

Effect of dietary oil supplementation on fatty acid profile of backfat and intramuscular fat in finishing pigs

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ABSTRACT - Two groups of finishing gilts were fed, for 4 weeks, a commercial feed enriched (2%) with either rapeseed oil or sunflower oil. Pig growth was monitored bi-weekly and the fatty acid composition of backfat and *Longissimus* muscle was determined after slaughtering. Type of dietary oil affected significantly the fatty acid profile of pork fat, especially the C18:3n-3 concentration which was higher in pigs fed rapeseed oil than in those fed sunflower oil. The content of monounsaturated fatty acids (MUFA) of *Longissimus* muscle was significantly higher than that of backfat, due to the its higher concentration of C18:1cis9 and C16:1. Differently, the long-chain n-3 polyunsaturated fatty acids (PUFA) content was higher in backfat than in *Longissimus* muscle. These results confirm that it is possible to manipulate the fatty acid composition of the diet, in order to improve the health properties of the adipose tissues of pork meat.

Key words: Swine, Rapeseed oil, Sunflower oil, Fatty acid composition.

Introduction - Pork meat and products are one of the main sources of saturated fatty acids (SFA) in the human diet. The SFA have been related to various cancers and coronary heart diseases, whereas long-chain n-3 polyunsaturated fatty acids (PUFA), which have a wide range of biological effects, are believed to be beneficial to human health (Givens, 2005). Current pig production in intensive systems has provided pork meat at a reasonable price and quality for consumers. In swine carcass, fat is deposited in different anatomical locations, such as visceral, subcutaneous, and intramuscular (within muscle). In addition, the fatty acid composition differed between the anatomical locations of adipose tissues in pig's carcass, especially for the monounsaturated fatty acids (MUFA) and SFA concentrations (Monzioli *et al.*, 2007). It is generally accepted that the fatty acid composition of pork meat depends on the composition of the dietary fat, the duration of the feeding treatment (Cava *et al.*, 1997), the genetic type and the live weight at slaughter (Lo Fiego *et al.*, 2005; Kouba and Bonneau, 2009). In finishing pigs, adding fat to the diet has the advantage of increasing the caloric content of diet and improving the production efficiency. In many cases, pig diets are supplemented with vegetable oils containing a high percentage of unsaturated fatty acids, favoring the production of healthy pork meat for consumers. The rapeseed oil is rich in 18 carbon fatty acids such as C18:1cis9, C18:2n-6 and C18:3n-3, which represent about 60, 20 and 10% of its fatty acids, respectively. Differently, the sunflower oil is rich in C18:1cis9 and C18:2n-6 (30 and 50% of fatty acids, respectively) as well, but has only traces of C18:3n-3 (about 1%).

An experiment was carried out with the aim to study the fatty acid profile in the backfat and intramuscular (*Longissimus* muscle) fat from carcasses of pigs fed diets enriched with 2% of rapeseed or sunflower oils.

Material and methods - Twenty gilts of the Landrace x Large White crossbred were fed a commercial diet before the beginning of the experiment. Then, the pigs, weighing 96.3 ± 1.1 kg (mean \pm s.d.), were allotted to one of two treatments on the basis of body weight and were kept in pens (5 animals/pen). The two experimental diets were obtained by adding either rapeseed oil (RSO) or sunflower oil (SFO) to the commercial feed (at 2%). Each group (five animals) was fed 12.5 kg/d of feed throughout the experiment which lasted 4 weeks. The pigs were weighed bi-weekly. At the end of the experiment the pigs were slaughtered, after an overnight fast and electronarcosis. Subsequently, for fatty acid analysis a 7–10 cm carcass section, including the last rib with its *Longissimus* muscle and backfat portion, was removed from the left half-carcass of each pig. Samples of *Longissimus* muscle and backfat of each carcass were lyophilized and finely ground in a food processor. Fat extraction was performed according to the method described by Nudda *et al.* (2008), using chloroform:methanol (2:1). Fatty acid methyl esters (FAME) from the triglyceride fraction were prepared by esterification using sodium methoxide in methanol. The chromatographic conditions were the same as those described by Nudda *et al.* (2008). The fatty acids were identified by comparing retention times of peaks with those of methyl ester standards. The content of each FAME was expressed as a percentage of total FAME.

