DIFFERENTIATION OF IBERIAN HAMS FROM IBERIAN AND IBERIAN x DUROC PIGS BY ANALYSIS OF VOLATILE ALDEHYDES

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KEY WORDS: Iberian pigs, Iberian x Duroc pigs, Cured Hams, Volatile Aldehydes

BACKGROUND

The most valuable cured meat products of Spain are hams elaborated from pigs of the Iberian breed. The genuine Iberian hams arise from pigs feed extensively on pasture with acorn until they reach a live weight of about 140-160Kg. The thighs obtained are exceptionally marbled (around 10% i.m. fat) and acquire sensorial characteristics that not are found in other types of hams. The use of Duroc has been introduced for reasons of improve the performance and prolificity of Iberian pigs but their products (loins, hams...) have a reduced consumer acceptance reaching lower prices in the market. Despite its economic importance until now none scientific information is available on influence of breed on the flavour compounds and the sensorial quality of Iberian hams.

García *et al.*, (1991) examined the flavour compounds isolated from the genuine Iberian has and found that the lipid-derived carbonyls, alcohols and hydrocarbons dominated the volatiles. The variations in sensorial quality of cured Iberian hams could be attributed to the changes in the lipid composition of fat and also to degree of lipid breakdown during processing. Antequera *et al.*, (1994) have reported significant differences in the lipids from subcutaneous fat of carcases of Iberian x Duroc (50/50) with respect to Iberian pigs. Moreover changes in the composition of the free fatty acids fraction along processing were observed for the same authors. Them it would be convenient to know if these reported differences lead to modifications in the concentration of volatile aldehydes present in the cured hams.

METHODS

Selection of the hams

Five cured hams from Iberian pigs and five of Iberian x Duroc (50/50) pigs were selected. Pigs had been exclusively fed on pasture and acorns (*Querqus suber* and *Q. ilex*) until they achieved a final weigh of about 160Kg. Hams were processed according traditional way used for these products (Antequera *et al.*, 1992).

Samples were taken after ripening for 18 months from *Biceps femoris* muscles of each ham.

Lipids extraction

Lipids were extracted from samples with chloroform: methanol mixture (2:1) using the method of Folch (1957).

Acidity (FFA) and Peroxide value (PV)

The determinations of total FFA and peroxide value were carried out by the methods recommended by the AOAC (1984 a,b).

Water activity (Aw)

Aw was determined at 20°C by the graphic interpolation method using saturated salt solutions as standards (Landrock and Proctor, 1951).

Salt (ClNa), Nitrates and Nitrites

To estimate the salt, nitrates and nitrites contents were extracted with water/ethanol (60:40 v/v). The chlorides were quantified by the Carpentier Vohlard method (AOAC, 1984c).

Nitrite and nitrate were analyzed spectrophotometrically by using the Griess reaction and the brucine method (AOAC, 1984d,e) respectively.

Volatile aldehydes

The aldehydes from the hams were converted into 2,4-dinitrophenylhydrazone (2,4-DNP) derivatives and separated into individual compounds by high performance liquid chromatography (HPLC) according the method of Reindl and Stan (1982).

The 2,4-DNP derivatives were separated in an LKB HPLC with Supelcosil LC 18 column (5μm, 250x4,6mm) with isocratic elution of 1ml/min. The eluent was acetonitrile:water:tetrahydrofuran (75:24:1) and the temperature in the column was 40°C. Detection took place at 360nm.

The identification was realized by comparison with retention time of authentic standards (Sigma).

Table 1. Means and standad errors of different parameters in muscle *Biceps femoris* of Iberian and Iberian x Duroc hams

	IBERIAN	IBERIAN x DUROC	Level of significance
Moisture (%)	48,67±0,05	48,20±0,95	ns
Lipids (g/100g DM)	24,67±2,41	23.89±1,83	ns
Protein (g/100g DM)	44,99±0,59	44,69±0,72	ns
Aw	0,841±0,002	0,867±0,005	*
Cl^- (%)	6,24±0,73	5,45±0,76	ns
NO_3^- (ppm)	158,11±14,23	145,74±9,49	ns
NO_2^- (ppm)	0,21±0,05	0,87±0,34	ns
FFA (%oleic acid)	6,74±0,27	7,25±0,17	ns
PV	9,22±0,47	9,72±1,51	ns

Level of significance: ns=not significative (P>0.05); *=P<0.05.

Statistical analysis

Differences in the aldehydes content of hams from Iberian and Iberian x Duroc pig were analyzed by analysis of variance using the General Linear Model (GLM) procedure of SAS (1989). Discriminant analysis techniques were used to separate the two batches of hams, using stepwise discriminant analysis (STEPDISC) and canonical discriminant analysis (CANDISC) procedures of SAS (1989).

