

EFFECT OF 2 YEARS OF STORAGE ON SENSORY QUALITY OF PORK LOIN WITH A HIGH CONTENT OF POLYUNSATURATED FAT

Marchen Hviid* & Mari Ann Tørngren

Danish Meat Research Institute

Key Words: Frozen storage, rancidity, tenderness, polyunsaturated fat, shelf life, pork loin, oxidation

Introduction

Inclusion of polyunsaturated fatty acids (PUFA) in pigs' diets increases the risk of lipid oxidation in both the living organism and the carcass (Jakobsen, 1995). It means that the shelf life of meat and meat products during storage will normally become poorer and the storage time will be shorter compared to meat from pigs fed a 'normal' diet. In meat there are three different types of fat: lard (back fat) covering the meat, triglycerides in the inter- and intramuscular fat and phospholipids in the cell membranes. Phospholipids are mainly polyunsaturated, whereas triglycerides are mainly monounsaturated, making the phospholipids more oxidative labile. The diet will mainly influence the fatty acid composition in back fat and triglycerides whereas the fatty acid compositions in phospholipids are the same (Lauridsen *et al.*, 1999). Polyunsaturated fatty acids are desirable in meat due to their nutritive quality in the human diet, but large amounts will lead to softening of the products and make them susceptible to lipid oxidation (Warnants *et al.*, 1998). Oxidation occurs initially on the surface of the product when the meat/fat is exposed to oxygen. The oxygen or the primary or secondary oxidation products from the lipid oxidation might diffuse inside the meat and accelerate the oxidation in the rest of the product, so the entire product will get a rancid taste and off-flavour.

Objective

To investigate the shelf life and sensory quality in the back fat and middle of pork loins stored for two years at -20°C and compare them with the fatty acid composition in back fat, triglycerides and phospholipids in the loin.

Methodology

Thirty-six female pigs with an average slaughter weight of 75 kg were used for this experiment. The pigs were fed three different feeding stuffs, each resulting in a high level of unsaturated fat in the meat. After slaughtering at a commercial slaughterhouse (Danish Crown, Holstebro) both loins from each carcass were vacuum-packed, matured for four days and then stored at -20°C until thawing. Prior to the sensory analysis by a panel of 8 panelists, the loins were thawed for approximately 20 hours at 4°C . The loins were sliced in 20 mm thick chops. A cast iron frying pan was heated to 200°C before the chops were

placed on the pan, and the chops were turned every two minutes and fried to center temperature of 65–68°C. After frying the chops were cut in two and served to the panelists. Chops from the right loin were served after two years on frozen storage, and the following attributes of the meat were judged on a continuous scale from 0 (no intensity) to 15 (high intensity): tenderness, juiciness, sour taste, fried meat flavour, rancid flavour in back fat, rancid flavour in meat, faded flavour.

At the time of slaughter, the meat was analyzed for fatty acid composition of triglycerides and phospholipids, and the back fat for fatty acid composition of triglycerides using the GC-FID method. The fatty acid was divided into saturated fatty acid **SFA**, monounsaturated fatty acid **MUFA** and polyunsaturated fatty acid **PUFA**.

Results & Discussion

The fat content of the three types of feeding stuff all came from different vegetable fat sources and led to a higher level of PUFA in the lipids of the carcass compared with pigs fed a conventional diet. Lauridsen et al. (1999) found that PUFA in back fat and triglycerides from Danish pigs fed a basal (basic) diet was 11 and 5 compared with 27 and 10 in this experiment (Table 1).

There was no difference in the sensory analyzes in relation to the three types of feeding stuff after two years of storage, and the level of tenderness, juiciness and fried meat flavour in this experiment (table 2) was at the same level, that is normally found in fresh Danish pork shops (Magnussen, 2004).

After two years' frozen storage, the panelists were able to detect whether the meat had a rancid and faded flavour. The rancid flavour differs whether it is back fat or meat from the loin. The back fat was found more rancid, 50% of the loin had an intensity score of > 3, whereas 80% of the loins were <1 for rancid flavour in the meat, so the off-flavour product from the oxidation of the back fat will not be able to diffuse into the meat and result in a more rancid flavour.

Oxidation of the fat will commence in the back fat fraction and will led to a higher intensity of rancid flavour of the fat. The oxidation of the lipids inside the meat (triglycerides and phospholipids) will not produce sufficient off-flavour products for a trained person to be able to detect the flavour even after two years' frozen storage (Table 2 and Table 3).

The correlation between %PUFA in the back fat and the rancid flavour is significant, however, on a low level. While the level of rancid flavour is low and not detected in 80% of the meat samples, there will be no correlation between the % PUFA in the triglycerides and phospholipids and the rancid flavour of meat (Table 4). In this experiment the variation in PUFA was small (from 21 to 34). This could explain for the low correlation between PUFA and rancid flavour.

Conclusions

A storage time of up to two years will lead to a higher intensity of rancid flavour in the back fat, but not in the meat, because oxidation of PUFA will commence in the back fat. In this experiment the level of PUFA in the back fat was more than twice as high as in a basic pig feed, but it did not lead to an accelerated oxidation and a more rancid flavour of the meat. The amount of PUFA in back fat is significantly correlated to rancid flavour.

References

- Jakobsen, K. 1995. Possibilities of enriching mat with n-3 fatty acids. In: K. Ender (Ed.) Proc. 2nd Dummerstorf muscle-workshop, May 17–19, Rostock. pp141–148.
- Lauridsen, C. J.H. Nielsen, P. Henckel & M.T. Sørensen. 1999. Antioxidative and Oxidative status in Muscles of Pigs fed Rapeseed oil, Vitamin E and Copper. J. Anim. Sci. 77. pp105–115.
- Magnussen, C.C. 2004. Danish pigs – Sensory Quality of Organic and Conventional Fresh Pork. EU Workshop – Sustainable Pork Production. Copenhagen, 17th – 18th June.
- Warnants, N., M.J. Van Oeckel, C.V. Boucqué. 1998. Effect of Incorporation of Dietary Polyunsaturated Fatty Acids in Pork Backfat on Quality of Salami. Meat Science 49. pp435–445.

Tables and Figures

Table 1. The fraction of the fatty acid analyzed in the three fat types.

	Loin		Back fat
	Triglycerides	Phospholipids	Total lipid
SFA %	39	39	33
MUFA %	52	18	40
PUFA %	10	43	27

Table 2. The sensory analysis of the chops after 2 years of storage

Intensity (0 – 15)	
Tenderness	9.5
Juiciness	9.1
Sour taste	6.5
Fried meat flavour	7.0
Rancid flavour, back fat	3.4
Rancid flavour, meat	0.6
Faded flavour	1.4

Table 3. Frequency of loins (%) in groups with an increasing intensity of rancid and faded flavour

	Rancid		Faded
	Back fat	Meat	
< 1	22	81	36
1 – 2	19	8	36
2 – 3	8	6	19
3 – 4	8	5	9
4 – 5	18	–	–
5 – 6	6	–	–
6 – 7	14	–	–
> 7	5	–	–

Table 4. The correlation (Pearson) between the rancid flavour and the PUFA % of the three different fat types.

	Rancid flavour, back fat	Rancid flavour, meat
PUFA, phospholipid	0.301 (p=0.07)	0.200 (ns)
PUFA, triglycerides	0.138 (ns)	0.006 (ns)
PUFA, Back fat	0.133 p<0.05	0.035 (ns)