Sensory characteristics of dry-cured shoulders: Influence of crossbreeding

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***Abstract*— Present work was aimed to characterize the sensory attributes of dry-cured shoulders produced from pigs with different crossbreeding: Iberian female x Duroc male (ID) and Landrace x Large White female x Duroc male (LLD) pigs, all of them fed with commercial concentrates. In order to evaluate the influence of the genetic background, thirteen dry-cured shoulders were assessed for nineteen different attributes by a trained panel of 14 members, using a descriptive analysis method [1]. Dry-cured shoulders from ID pigs, reached higher scores for quality attributes as brightness, lean colour, odour and flavor intensity but higher values too of saltiness and rancid flavour. However, dry-cured shoulders from LLD pigs showed higher values in other quality attributes as cured flavor and marbling, its high value could be related with the lower value of saltiness in shoulders from LLD batch. The effect of crossbreeding on sensory characteristics of dry-cured shoulders showed large differences between batches in most of the attributes evaluated. These results have been obtained using trained panelists; however a consumer panel assessment is needed to better understand the relationship between sensory profile and dry-cured shoulder acceptability.**

***Keywords*—** Dry-cured shoulder, Flavour and Sensory evaluation.

I. INTRODUCTION

Dry-cured shoulders are products of high quality; however, the most recognize product by the consumer is the dry-cured ham. Nevertheless, the high sensory quality, the nutritional value and the short ripening process make of dry-cured shoulders a very interesting issue of study, because the results can be extrapolated to dry-cured ham, which involves a longer ripening process.

Technological characteristics of dry-cured shoulders and sensorial qualities of the final product depend on many factors related to the raw material and production process. The productive efficiency related with shoulders production is directly connected with the genetic aptitudes and physiological characteristics (weigh, handing and genetic) where pigs raise.

The use of Duroc males would be of great interest for ‘‘Protected Designations of Origin’’ (PDO) with a different purpose with the use of this race with Iberian breeds. In white pigs this objective is to improve the marbling of dry-cured products because it is very low in genetics Landrace / Large White. Moreover, the Iberian pig breed is commonly crossed with animals from the Duroc breed to improve some productive characteristics, minimizing the reduction in IMF content that could be occasioned if other pig breeds were used [1].

It is well known that intramuscular fat (IMF) plays a decisive role in the development of the sensory features of dry-cured products [2, 3]. Increasing IMF levels are generally considered as a way to enhance the eating quality of both fresh pork and dry-cured products such as hams and shoulders [4]. But it has a negative influence of the visible fat.

Thus, the objective of this work was to study the influence of different sensory characteristics on the overall quality of dry-cured shoulders to establish which of these sensory traits show a greater effect on the overall quality. This would be useful for shoulder producers, since it would allow controlling those features directly related to the acceptability of the shoulder.

II. MATERIAL AND METHODS

A. Animals

This study was carried out with 20 Landrace x Large White x Duroc crossbred pigs (LLD) (Landrace x Large White females and Duroc males) and 10 Iberian x Duroc crossbred pigs (ID) (Iberian females and Duroc males). LLD pigs were reared, fed and

slaughtered according to the ‘‘Protected Designations of Origin’’ (PDO) [5]. ID pigs were reared indoors and fed on commercial fatless concentrates. Animals were slaughtered by electrical stunning and exsanguinations at a local slaughterhouse after the fattening period at a live weight of 161–167 kg.

B. Dry-curing process

Dry-cured shoulders were placed in piles of salt at 4ºC and 80% relative humidity (RH), for 1 day/kg weight (salting) for ID shoulders and two less days for LLD shoulders. After salting, the salt from the surface was brushed and the shoulders were processed as follows. LLD and IB shoulders were held at 3,5ºC and 75–80% RH for 5 days, after 3,5ºC and 78-82% HR for 60 days (post-salting step). Temperature was thereafter increased from 3,5ºC to exterior conditions at less than 1ºC per two days (it depend the time of year) during 30 days. Finally, shoulders were kept in a room under natural conditions for the rest of dry-cured process, about 10 months (drying stage).

C. Fat extraction and fatty acid analysis

Intramuscular total lipids from dry-cured shoulders were extracted and quantified according to the method described by [6]. Fatty acid methyl esters (FAMEs) were prepared by acidic-trans-esterification in the presence of sulphuric acid (5% sulphuric acid in methanol). FAMEs were analyzed by gas chromatography according to the method described by [7].

