissimus dorsi* for good processing quality. The Swiss even considered including intramuscular fat content as an additional payment criteria for pigs (Affentranger et al.,1996). Phospholipids are the most important intramuscular lipid fraction which affects oxidative off flavours in muscle during processing and storage (Houben & Krol, 1983; Kanner, 1994).

A Polyunsaturated to saturated (P/S) ratio in intramuscular fat of more than 0.5 is the recommended value for the Finnish diet (Honkavaara, 1989). The recommended minimum P/S ratio in the United Kingdom is 0.45. It has been recommended that human dietary fat has a P/S ratio of 1 in the USA. Fat from retail pork has been reported to have a P/S ratio of less or equal to 0.3 in the USA (Leszczynski et al., 1992). The recommended ratio of n-6:n-3 PUFA is 1:1 (the same as those of primitive man). In current British diets it is approximately 10:1 and may be one of the causes for the so called "Diseases of Western Civilization" (Enser et al., 1996).

During the 1996 period, 56 % of all pigs slaughtered in South Africa had a carcass mass less than 55 kg while 87 % had a carcass mass of less than 71 kg (Red meat information booklet, May 1997). The South African consumer and butcher is uninformed about the use of heavier pig carcasses. Heavier pig carcasses will result in higher profits for the farmer and butcher and a larger variety of meat cuts. (Welgemoed, 1995).

Objectives:

The main objectives of this work was to determine the effect of slaughter weight on the intramuscular lipid content and composition of South African pigs on a specified but typical finishing diet. Secondary objectives was to determine how slaughter weight affect the technological and nutritional quality of intramuscular fat.

Methods:

Sixty pigs of the same genetic source, of the same age, reared under the same conditions and fed the same diet, were used. When the average weight of all the pigs reached 90 kg, the first group was slaughtered. Then, with weekly intervals, the remaining pigs were slaughtered until a final slaughter weight of 120 kg were obtained. Data from all pigs were finally divided into three slaughter weight groups. After slaughtering, a core sample of the *M. longissimus dorsi* was taken 45 mm from the mid-dorsal line between the second and third last rib. Samples were stored in Nunc cryotubes in liquid nitrogen.

Extraction of total lipid was done according to the technique of Folch *et al.*, 1957. The extracted lipid was subjected to silicic acid column chromatography to determine the neutral-, glyco-, and phospholipid content of the total lipid fraction. Methylation to prepare fatty acid methyl esters for gas chromatography was done by using methanol-BF3. Fatty acid methyl esters were quantified using a Varian GX 3400 flame ionization gas chromatograph, with a fused silica capillary column, Chrompack CPSIL 88 (100 m length, 0.25 µm ID, 0.2 µm film thickness). Identification of sample fatty acids was made by comparing their relative retention times with those of standards (Sigma). Iodine value was calculated from fatty acid composition according to the method of Ham et al. (1998). Double bond index was determined according to the method of Alam & Alam (1986). Peroxidizability index was determined according to the method of Pamplona et al. (1998).

Differences in parameters between different treatments were determined by using an GLM ANOVA procedure (NCSS, 2000). The Newman-Keuls multiple range test (α=0.05) was used to identify differences between treatment means.

Results and discussion:

Results are presented in Table 1. Only fatty acids occurring at more than 1 % are indicated. Increased slaughter weight results in a significantly increased intramuscular fat content, reaching the important 2 % value at the high slaughter weight group (118.82 ± 4.58 kg). There is also a significant decrease in phospholipid content of intramuscular fat with increased slaughter weight. Although this decrease is a function of increased total fat content, it may implicate that intramuscular fat of heavier pigs are more resistant to oxidation than those of lighter pigs. The significant decrease in double bond index and peroxidizability index towards the heavier slaughter weight groups also confirm the higher oxidative stability of muscle from heavier pigs. There is a significant decline in polyunsaturated fatty acids (C18:2 & C22:6) with increased slaughter weight as confirmed by the significant decrease in iodine value in the heavy slaughter weight group. Intramuscular fat from the lighter slaughter weight groups are, from a nutritional point of view, more acceptable. The total polyunsaturated fatty acid content as well as P/S ratio were significantly higher in lighter pigs.