Analyses of variance were performed on fatty acid composition data using the general linear model procedures of SAS. The model included the effects of tissue, dietary enriching oil and their interactions.

Results and conclusions - Type of dietary oil did not affect significantly ($P > 0.05$) the final body weight (111.9 and 114.4 kg for RSO and SFO, respectively) and the mean average daily gain (0.657 and 0.668 kg/d for RSO and SFO, respectively) of the pigs. This demonstrates that the experimental diets did not differ for nutritional value. The oil x tissue interactions were not significant ($P > 0.05$) for any variables, indicating that the oil added in the diet did not influence the fatty acid profile associated with different tissues. The mean fatty acid profiles of backfat and *Longissimus* muscle fat of the two experimental groups are reported in Table 1. The results showed that the type of oil added to the diet significantly ($P < 0.05$) affected the fatty acid profile of the pig meat. In particular, the tissues of RSO supplemented pigs have a higher percentage of C18:3n-3 and a lower n6/n3 ratio than those fed SFO. This effect could be due to the relevant presence of C18:3n-3 in rapeseed oil. Differently, the fat of pigs fed SFO had a higher content of C14:0, C16:0 and C16:1. These results agree with data of another experiment in which finishing pigs were fed different dietary fat (Mithaothai *et al.*, 2007). The CLAc9,t11 content was not affected by the dietary oil and the values observed in this trial were in agreement with those reported in other experiments in which the CLA was not added in the diet (Martin *et al.*, 2008).

The fatty acid compositions differed between the anatomical locations of adipose tissues analyzed, in particular for the MUFA and PUFA concentrations, whereas no differences were observed for the SFA. The content of MUFA was significantly higher in *Longissimus* muscle than in backfat, due to its higher concentration of C18:1cis9 and C16:1. This result did not agree with the data reported in an experiment carried out with pigs from seven different groups of genotype and sex (Monziols *et al.*, 2007). The CLAc9,t11 concentration was significantly higher ($P < 0.05$) in backfat than *Longissimus* muscle. The PUFA content was higher in backfat than in *Longissimus* muscle, in accordance with the results of Monziols *et al.* (2007).

In conclusion, the fatty acid profile of adipose finishing pig tissue was significantly affected by the fatty acid composition of the diets administered during the last four weeks before slaughtering. The present experiment confirmed that the various adipose tissues of pig differ for their fatty acid composition. The backfat tissue had a higher concentration of PUFA and a lower content of MUFA than the intramuscular fat of *Longissimus* muscle. Our data demonstrate that it is possible to manipulate the fatty acid composition of diet in order to improve the health properties of the adipose tissues of pork meat.

Table 1. Fatty acid composition of backfat and Longissimus muscle of finishing pigs fed diet added with 2% of rapeseed oil (RSO) or sunflower oil (SFO) for the last 4 weeks.

Fatty acid, g/100 g FAME	oil		tissue		SEM	P	
	RSO	SFO	backfat	muscle		oil	tissue
C14:0	1.07	1.20	1.13	1.14	0.026	**	ns
C16:0	21.73	22.50	21.91	22.31	0.264	*	ns
C16:1	1.88	2.20	1.73	2.36	0.093	*	**
C18:0	13.15	13.10	13.28	12.97	0.261	ns	ns
C18:1cis9	37.84	37.79	35.50	40.13	0.514	ns	**
C18:2n-6	16.95	15.93	19.31	13.57	0.602	ns	**
C18:3n-3	1.15	0.96	1.28	0.82	0.045	**	**
CLA c9,t11	0.11	0.10	0.12	0.09	0.007	ns	*
C20:4n-6	0.43	0.38	0.30	0.52	0.024	ns	**
SFA ¹	36.53	37.34	36.89	36.98	0.421	ns	ns
MUFA ²	44.81	45.29	42.11	48.00	0.650	ns	**
PUFA ³	18.66	17.36	21.00	15.02	0.643	ns	**
MUFA/SFA	1.23	1.22	1.14	1.30	0.026	ns	**
PUFA/SFA	0.51	0.47	0.57	0.41	0.020	ns	**
n6/n3	13.97	15.87	14.47	15.37	0.439	**	ns

¹SFA, total amount of saturated fatty acids; ²MUFA, total amount of monounsaturated fatty acids. ³PUFA, total amount of polyunsaturated fatty acids.

ns= $P>0.05$; *= $P<0.05$; **= $P<0.01$.

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