FATTY ACID PROFILE AND CONSUMER TASTE EVALUATION OF PORK AS INFLUENCED BY DIETARY LINSEED OR FISH OIL SUPPLEMENTATION

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Introduction

Higher intakes of n-3 polyunsaturated fatty acids (PUFA) are recommended from a health point of view. Pork, as part of the diet, can contribute to this higher intake when its fatty acid (FA) profile is steered by supplementing the feed with n-3 FA sources. However, these changes may influence the shelf-life and palatability of the meat and meat products. PUFA are more prone to oxidation causing rancid, fishy and other abnormal flavours. In addition, the FA profile may affect the formation of volatile compounds during preparation.

In this experiment, dietary supplementation with linseed or fish oil, being a rich linolenic and n-3 long chain PUFA source (LCPUFA) respectively, was compared to standard feeding practice. Intramuscular FA composition was determined. Meat was grilled and three types of meat products (fermented sausage, cooked and dry cured ham) were manufactured and tested by an untrained consumer panel at a fair.

Materials and Methods

Experimental setup and material: Crossbred pigs (n=66; Topigs40xPietrain) at a mean (sd) live weight of 36.4 (4.5) kg were randomly allocated to one of three feeding groups. Each group was housed in 2 pens of 11 animals, and consisted of an equal number of barrows and gilts. All diets (S, L and F) were grain-soybean meal based and were formulated for an equal energy supply (2225 kcal). In group L and F, 1.2% of the dietary fat was supplied by linseed (group L; α-linolenic acid (α-LNA) supply) or by fish oil (group F; eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) supply) respectively. These 2 diets and the standard diet had an equal fat content of 4%, adjusted by the addition of animal fat. The trial lasted for 14–17 weeks. Animals were slaughtered in 2 groups with a 3 week interval in a commercial slaughterhouse (Westvlees, Belgium). From each feeding group, 12 animals were selected on average live weight. Mean (sd) live weight at slaughter and cold carcass weight was 97.1 (6.1) kg and 78.6 (5.1) kg respectively. The *M. longissimus thoracis* (LT; starting from the 7th rib, left carcass side) was sampled at 24 h *post mortem* (day 0) and sliced into 2.5 cm thick chops which were then immediately vacuum packed and stored at –18°C. In addition, 4 animals from each feeding group were randomly selected for the preparation of cooked cured ham, dry cured ham and fermented sausage according to standard recipes and manufacturing procedures at a butchery school (KTA, Diksmuide, Belgium). The fermented sausage was prepared by using 1/3 meat and 1/3 backfat from the experimental animals, and 1/3 beef. A taste panel was organised using these meat products on the occasion of the agricultural fair Agriflanders (Ghent Expo, Belgium, 2005).

Fatty acid analysis: Fatty acids were extracted according to Folch *et al.,* (1957), methylated and analysed by gas chromatography as described by Raes *et al.,* (2001).

Taste panel: Because of the impossibility of grilling meat at the fair, a smaller taste panel session was organised at the laboratory to have taste panel data which included grilled pork. Visitors at the fair were invited to taste one of the three meat products and were given a brief explanation about the aim and setup of the experiment. The participants were asked to score meat pieces for taste preference, taste intensity and overall preference on a 1 to 5-scale (1 = dislike, weak; 5 = like, strong). Overall preference was defined as the combination of the other two traits and the mouth-feel impression. Meat samples were served under red light in order to mask possible colour differences. The participants received 4 pieces per meat product (1.5*1.5*1.5 cm), with one piece from each feeding group and a 4th piece as replicate of one of the other 3 pieces. This was done to test for the consistency of scoring. Data from panelists not scoring consistently or not having completed the questionnaire thoroughly, were excluded from the statistical analysis.

Statistics: For the LT fatty acid data, a General Linear Model with fixed factors feeding group and gender was used. The interaction term was not significant. Effect of feeding group on the taste panel data was tested by one-way Anova for each type of meat product separately. The feeding group means were further compared with the Bonferroni *post hoc* test. The analyses were performed using S-Plus (version 6.0).

Results and Discussion

(*:P<0.05; **:P<0.01; ***: P<0.001; ns: not significant; [a,b,c]: means with different superscripts differ significantly at P<0,05)

Fatty acid composition:

Table 1: Fatty acid profile (g/100g FA) of the LT muscle.