OBJECTIVES

In this work, the purpose was to determine the differences in volatile aldehydes between hams from Iberian and Iberian x Duroc pigs.

RESULTS AND DISCUSSION

In table 1 are showed the different parameters physicochemical analyzed. The intramuscular fat, no significant differences were found between the two groups of the hams. No significant differences in chlorides and nitrates and nitrites were found, these findings make us to suppose that salt penetration during the processing was similar in all the hams. Only in water activity (Aw) the differences were

significatively, likely because green hams from Iberian x Duroc pigs were bigger than Iberian pigs (Antequera *et al.*, 1994).

The total content of free fatty acid (FFA) and peroxide value (PV) (Table 1) are similar in the two types of hams. This fact shows that conditions (relative humidity and temperature) during the ripening are very important, and these are more influenced by the physicochemical characteristics than the differences found in green hams.

Aldehydes have very-low-threshold olfactory concentrations, and therefore constitute an important group of natural flavours. These components are formed during processing, mainly by oxidation of unsaturated fatty acid in enzymatic and non enzymatic reactions (Ohloff, 1973; Tressl *et al.*, 1981).

In the table 2 is showed the composition of aldehydes in Iberian hams from Iberian and Iberian x Duroc pigs. Among them, the most abundant were hexanal and nonanal, the main secondary products of the oxidation of linoleic and oleic acids respectively. The higher amount of nonanal observed in hams from Iberian pigs could favoured a desirable flavour that this type of ham possesses (García *et al.*, 1991; López *et al.*, 1992).

Table 2. Means and standar errors of volatile aldehydes in *Biceps femoris* muscle of Iberian pigs and Iberian x Duroc pigs ham.

ALDEHYDE (ng/g)	IBERIAN	IBERIAN x DUROC	Level of significance
C6	1857,84±369,12	1305,22±138,70	ns
C7	199,84±44,03	176,36±54,56	ns
C8	239,20±53,39	85,68±23,39	*
C9	1092,35±245,11	503,25±95,15	*
2-C9	0,04±0,04	0,29±0,09	*
2,4-C9	0,01±0,02	0,82±0,82	ns
2,4-C10	9,05±0,08	13,39±2,51	ns

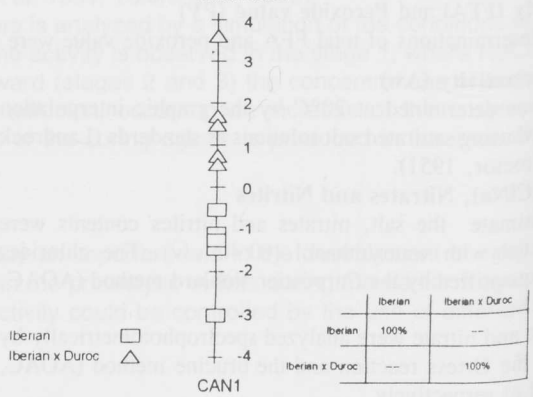
Level of significance: ns=not significative (P>0.05); *=P<0.05.

Octanal and heptanal, originate in the homolysis of hidroperoxides formed during oleate degradation (Ladikos and Lougovois, 1990). Similar amount of heptanal was found in the two groups of hams. However, the level of octanal was higher in hams from Iberian pigs. The increase in octanal is very important for the development of desirable flavour. Odor of octanal has been described as fruity, green, sweet (Specht and Baltes, 1994). Unsaturated aldehydes (2-nonenal, 2,4-nonadienal and 2,4 decadienal) appear in low quantities in Iberian hams. Were observed significative differences in 2-nonenal that have influence on fresh and cucumber (Stahnke, 1994). The 2,4-decadienal, which degrades to hexanal, was the more abundant in both cases. This aldehyde is associated to rancid and fried flavours (Stahnke, 1994). Low quantities of them could make worse the desirable flavour of octanal and nonanal (Baines and Mloztiewicz, 1984).

The higher amount of linoleic acid was observed by the authors in hams from Iberian x Duroc pigs (Antequera *et al.*, 1994), could result in differences observed in the concentration of volatile aldehydes and the aroma final of these hams.

Discriminant factorial analysis has been done with all aldehydes (Fig. 1), resulting in a 100% discriminant percentage of samples. Octanal, nonanal and 2-nonenal were the aldehydes selected by the discriminant analysis.

Figure 1.- Graphic representation of the canonical variable of aldehydes of hams from Iberian and Iberian x Duroc pigs and percentage of hams correctly classificated.



CONCLUSIONS

The differences observed in the parameters physicochemical studied between the two groups of hams were of little relevance.

The composition of volatiles aldehydes shows that the aldehydes generated from oleic were higher in hams from Iberian pigs.

Using discriminant factorial analysis of aldehydes was obtained a 100% percentage of discrimination between hams from Iberian and Iberian x Duroc pigs.

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