

EXTENDED MAP STORAGE REDUCES SATURATED AND INCREASES MONOUNSATURATED FATTY ACIDS IN MARBLED PORK LOIN

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Abstract – This study analysed the impact of 20-day MAP storage on fatty acid composition of marbled pork loin. A total of 73 pork loin samples (4.68±1.39% of intramuscular fat) were sliced to measure pH and fatty acid composition at 1, 10 and 20 days of MAP storage (70% O₂/30% CO₂). Extended MAP storage (up to 20 days, 70% O₂/30% CO₂) reduces SFA and concomitantly increases MUFA content in marbled pork loin. However, most of PUFA, especially n-3, remained uniform at long MAP storage periods.

Key Words – intramuscular fat, nutritional quality, packaging.

I. INTRODUCTION

At present, red meat is mainly prepared and packaged centrally rather than sold at retail stores. Several packaging conditions are used, including modified atmosphere (MAP). Retail-ready fresh pork in MAP contains oxygen-rich gas mixtures to provide a bright-red colour that is attractive to the consumer. However, oxygen-rich packaging may turn out oxidation and/or hydrolysis of meat fatty acids during extended storage under refrigeration. This study analysed the impact of 20-day MAP storage on fatty acid composition of marbled pork loin.

II. MATERIALS AND METHODS

A total of 73 barrows with 201±1 days of age and 132.9±10.4 kg of body-weight (average ± standard deviation) were selected from a purebred Duroc population (Selección Batallé, Riudarenes, Girona, Spain). The pigs' feed during the last two months of finishing had 2,400 kcal of net energy/kg, 0.84% of total lysine (13.3% of crude protein), and 5.6% of ether extract. The pigs were stunned using CO₂, exsanguinated, scalded, skinned, eviscerated, and split down the midline. The overall carcass weight was 98.8±8.7 kg. A section of 400 g of *L. thoracis* muscle was excised at the 3th-4th last rib area after 20 h carcass chilling (2 °C). Samples were placed in individual plastic bags and vacuum-packaged at 4 °C. The loin sample was sliced into three parts to measure pH and fatty acid composition at 1, 10 and 20 days of MAP storage. Pork loin slices were placed (in groups of 3) on polypropylene trays (9.5 x 13.5 x 2.5 cm) that were sealed with a two mold modified atmosphere packaging machine (ILPRA, Model Basic VG) using a barrier film after filling with a gas mixture (70 %O₂/30% CO₂; Abelló Linde S.A, Barcelona, Spain). The packages were evacuated using a 700 mm Hg vacuum. The trays were kept in dark at 4 °C for 20 days and they were sequentially opened for pH and fatty acid determination. Meat pH was measured on a 3 g homogenized sample (ground meat) that was blended with 27 ml of distilled water with a homogenizer (1,500 rpm during 10 s) [1]. Meat fatty acid methyl esters (FAMES) were directly obtained by transesterification using a solution of boron trifluoride 20% in methanol, followed by 2 h heating at 80°C, centrifugation at 2,500 rpm during 5 min and collection of the final supernatant. Analysis of FAMES were performed in duplicate by GC with a 30 m x 0.25 mm capillary column (Agilent DB-23, Agilent Technologies, Santa Clara, USA) and a FID with helium as the carrier gas at 2 mL/min. The oven temperature program increased from 150-220 °C at 8 °C per min, and the injector and detector temperatures were both 250 °C. The quantification was carried out through area normalization after adding into each sample 1,2,3-tripentadecanoylglycerol as internal standard. The data were analysed with a standard least squares model including MAP storage time as fixed effect. Differences (P<0.05) between least square means were assessed using a Tukey test. Linear regressions coefficients for storage time were also estimated.

III. RESULTS AND DISCUSSION

The average intramuscular fat of the samples was 4.68±1.39%. Pork loin slices increased their pH linearly throughout 20-day MAP storage period (P<0.001; Table 1). Gas mixtures should provide a balance between oxygen-rich atmosphere benefits on meat colour and the CO₂ inhibitory effect on microbial growth [1], which increase above

pH=6.0 [2]. Thus, the FA composition of pork loins stored up to 20 days in MAP may have undergone mild microbial spoilage according to meat pH.

The saturated fatty acids (SFA) concentration decreased quadratically with advancing MAP storage time ($P<0.001$; Table 1), mainly due to the reduction of C16:0 and C18:0 at 20 days. An opposed trend was observed in monounsaturated fatty acid (MUFA) concentration, which were increased by storage time ($P<0.001$; Table 1), mainly due to C18:1 n-9 and C18:1 n-7 rise at 20 days. A similar triacylglycerol (enzymatic) hydrolysis was described in 14-day refrigerated chicken breast muscles, which in that case did not promote lipid oxidation [3].

In the present study, polyunsaturated fatty acid (PUFA) content of pork loins was not regular during storage. Linolenic acid (C18:3 n-3) was not affected by storage but the PUFA n-6 contents were increased in some cases (C18:2, C20:2, C20:3) and decreased in some other (C20:4) at the end of storage period. In agreement with the current results, Díaz et al. [4] found that n-3 were less prone to oxidation than n-6 PUFA, being especially affected those with longer chains and greater degree of unsaturation.

Table 1. pH and fatty acid composition (g/100 g FA) of pork loin stored under refrigeration in MAP for 1, 10 or 20 days

	Day 1	Day 10	Day 20	SEM	Linear slope	P-value
Meat pH	5.77c	5.90b	6.04a	0.03	+0.01	<0.001
C14:0	1.66	1.69	1.62	0.02	-	NS
C16:0	26.04b	26.77a	24.15c	0.15	-0.08	<0.001
C18:0	12.00a	11.71a	10.39b	0.10	-0.08	<0.001
C20:0	0.197a	0.183b	0.153c	0.003	-0.002	<0.001
∑ SFA	40.2a	40.4a	36.6b	0.24	-0.17	<0.001
C16:1	3.87b	3.92b	4.17a	0.06	+0.01	<0.001
C18:1 n-7	4.22b	4.21b	4.52a	0.03	+0.01	<0.001
C18:1 n-9	42.47b	42.90b	45.50a	0.22	+0.15	<0.001
C20:1	0.755b	0.787b	0.844a	0.012	+0.005	<0.001
∑ MUFA	51.3b	51.8b	55.0a	0.21	+0.18	<0.001
C18:2 n-6	6.08ab	5.68b	6.17a	0.12	-	NS
C18:3 n-3	0.292	0.282	0.299	0.005	-	NS
C20:2 n-6	0.294ab	0.287b	0.309a	0.005	-	NS
C20:3 n-6	0.201ab	0.181b	0.214a	0.006	-	NS
C20:4 n-6	1.59a	1.39b	1.38b	0.06	-0.01	<0.01
∑ PUFA	8.46a	7.82b	8.37ab	0.19	-	NS

NS=not significant ($P>0.05$). Within each row, different letters indicate significant differences between storage times ($P<0.05$).

IV. CONCLUSION

Extended MAP storage (up to 20 days, 70% O₂/30% CO₂) reduces SFA and concomitantly increases MUFA content in marbled pork loin. However, most of PUFA, especially n-3, remained uniform at long MAP storage periods.

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