PHOSPHOLIPID AND TRIGLYCERID FRACTIONS FROM PORK MUSCLE, AS AFFECTED BY DIETARY FAT

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The development of off-flavours in preserved meat, frozen (ground) meat and meat products due to rancidity is a well-known problem, for example with regard to the development of warmed-over-flavour. The major factor being held responsible for this phenomenon are the phospholipids, due to their polyunsaturated nature (Igene and Pearson, 1979). This characteristic together with the presence of heme-iron, which can act as a catalyst in the initial oxydation step, lead to ideal conditions for oxydation in meat. Meanwhile it is not clear whether phospholipids are influenced by dietary fat, especially polyunsaturated fat (PUFA). This research was aimed at investigating the influence of dietary fat on the phospholipid and triglycerid fatty acid pattern of intramuscular fat (IMF).

Four different feeds with increasing PUFA contents (Table 1) were administered (25-105 kg) to 10 barrows and 10 gilts of a Piétrain x Seghers® Hybrid cross (Seghers Company, Buggenhout, Belgium) for each feed. Pigs were slaughtered at 105 kg and meat was sampled at the 3/4th last rib from the longissimus thoracis, trimmed from visible fat and ground for subsequent analysis. The ground meat was stored in plastic jars at -20°C for a period of maximally 1 year. After all pigs had been slaughtered and sampled, ground meat samples were thawed and collected. A series of pooled samples was made according to treatment and sex. Total intramuscular lipid was extracted from the muscle by a modified Bligh and Dyer (1959) method. The obtained lipid was than fractionated in an apolar (mainly triglycerids) and a polar (phospholipid) fraction according to Juaneda and Rocquelin (1985). The fractions were rotary evaporated and fatty acid methyl esters were prepared (Sukhija and Palmquist, 1988) for gas chromatographic analysis. The obtained results were treated with ANOVA multi factor analysis and means were compared with the Scheffé test.

Differences between sexes (not shown) were negligible for the phospholipid fraction; for the triglycerid fraction the same pattern as for backfat - gilts more unsaturated than barrows - was followed. The dietary influence was, as expected, evident (Table 2) in the triglycerid fraction - being the major part of the IMF - as C18:2 and C18:3% increased with their level in the diet (Warnants et al., 1996). The saturated and monounsaturated fatty acids in the IMF were invariable throughout dietary treatments, as their levels in the feeds were kept constant. A clear linseed effect was seen in the 4th group were C20:5n-3 appeared in the IMF (Romans et al., 1995). The phospholipids showed a multitude of fatty acids, C18:2 making up the major part of this fraction (Table 3). Due to the low levels present in the extracts, some fatty acids did not reach the detection limit. However, despite high variation on the data and hardly detectable levels a feed fat effect was apparent, which is in agreement with the results of Pfalzgraf et al. (1995). C18:2, being a n-6 fatty acid increased from diet 1 till diet 3; the linseed fed group was much lower in this fatty acid, but higher in C18:3, as a n-3 fatty acid. The C20:4 and C20:5 fatty acids showed a remarkable feed influence: C20:4 reflected the n-6 fatty acid intake and C20:5 the n-3 fatty acid intake. The C22-fatty acids, maybe as a result of their susceptibility to oxydation, were less clearly influenced by the feed. For C22:4n-6 the level associated with diet 4 was presumably too low for detection. C22:5n-3 and C22:6n-3 levels were highest for diet 3 and not for diet 4, as might have been expected. It was furthermore noted that the meat samples of the diet 3 and 4 groups were more susceptible to spoilage due to rancidity than the first 2 dietary treatments.

In conclusion, not only the triglyceridic but also the phospholipidic fraction of IMF is influenced by dietary polyunsaturated fat, in spite of its relatively constant composition as a structural lipid class. This holds implications for the keepability of meat enriched in PUFA.

