INFLUENCE OF FISHOIL IN FEED ON FATTY ACID COMPOSITION AND SENSORY QUALITY OF PORK

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Background

Fishmeal of high quality is one of the best protein sources for pigs. Because of its high content of n-3 polyunsaturated fatty acids, fishmeal can lead to a higher content of these fatty acids in carcass fat. This can give rise to off-flavours in the meat and may reduce the storage stability of products made from the pork (Miller et al., 1990; Hertzman et al., 1988). However, these negative influences are mainly due to the fat content of the fishmeal. In most pig breeding countries the fishmeal, used in pig feed, may contain as much as 8-12 % fat. Therefore this protein source has to be avoided in feeds for pigs over 40 kg. In recent years Icelandic pig farmers have turned to using fishmeal with a low fat content (2-4%) to overcome this problem.

Objectives

The aim of this project was to find the highest amount of low-fat fishmeal that can be used in feed for slaugter pigs avoiding negative influences on the sensory quality of the porkmeat.

Methods

Four groups of pigs, six in each, were fed iso-calorically for 10 weeks on four different test diets. The diets were based on barley, soybean meal and fishmeal. Dietary treatments consisted of a control diet, containing 3 g fish oil / kg diet, coming solely from the fishmeal, and three test diets fortified with fish oil and thus containing 5, 7 and 9 g fish oil / kg diet.
Samples of *M. longissimus dorsi* and subcutaneous fat were taken from each carcass and analysed for fatty acid composition and intramuscular fat content (IMF). For sensory analysis samples of *L. dorsi* were cut into 2 cm slices and wrapped in polyethylene film during freezer storage at –20°C.
Fatty acid analysis was performed by capillary gas chromatography on chloroform-methanol extracts from diets and intramuscular fat (Bligh & Dyer, 1959). The subcutaneous fat was methylated directly.
Sensory analysis was carried out on a fresh sample and repeated after six months of storage. Prior to the sensory evaluation, the samples were vacuum packaged and heated to an internal temperature of just exceeding 68°C. A trained eight-member panel evaluated the samples using a scale from 0 to 100 for juiciness, tenderness, meat flavour, acidulous taste, off-flavour of both meat and fat as well as rancid flavour of fat.
The statistical analysis was carried out with the Number Cruncher Statistical Software CS 6.0.21, 1996 using the GLM-procedure. In case of statistical significance, the Duncan's multiple range was performed. Principal Component Analysis was performed with the Sirius Chemometrics software.

Results and discussion

pH measurements revealed two PSE porks and these were excluded from the study. The fatty acid pattern in the dietary fish oil (Table 1) was reflected in subcutaneous fat and muscle (Tables 2 and 3). The addition of fish oil to diets increased the concentration of the fatty acids 20:1 in subcutaneous fat and 20:5n-3 (EPA), 22:5n-3 (DPA), and 22:6n-3 (DHA) in subcutaneous fat and muscle. No significant change was seen in the concentration of other fatty acids. The sum of DPA and DHA were from 0.9 to 1.5 % in subcutaneous fat. According to Swedish and Finish recommendations DPA and DHA should not exceed 0,5 % in subcutaneous fat if rancidity, off-flavour and fishy flavour are to be avoided (Arnkværn,E & Bronken Lien, E., 1997).
Results from the sensory analysis showed the fresh meat was juicy, tender and had high meat flavour (Table 4). The lower score for juiciness in group 3 and for tenderness in group 7 may be explained by individual outlying results in both groups. Some off-flavour of fresh meat and fat was observed in all groups but the differences between groups were not significant.
During storage the meat became less juicy and tender, the meat flavour decreased and acidulous taste increased. After 6 months of freezer storage increased off-flavour of fat was noted especially with 7 and 9 g fish oil / kg diet. Also, rancid flavour was significantly higher in fat from 9 g fish oil / kg diet than in fat from 3 g fish oil / kg diet.

