Influence of Dietary Fishmeal and Fat on Fatty Acid Composition and Eating Quality of Pigs

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Background :

Fish meal and hydrogenated fish oils are used in the diets for growing pigs in Iceland. The level of fishmeal is 7-12% until the day of slaughter, leading to a higher content of n-3 polyunsaturated fatty acids in the subcutaneous and intramuscular fat. This may give the pigmeat a healthier image but it should also promote lipid oxidation , off-flavours and reduced storage stability. But pork has a good image in Iceland and hardly any complaints have been made on the eating quality of fresh meat and frozen meat. No data has been available on influence of various diets the fatty acid composition and eating quality of pork as perceived by consumers in Iceland.

Objectives

The aim was to study the influence of the amount of dietary fishmeal and fat on the fatty acid composition and eating quality of pork.

Methods

Six groups of pigs, four in each, were fed iso-calorically for two months on six different test diets. Two levels of fishmeal were given and fat sources were soya oil, tallow or hydrogenated fish oil. The main component of the diets was barley and the diets were balanced by varying the level of soy-bean meal. Samples of *M. longissimus dorsi* and subcutaneous fat were taken from each carcass and analysed for fatty acid composition and intramuscular fat content. For sensory analysis samples of *L.dorsi* were taken, cut into 2 cm slices and wrapped in polyethylene film during freezer storage at -20°C storage.

An overview of the experimental diets

1	Control
2	7 % fishmeal
3	12 % fishmeal
4	12 % fishmeal + 10 % tallow (lamb fat)
5	12 % fishmeal + 10 % hydrogenated fish oil
6	12 % fishmeal + 10 % soya oil

Intramuscular fat content was determined by Soxhlet extraction after acid hydrolysis. Fat in the adipose tissue was determined by subtracting the ash and protein from the dry matter. Fatty acid analysis was performed by capillary gas chromatography on chloroform-methanol extracts from diets, intramuscular fat and adipose tissue (Bligh & Dyer, 1959). Fatty acids were converted to methyl esters by base-catalyzed transesterification, any free acids in the fat were esterified by subsequent reaction with BF_3/CH_3OH. The fatty acid distribution within the major lipid classes were obtained by a fractionation of the classes on TLC plates prior to fatty acid analysis. Sensory analysis was carried out after 0, 2, 4 and 7 months storage. It was carried out by a trained panel, on loin chops with fat, fried at 165°C to an internal temperature of 68°C. Juiciness, tenderness, meat flavour and off-flavour of meat and fat were judged by a descriptive test. Differences between groups were tested for significance by one-way analysis of variance. In case of statistical significance, the Duncan's multiple range test was performed.

Results

The lipid content and fatty acid composition of the experimental diets were influenced by the level of fish meat and the amount and source of dietary fat. The total lipid content was very variable or 1% to 12,9%. This must be considered when comparing the diets as the synthesis by the pig itself is decreased and more dietary fatty acids are deposited in adipose tissue as the amount of dietary fat increases.

The main fatty acids in back fat of pigs are the long-chain fatty acids 16:0, 18:0 and 18:1, which are synthesized in the tissue itself. In the groups fed on low fat diets these fatty acids correspond to about 77% of the total amounts of fatty acids. The result was similar for the group fed with tallow, but these fatty acids account for 63-67% of the total amount in groups fed with soya oil and hydrogenated fish oil.

The total amount of polyunsaturated fatty acids in the diets is reflected in the fatty acid profile of the subcoutaneous fat. The back of the pigs on the soy bean oil diet was very soft and with high content of 18:2n-6 and 18:3n-3. The hydrogenated fish oil increased the contents of 20:1 and 22:1.

The pattern was very similar in the intramuscular fat (table 1) but the values are generally lower with exceptions of the long chain polyunsaturated fatty acids. Analysis of lipid classes revealed that these fatty acids are predominantly located in the phospholipid fraction whereas saturated and monounsaturated fatty acids are mainly found in the triglycerides.

All the fresh meat except for the pigs in group 5 was of good sencoric quality. No off-flavour was detected in the back fat. After 7 months of storage off-flavour was only detected in the meat and fat of group 5. Some products of the hydrogenation of the fish oil are possibly responsible for the off-flavour.
The influence of dietary fishmeal and fat on the quality of processed meat was not studied.

Conclusions :

1. Up to 12% fishmeal in the diet did not affect the eating quality of fresh pork or after 7 months of freezer storage.
2. The combination of 12% fishmeal and 10% of hydrogenated fish oil produced meat with off-flavour.
3. Soy bean oil in the diet resulted in very soft backfat.
4. The combination of 12% fishmeal and 10 % tallow resulted in firm backfat and a pigmeat with good eating quality.

References :

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TABLE 1
The contents of lipids and fatty acid composition of total fatty acids in the ***longissimus dorsi*** of pigs

	Dietary treatment						*Pooled SD*	*Level of significant*
	1	*2*	*3*	*4*	*5*	*6*		
Total lipids (%)	**1,2**	**1,3**	**1,4**	**1,6**	**0,8**	**0,9**		NS
Fatty acids (%A)								
14:0	1,1	1,3	1,1	1,4	1,5	1,0	0,12	***
16:0	22,5	23,1	22,8	21,6	22,1	19,8	0,98	**
16:1n-7	3,1	3,6	2,9	2,7	3,3	2,1	0,26	***
18:0	12,2	12,0	12,7	11,3	10,8	9,9	1,31	
18:1n-9	36,2	38,0	37,5	36,5	29,7	28,3	1,25	***
18:1n-7	4,3	4,6	4,2	3,7	4,3	3,5	0,24	***
18:2n-6	10,2	8,8	9,4	11,1	13,1	23,8	2,18	***
18:3n-3	0,4	0,4	0,9	1,1	0,9	1,5	0,11	***
20:1n-9 + n-7	0,9	0,8	1,0	1,0	2,8	0,6	0,15	***
20:4n-6	1,9	1,3	1,3	1,2	1,9	2,1	0,52	NS
20:5n-3	0,8	0,9	1,0	1,3	2,1	0,8	0,43	*
22:1n-11 + n-9	ND	ND	ND	ND	ND	ND	ND	
22:5n-3	0,8	0,9	1,0	0,9	1,1	0,8	0,21	NS
22:6-n-3	0,6	0,8	1,0	1,1	1,3	0,9	0,28	*

Significant level: p≤0,05*, p≤0,01**, p≤0,001***
NS: not significant
ND: not detectable