Fatty acid	S	L	F	P
C18:2n-6	11.23[a]	10.44[ab]	8.84[b]	*
C20:4n-6	2.90[a]	2.38[b]	1.65[c]	***
C22:4n-6	0.39[a]	0.29[a]	0.15[b]	***
C18:3n-3	0.55[b]	1.24[a]	0.47[b]	***
C20:5n-3	0.22[c]	0.54[b]	1.37[a]	***
C22:5n-3	0.47[b]	0.75[a]	0.82[a]	***
C22:6n-3	0.14[b]	0.18[b]	1.02[a]	***
Σn-3 PUFA	1.38[c]	2.72[b]	3.68[a]	***
Σn-6 PUFA	15.09[a]	13.66[a]	11.12[b]	**
n-6/n-3	11.02[a]	5.23[b]	3.03[c]	***
SFA	34.48[ab]	34.03[b]	35.48[a]	**
MUFA	44.59	44.48	45.62	ns
PUFA	16.81	16.66	15.07	ns
Total FA (g/100g)	1.38[b]	1.49[b]	1.79[a]	*

Total MUFA and PUFA proportion did not significantly differ between feeding groups. Although the total n-3 PUFA supply by the feed was higher in group L compared to group F, the n-3 PUFA proportion was significantly higher for group F > group L > group S. As expected, the n-3 LCPUFA proportion was highest in group F, whereas the α-LNA content was highest in group L. The supply of the n-3 LCPUFA precursor α-LNA in group L yielded a significant increase in the proportion of EPA and DPA compared to group S, but did not result in an increase in DHA. Hence, this study supports other literature findings that specific dietary supply of DHA is needed in order to increase the DHA content of pork. The n-6 PUFA proportion was significantly higher in both the S and L group compared to the F group, as a result of the lower feed LA supply in the F group. The proportion of LA was not significantly different between the L and S group. However, the highest proportion of arachidonic acid (C20:4n-6; AA), the major desaturation/elongation product of LA, was found in group S, probably because of the higher proportion of α-LNA in this group which can be in competition with LA for the enzymes of desaturation/elongation.

Taste panel:

Table 2: Taste parameter scores.

	S	L	F	P
cooked cured ham				
taste preference	3.65[a]	3.30[b]	2.98[c]	***
taste intensity	3.62[a]	3.14[b]	2.94[c]	***
overall preference	3.58[a]	3.22[b]	2.99[c]	***
fermented sausage				
taste preference	3.29[a]	3.13[a]	2.88[b]	***
taste intensity	3.38[a]	3.20[ab]	3.14[b]	**
overall preference	3.35[a]	3.09[b]	2.88[c]	***
dry cured ham				
taste preference	3.23	3.29	3.26	ns
taste intensity	3.31	3.31	3.31	ns
overall preference	3.15	3.24	3.22	ns
grilled meat				
taste preference	3.75[a]	3.34[ab]	3.17[b]	*
taste intensity	3.58[a]	3.10[ab]	3.06[b]	*
overall preference	3.73[a]	3.31[ab]	3.06[b]	**

For the dry cured ham, the cooked cured ham and the fermented sausage, data from 210, 208 and 255 people respectively were retained for the statistics. For the grilled meat, 30 people were retained. For the cooked cured ham, the scores for all parameters were significantly higher for group S > group L > group F. For the taste intensity and taste preference of the fermented sausage, group S again scored significantly higher compared to group F, whereas the score for the L group was intermediate. Overall preference for the fermented sausage was significantly different between the groups and scored highest for group S > group L > group F. For the dry cured ham, the taste parameters did not reveal significant differences between the groups. For the grilled meat, scores for all taste parameters were significantly higher for the S group compared to the F group, whereas results for the L group were intermediate. In general, for all meat products, differences between feeding groups were small and the general appreciation was on average 3 or higher (on a scale of 1 to 5). However, the meat products of the fish oil fed animals were scored lower.

Conclusions

From this study, it seems that meat products originating from animals fed on a relatively low level of dietary fish oil were generally less appreciated by an untrained consumer panel compared to meat products originating from animals fed on a standard diet or a diet containing linseed. However, the differences, although significant, were not pronounced. On the other hand, the level of supplementation did induce significant increases in the proportion of beneficial n-3 long chain PUFA.

References

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