D. Descriptive sensory test

Thirteen dry-cured shoulders (ten from ID and twenty from LLD batch) were assessed by a trained panel of 12 members, using a quantitative-descriptive analysis method (QDA) [8] for 19 different attributes. Panellists were trained and had previously participated in sensory evaluation of dry-cured products. The sensory traits, their definitions and extremes are summarized described in numerous works [8, 9, 10] Questions were presented to assessors in the normal perception order, as follows: visual analysis, odour perception, lean texture and flavour. Three different dry-cured shoulders were randomly selected out of the 30 dry-cured shoulders processed and evaluated in each daily session. A total of 10 sessions were carried out. Sample order was also randomized. Two thin slices (1.0–1.5 mm) of each shoulder were given to the assessors. Slices were obtained using a commercial slicing machine and immediately served on glass plates to the panellist. Both the slices and the plates were at room temperature (20–23 ºC). A glass of water of about 200 mL at 12 ºC was provided to each assessor. All sessions were done in a four booth sensory panel room at 22 ºC equipped with white fluorescent lighting. 19 traits concerning sensory characteristics of dry-cured shoulders (Table 1), grouped in appearance, odour, texture, taste and flavour were assessed by the panellist using a 10 cm unstructured line, ranging for ‘‘less’’ to ‘‘more’’. FIZZ Network (version 1.01: Biosystemes, France) program was used for the sessions and the recording data obtained. The mean of all panellist scores for each attribute of each evaluated dry-cured shoulder was calculated to perform the statistical analysis.

E. Statistics

Treatment of anomalous data was carried out using Grubb test, recommended by ISO rules. The statistical analysis was carried out an analysis Multivariate analysis using the statistical package SPSS software (v. 12.0)

III. RESULTS AND DISCUSSION

IMF content and the percentage of saturated (SFA), monounsaturated (MUFA) and polyunsaturated (PUFA) fatty acids of the total fatty acids of dry-cured shoulders are shown in Table 1. Not differences between genotype were found in the intramuscular fat content and in the SFA proportion. Nevertheless, the genotype significantly affected the MUFA and PUFA proportions. ID batch had a larger proportion of MUFA. In contrast, dry-cured shoulders from LLD batch had a larger proportion of PUFA.

Mean scores of appearance, odour, texture, taste and flavour traits are presented in Table 2 and Figure 1. Among flavor traits, only fluidness, lean hardness and bitterness not showed significant (p<0,05) differences between batches.

Table 1. Intramuscular fat content and fatty acid profile (mean values ± SD) of total fatty acids from dry-cured shoulders.

	ID	LLD	p^a
IMF (g/100g)	7,5 ± 2,8	6,9 ± 0,7	0,357
C18:1	47,7 ± 3,0	45,6 ± 1,8	0,023
Σ SFA	39,4 ± 3,2	39,7 ± 2,8	0,762
Σ MUFA	52,4 ± 3,4	50,0 ± 1,8	0,019
Σ PUFA	8,0 ± 2,2	10,1 ± 1,3	0,003

[a] p: effect was considered significant at $p < 0.05$.

Panellist perceived important differences in the appearance of dry-cured shoulders. Shoulders from ID showed significantly higher scores for brightness and redness, while LLD batch showed higher scores for marbling.

Table 2. Sensory profile (mean values ± SD) of dry-cured shoulders from crossbred pigs (ID and LLD)

Item	ID	LLD	p^a
Appeareance			
Yellowness	1,0 ± 0,4	0,8 ± 0,1	0,013
Pink	0,7 ± 0,2	1,6 ± 0,4	0,000
Redness	5,6 ± 0,8	3,9 ± 0,9	0,000
Brightness	3,7 ± 0,9	3,2 ± 0,3	0,019
Marbling	2,5 ± 0,9	3,4 ± 0,8	0,016
Odour			
Intensity	4,7 ± 0,7	3,3 ± 0,7	0,000
Texture			
Fat hardness	3,1 ± 1,2	4,0 ± 0,8	0,020
Fluidness	3,8 ± 1,1	3,9 ± 0,5	0,707
Lean hardness	2,6 ± 0,8	2,4 ± 0,8	0,427
Dryness	1,8 ± 0,2	2,6 ± 0,6	0,001
Juiciness	4,4 ± 0,8	5,3 ± 0,8	0,008
Pastiness	3,9 ± 1,8	2,1 ± 0,8	0,000
Flavour			
Saltiness	6,1 ± 0,3	5,4 ± 0,6	0,003
Sweetness	0,4 ± 0,1	1,0 ± 0,2	0,000
Bitterness	0,6 ± 0,2	0,7 ± 0,2	0,196
Flavour intensity	5,8 ± 0,4	4,8 ± 0,7	0,001
Cured flavour	3,9 ± 0,9	4,8 ± 0,4	0,001
Rancid flavour	1,7 ± 0,6	2,6 ± 0,6	0,001
After-taste flavour	5,9 ± 0,6	0,8 ± 0,3	0,000