Literature

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Table 1. PUFA profile of the 4 dietary treatments

	Diet 1	Diet 2	Diet 3	Diet 4
g C18:2/kg feed	19	22	25	13
g C18:3/kg feed	2	3	3	16
g PUFA/kg feed	21	25	28	29
Main PUFA source	Full fat soybeans	Full fat soybeans	Soybean oil	Linseed
Main fatty acid family	n-6	n-6	n-6	n-3

Table 2. Fatty acid profile of the intramuscular triglycerid subfraction as a function of dietary treatment (results in weight%)

	Diet 1	Diet 2	Diet 3	Diet 4
C14:0	2.01±0.81	1.90±0.81	1.92±0.02	2.00±0.70
C16:0	26.53±0.81	25.95±2.03	26.46±0.37	25.70±1.00
C16:1	3.59±0.09	3.59±0.80	3.47±0.30	3.83±0.28
C18:0	12.84±0.75	12.34±1.60	12.19±0.32	12.25±1.07
C18:1	46.42±2.59	46.20±1.25	45.25±0.48	44.70±1.62
C18:2	7.30^{a}±1.51	8.25^{a}±0.40	9.57^{b}±0.03	5.82^{c}±0.84
C18:3n-3, C18:3n-6	0.70^{a}±0.14	0.83^{a}±0.05	1.07^{b}±0.01	4.43^{c}±0.82
C20:0	0.15±0.03	0.16±0.02	0.17±0.04	0.18±0.03
C20:1	0.73^{a}±0.04	0.70^{a}±0.31	0.51^{b}±0.02	0.67^{a}±0.10
C20:2	0.31^{a}±0.09	0.32^{a}±0.10	0.35^{a}±0.11	0.20^{b}±0.03
C20:4n-6	0.45^{a}±0.07	0.41^{a}±0.03	0.46^{a}±0.11	0.77^{b}±0.03
C20:5n-3	n.d.	n.d.	n.d.	0.19±0.02

n.d.: not detected
Results within one row with different superscripts are significantly different at P<0.05

Table 3. Fatty acid profile of the intramuscular phospholipid subfraction as a function of dietary treatment (results on area% basis)

	Diet 1	Diet 2	Diet 3	Diet 4
C14:0	n.d.	0.46±0.09	n.d.	0.50±0.10
C15:0	7.53±0.54	7.08±0.56	8.38±2.40	7.18±0.92
C16:0	20.26±3.96	21.17±4.71	25.75±11.15	27.80±13.80
C16:1	0.82±0.12	0.83±0.10	0.59±0.15	0.58±0.23
C17:0	4.08±0.25	3.88±0.01	3.77±0.10	4.60±0.69
C17:1	2.94±0.31	2.97±0.58	3.45±0.42	2.97±0.35
C18:0	8.96±0.18	8.85±0.28	10.82±2.93	10.20±1.46
C18:1	12.45±1.14	11.93±2.69	12.74±4.08	12.06±3.58
C18:1n-7	3.30±0.07	3.07±0.13	2.99±0.11	2.61±0.28
C18:2	32.10^{a}±0.25	33.30^{b}±0.45	36.62^{b}±4.69	30.14^{c}±1.30
C18:3n-3, C18:3n-6	0.89^{a}±0.03	0.70^{a}±0.01	0.62^{a}±0.04	4.32^{b}±0.30
C20:0	n.d.	0.31±0.09	n.d.	n.d.
C20:1	n.d.	0.66±0.10	0.74±0.15	n.d.
C20:2	n.d.	0.71±0.60	n.d.	n.d.
C20:3n-6	0.85^{a}±0.01	0.73^{ab}±0.19	0.60^{b}±0.05	0.47^{c}±0.03
C20:4n-6	7.54^{a}±0.22	7.31^{a}±0.92	7.00^{a}±0.75	3.97^{b}±0.08
C20:5n-3	0.63^{a}±0.40	0.90^{a}±0.50	0.61^{a}±0.95	3.83^{b}±0.91
C22:4n-6	0.82±0.11	0.72±0.08	0.76±0.09	n.d.
C22:5n-3	1.38^{a}±0.10	1.21^{a}±0.08	3.01^{b}±0.15	2.73^{b}±0.86
C22:6n-3	0.54^{a}±0.20	0.36^{ab}±0.10	1.30^{c}±0.16	0.68^{b}±0.09

n.d.: not detected
Results within one row with different superscripts are significantly different at P<0.05