Conclusions

The dietary inclusion of fish oil increased the concentration of polyunsaturated n-3 fatty acids in the meat and fat of pigs. The sum of DPA and DHA in subcutaneous fat exceeded recommended maximum levels (0.5%) in all groups. In addition sensory evaluation revealed off-flavour in all the groups. In light of this the use of the fishmeal in pig feed until the day of slaughter should be reconsidered.

References

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Table 1. The fat content (%) and composition of n-3 PUFAs (area %) in diets: 3, 5, 7 and 9 g fish oil/kg diet.

	3	5	7	9
Fat (%)	2.9	3.2	3.5	3.7
20:5n-3, EPA	1.7	2.0	2.4	2.8
22:5n-3, DPA	-	0.1	0.3	0.3
22:6n-3, DHA	2.4	2.6	3.1	3.6

-not detectable

Table 2. The composition (area %) of 20:1 and n-3 PUFAs of subcutaneous fat in groups: 3, 5, 7 and 9 g fish oil/kg diet.

	Group				SE	Level of significance[1]
	3	5	7	9		
20:1	1.38^{a}	1.44^{a}	1.50^{a}	1.65^{b}	0.04	**
20:5n-3, EPA	0.18^{a}	0.20^{ab}	0.23^{b}	0.39^{c}	0.01	***
22:5n-3, DPA	0.37^{a}	0.38^{a}	0.44^{b}	0.59^{c}	0.02	***
22:6n-3, DHA	0.57^{a}	0.55^{a}	0.62^{a}	0.92^{b}	0.03	***

Table 3. The IMF content (%) and the composition (mg/100 g) of n-3 PUFAs of muscle tissue in groups: 3, 5, 7 and 9 g fish oil/kg diet.

	Group				SE	Level of significance[1]
	3	5	7	9		
IMF (%)	3.0	3.5	3.2	3.4		NS
20:5n-3, EPA	11^{a}	11^{a}	10^{a}	17^{b}	1	***
22:5n-3, DPA	10^{a}	14^{ab}	13^{ab}	18^{b}	2	*
22:6n-3, DHA	14^{a}	15^{a}	22^{b}	25^{b}	2	**

Table 4. Sensory analysis of fresh meat and subcutanous fat and after 6 months of storage (shaded rows): 3, 5, 7 and 9 g fish oil/kg diet.

	Group				SE	Level of significance[1]
	3	5	7	9		
Juiciness^{fresh}	66.0^{a}	71.5^{b}	72.0^{b}	71.0^{b}	1.4	*
Juiciness$^{6\ month}$	55.1	50.5	52.6	56.7	2.3	NS
Tenderness^{fresh}	75.8^{a}	75.6^{a}	68.7^{b}	75.7^{a}	1.3	**
Tenderness$^{6\ month}$	68.7^{a}	61.8^{b}	61.8^{b}	62.5^{b}	1.1	**
Meat flavour^{fresh}	69.7	72.4	70.3	68.9	1.4	NS
Meat flavour$^{6\ month}$	61.4	63.5	65.5	67.1	1.7	NS
Acidulous taste ^{fresh}	22.1	19.8	18.0	21.5	1.6	NS
Acidulous taste $^{6\ month}$	34.5	31.5	32.0	34.8	2.0	NS
Off-flavour of meat^{fresh}	14.8	10.7	14.0	11.6	1.8	NS
Off-flavour of meat$^{6\ month}$	18.4	15.9	15.6	19.8	1.4	NS
Off-flavour/odour of fat^{fresh}	13.5	10.9	9.4	11.0	1.5	NS
Off-flavour/odour of fat$^{6\ month}$	15.2^{a}	17.9^{ab}	19.8^{b}	19.9^{b}	1.0	*
Rancid flavour/odour of fat$^{6\ month}$	23.9^{a}	30.1^{ab}	27.5^{ab}	39.8^{b}	3.2	*

[1]Significance level: NS, not significant, *p<0,05; **p<0,01; ***p<0,001.
Different superscripts in a row indicate significance of differences, with p<0,05.