[a] p: effect was considered significant at $p < 0.05$.

Some of these results reveal an influence of Iberian breed on these sensory traits, however not significant differences were found in IMF content between batches, because the crossbreeding of Iberian pigs with Duroc increase the lean content of the carcass, and a concomitantly decreases de IMF content [8].

Sensory traits like brightness and marbling have been described as an important and positive role in consumer preference [9]. Authors reported that the melting point of fat from Iberian pigs shows a higher correlation with oleic acid than with any PUFA such as linoleic acid and thus, the oleic acid positively influences the brightness of dry-cured products [2]. In the present work, the ID batch showed higher scores for brightness and higher proportion of MUFA and mainly of oleic acid. Furthermore, the structural differences [11] between batches could lead to a different intense diffusion of fat from inside of the adipocytes to outside in dry cured products, increasing the fat spreading on the lean surface from LLD in comparison with ID bath, showing higher score of marbling with the same IMF content.

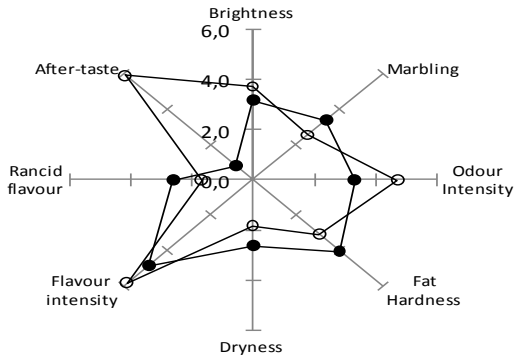

Figure 1. Sensory analysis of dry-cured shoulders from ID and LLD batches. Bottom figure: effect of genotype (○: ID, ●: LLD)

Sensory perception related to odour is one of the sensory attributes that most influences the acceptability of dry-cured products [10]. IMF content has been related to odour intensity [9]; however despite the differences found by panelist in the odour and flavour intensity, no differences were found for the IMF content between genotypes. This could be due to the use of a rubbing mixture of curing agents (salt and nitrite) and the processing time which could have disguise the aroma compounds produced to different extent. In addition, the lack of differences in the fatty acid profile and more specifically in the proportion of oleic acid, could explain the differences in odour

attributes despite the absence of differences in IMF content.

Significant differences (p<0,05) were obtained for fat hardness, dryness, juiciness and pastiness between two batches. Dry-cured shoulders from LLD batch had lower score in pastiness but higher scores in the other attributes. These differences have been ascribed to the IMF content by other authors [12, 13]. The absence of differences in the IMF content could be related with the higher scores of marbling in LLD batch, related to with the animal structural differences cited previously.

The taste compounds of meat and meat products is mainly due to sodium chloride, amino acids, peptides and nucleotides [14], so differences in the concentration of these compounds could be the cause of the different taste perceptions. In this sense, shoulders from LLD were perceived as sweeter, while shoulders from ID were scored saltier. These results are in agreement with [9, 10], who reported an inverse relationship between sweetness and saltiness, as sweet notes were not easily perceived in salty meat products. These important differences in salty taste could be responsible of the high significant differences showed in other attributes as after taste flavor.

Rancid flavor was significantly different between the studied batches, with the highest score being for LLD shoulders, probably as a consequence of higher proportion of PUFA in this batch, more prone to autooxidation and compounds derived from its oxidation show rancid notes.

IV. CONCLUSSIONS

The effect of crossbreeding on sensory characteristics of dry-cured shoulders was greater than the effect of the IMF content. These results have been obtained using trained panelists; however a consumer panel assessment is needed to better understand the relationship between sensory profile and dry-cured shoulder acceptability.

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