LIPID OXIDATION IN VACUUM-PACKED PORTUGUESE DRY-CURED HAM

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Background and objectives

The subject of this work is the Alentejano dry cured ham, a traditional unsmoked product made with meat from Alentejano pig breed (*Sus mediterraneus*). This autochthonous breed is raised in Portugal (mainly in the Alentejo region) and Spain. The diet of the Alentejano pig habitually contains a high proportion of acorns because they are raised extensively in *Quercus ilex*, *Q. rotundifolia* and *Q. suber* woods. Alentejano ham has a high commercial value because of its characteristic flavour, the result of a combination of the marbled meat and the diet of the Alentejano pigs.

Several studies have been made about dry-cured ham from *Sus mediterraneus* (Flores *et al.*, 1988; Antequera *et al.*, 1992; López *et al.*, 1992; Sanabria *et al.*, 1997; Elias and Carrascosa, 2000).

The aim of this work was to study the lipid oxidation of vacuum-packed Alentejano ham, as affected by processing and slicing methods.

Methods

Alentejano pigs were bred in an extensive camping system in the Alentejo, a portuguese region, feeding a diet consisted mainly of acorns. After slaughter, hams weighing 6/7 kg on average were processed and cured in two local factories using the following processing methods:

Process 1) dry salting under a pile of sea salt for 25 days (10-14°C and 65-85% Relative Humidity (RH)); superficial washing with cold water to remove excess surface salt; post salting during 3 weeks at same conditions of dry salting; drying in cellars until 12 months after dry salting from 12 to 26°C and from 75 to 50% RH, which are the natural conditions of the Alentejo climate.

Process 2) dry salting under a pile of sea salt for 7 days (2-4°C and 95%RH); superficial washing with cold water; post salting during 60 days (12-14°C and 90-95%HR); drying for 40 days at 12-14°C and 70-80%RH, and 320 days at 15-20°C without RH control.

When the process was completed 5 hams were taken from each process and deboned. They were than sliced perpendicularly to their longitudinal axis and from each ham were obtained 4 portions: 3 of them were mechanically sliced and vacuum packed in plastic bags (Cryovac®) each containing approximately 250g maintained in 7°C ± 1°C and analysed after 2, 5 and 8 months of storage; the other portion was used to obtain data on time 0, without storage.

All samples were vacuum packed and stored at -30°C until analysis. 6g of frozen samples were minced for the analysis.

For the isolation of volatile compounds the purge conditions were: 45°C for sample temperature; 10ml/min of Helium for purge flow; 15 min for purge time. Gas chromatography was performed for separation and identification of volatile compounds; were used a 50m x 0.32mm id fused silica column coated with a Phenyl-methyl-silicone of 1.05 µm, using Helium as the carrier gas. The column was held at 50°C while transferring the headspace components; after 5 min. the oven temperature increased 5°C/min. until it reached 210°C and then it was held for 1 min. Mass spectrometer was scanned from 10m/z to 400m/z. The ion source was maintained at 280° and the spectra was obtained by electron impact (70ev). The spectrum was identified by comparison with a Wiley library.

The Statistic program was used to perform Anova analysis and means comparisons (Tukey).

Results and discussion

Table 1 shows the average of area/10^6 of the volatile compounds identified in the head space of all samples analysed.

The results about ketones show that 2-butanone and 2-pentanone was kept almost constant during storage time, however the values of 2-propanone exhibited a tendency to decrease during that time, on a non significant level. According to Vidal-Aragón *et al.* (1994), degraded hams exhibited values of 2-butanone, 2-pentanone and 2-propanone of 122,4, 101,8 and 591,8 respectively and they found lower values in good hams, 93,1, 26,7 and 38,4 respectively. So the low level in these observed components seems to be a factor of quality.

About n-alkanes, only heptane showed significant differences with higher values at 3 and 5 month of storage. However these compounds don't have an important role in the sensorial characteristics.

Aldehydes exhibited changes during the storage time, with tendency for increasing values, mainly in samples from process 2. These compounds are related with good sensorial quality of cured ham (Antequera, 1991). So the results obtained should be an advantage. Hexanal and nonanal are the most important secondary products obtained trough the oxidation of oleic and linoleic acids, respectively.

Conclusions

The results of all the compounds studied in this work exhibited a desirable evolution so it can be concluded that the storage conditions are adequate for those products.

However the products from process 1 showed higher values of the studied compounds that those obtained from process 2.

The most important values found during this work was the results of Aldehydes group analyses, and in that group Hexanal was the compound with highest values.

Table 1 – Autoxidation compounds (average of area/10^6 of the volatile compounds identified in the head space of all samples analysed) from sliced vacuum package Alentejano dry cured ham during refrigeration.

COMPOUNDS	PROCESS	STORAGE TIME (months)			
		0	2	5	8
2-propanone	1	16,4 ± 4,4	7,2 ± 4,7	8,9 ± 1,1	2,8 ± 2,8
	2	23,7 ± 10,1	1,2 ± 1,2	3,1 ± 2,6	5,5 ± 5,5
Pentane	1	10,5 B	6,8 ± 6,8	13,8 ± 2,0	14,4 ± 8,9
	2	0 A	4,8 ± 3,0	5,7 ± 3,6	9,2 ± 6,3
2-butanone	1	11,0 ± 3,9	7,6 ± 1,9 B	6,5 ± 0,7 A	15,4 ± 6,9
	2	8,2 ± 4,1	3,1 ± 0,4 A	1,5 ± 0,6 B	4,5 ± 1,2
Hexane	1	16,3 ± 9,9	15,9 ± 3,4 B	15,9 ± 1,5	5,3 ± 5,3
	2	2,7 ± 1,7	7,9 ± 1,3 A	11,3 ± 3,7	2,9 ± 2,2
2-pentanone	1	5,1 ± 0,7 A	3,7 ± 1,4	3,8 ± 1,3	8,4 ± 1,8
	2	12,7 ± 2,0 Bab	5,1 ± 0,6 a	5,9 ± 0,9 a	15,6 ± 3,2 b
Pentanal	1	15,9 ± 2,7 a	58,9 ± 9,5 b	25,8 ± 3,8 a	26,5 ± 13,7 ab
	2	15,1 ± 2,0	36,8 ± 5,0	18,8 ± 3,3	38,4 ± 13,8
Heptane	1	17,3 ± 7,7 a	68,7 ± 6,0 Bb	61,6±12,7 Bab	47,6 ± 17,2 ab
	2	5,2 ± 1,5	24,3 ± 1,9 A	13,3 ± 2,9 A	16,4 ± 9,4
Hexanal	1	68,4 ± 13,4 a	188,9±12,2 Bb	130,1 ±10,4 ab	181,7 ± 40,8 b
	2	72,2 ± 11,5 a	136,1±9,6 Aab	98,7 ± 19,3 a	285,4 ± 74,3 b
Heptanal	1	9,6 ± 2,0	24,7 ± 9,2	17,8 ± 2,7	20,0 ± 6,0
	2	10,8 ± 1,6	22,4 ± 2,4	13,0 ± 3,8	46,0 ± 22,3
Nonanal	1	0 A	5,4 ± 4,0	2,3 ± 1,1	6,2 ± 1,5 A
	2	4,5 ± 0,8 Ba	4,1 ± 1,2 a	6,2 ± 2,0 a	15,7 ± 2,7 Bb

For each compound , different capital letters at the same column or different small letters at the same row represent means significant different ($p<0,05$).

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