Conclusions:

From this study it can be concluded that technological properties of intramuscular fat improve with increased slaughter weight while nutritional value is favoured by lower slaughter weights. The current South African practice of slaughtering very light pigs may be maintained for the fresh meat market, but the slaughtering of heavier pigs for the processing market would be advisable.

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Table 1: Summary of results on intramuscular fat quality of pigs.

	Slaughter weight groups			
	1	**2**	**3**	**Significance level**
n	20	20	20	
Slaughter weight (kg)	93.70 ± 4.44	105.81 ± 2.54	118.82 ± 4.58	
Carcass mass (kg)	74.56 ± 4.63^{a}	85.09 ± 2.70^{b}	95.61 ± 3.99^{c}	***
General Chemistry:				
Intramuscular fat content (%)	1.73 ± 0.34^{a}	1.81 ± 0.27^{a}	2.04 ± 0.42^{b}	***
Neutral lipids (% of total lipid fraction))	61.64 ± 7.52^{a}	63.49 ± 6.79^{ab}	66.43 ± 6.72^{b}	*
Glycolipids (% of total lipid fraction)	3.68 ± 1.46	3.67 ± 1.35	3.58 ± 1.48	NS
Phospholipids (% of total lipid fraction)	32.44 ± 10.50^{b}	29.93 ± 9.02^{b}	25.05 ± 10.00^{a}	**
Iodine value	68.99 ± 6.18^{b}	67.01 ± 5.00^{b}	66.30 ± 4.99^{a}	*
Fatty acid composition:				
C14:0(Myristic)	2.10 ± 0.46	1.89 ± 0.42	1.91 ± 0.41	NS
C16:0 (Palmitic	20.19 ± 1.85	20.67 ± 1.81	20.67 ± 1.79	NS
C16:1c9(Palmitoleic)	3.57 ± 0.39	3.53 ± 0.37	3.68 ± 0.42	NS
C18:0 (Stearic)	11.03 ± 0.67	10.91 ± 0.65	10.91 ± 0.64	NS
C18:1c9 (Oleic)	34.71 ± 4.92	35.74 ± 3.80	36.67 ± 3.57	NS
C18:1c7 (Vaccenic)	5.39 ± 0.67^{a}	5.60 ± 0.79^{a}	6.00 ± 0.67^{b}	***
C18:2c9,12 (Linoleic)	10.79 ± 2.70^{b}	9.83 ± 2.36^{ab}	9.48 ± 2.14^{a}	*
C20:4c5,8,11,14 (Arachidonic)	1.93 ± 0.80	1.76 ± 0.66	1.69 ± 0.67	NS
C24:0 (Lignoceric)	1.79 ± 1.31	1.46 ± 0.89	1.22 ± 0.88	NS
C22:6c4,7,10,13,16,19 (Docosahexanoic)	1.31 ± 0.90^{b}	1.06 ± 0.58^{ab}	0.89 ± 0.54^{a}	*
Total Saturated (%)	36.21 ± 1.40	36.10 ± 1.45	35.81 ± 1.62	NS
Total MonoUnsaturated (%)	44.76 ± 5.33^{a}	45.93 ± 4.00^{ab}	47.42 ± 3.97^{b}	*
Total Poly Unsaturated (%)	15.69 ± 4.37^{c}	14.23 ± 3.70^{b}	13.63 ± 3.48^{a}	*
Total Unsaturated (%)	60.45 ± 1.53	60.45 ± 1.20	61.05 ± 1.33	NS
C18:0/C18:2	1.08 ± 0.32	1.16 ± 0.29	1.23 ± 0.35	NS
% Poly Unsaturated/% Saturated	0.54 ± 0.16^{b}	0.48 ± 0.14^{a}	0.47 ± 0.13^{a}	*
n-6/n-3	5.17 ± 1.36	5.61 ± 2.01	5.43 ± 1.00	NS
Double bond index	86.34 ± 8.50^{b}	83.65 ± 6.75^{a}	82.58 ± 6.73^{a}	*
Peroxidizability index	33.16 ± 12.25^{b}	29.33 ± 9.16^{ab}	27.40 ± 8.98^{a}	*

Means with different superscripts differ significantly NS = not significant * = p<0.05 ** = p<0.01 *** = p<0.001