EFFECT OF MUSCLE TYPE ON VOLATILE PROFILE OF DRY-CURED HAM

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I. INTRODUCTION

The final quality of dry cured ham is influenced by many factors such as chemical composition, genotype, ripening process, salt content, etc. [1]. According to Morales et al. [2], seventy nine percent of consumers consider odor as a very important factor in the decision to purchase the product. Due to dry-cured ham is an important product in Spain, improving its sensorial characteristics is essential to generate added value. Dry-curing is a very complex process which involves many biochemical reactions and changes [3]. During ripening, proteins and lipids undergo intense degradations processes, resulting in a considerable amount of small peptides, free amino acids, free fatty acids and great number of volatile compounds which contribute to the characteristic flavor of the ripened products [4]. In addition, the *biceps femoris* (BF) and *semimembranosus* (SM) muscles, the two most representative muscles in ham, are subjected to different conditions during the dry-cured ham process. Thus, the aim of this study was to evaluate the effect of the type of muscle on volatile compounds profile of dry-cured ham.

II. MATERIALS AND METHODS

Two hundred raw hams from Large white and Landrace breeds were obtained from a commercial slaughterhouse and elaborated according to the traditional procedure. At the end of the process, *semimembranosus* and *biceps femoris* muscles were selected to the volatile analysis. The extraction of the volatile compounds was carried out using solid-phase microextraction (SPME) and the quantification was performance using GC-MS technique following the chromatographic conditions described by Domínguez et al. [5]. The effect of muscle type on volatile compounds profile was examined using a one-way ANOVA with IBM SPSS Statistics 23.0 program software package. Before statistical analysis, database was tested to probe it followed a normal distribution.

III. RESULTS AND DISCUSSION

The volatile compounds were classified into the main chemical families (Table 1). There were significant (P<0.001) differences on the total volatile compounds between muscles, showing the highest concentration in BF muscle (70365.46x10^3 AU/ g dry cured ham). The hydrocarbons were the main family in SM muscle, whereas in BF muscle were aldehydes. Hydrocarbons are generally considered to have no substantial impact on flavor because of their high odor threshold values. This finding is in disagreement with those reported by Bermudez et al. [6] who found that esters were the most abundant family in Celta dry-cured ham. Significant differences were found in the aldehyde content (P<0.001), reaching the lowest values in SM muscle. Among the aldehydes, hexanal and 3-methyl-butanal were the majority compounds in both muscles. These compounds derived from the ham spoilage [7], due to lipid oxidation and Strecker reactions [8] respectively, and give nutty, grass and fatty notes. It is known that ketones and esters are important odor active compounds in dry-cured products due to their low threshold. In this line, SM muscle showed lower amount in both of them than in BF.

On the other hand, there were significant differences (P<0.001) in the alcohol content between muscles, showing the highest content in BF muscle (7563.13 x10^3 vs. 3511.39 x10^3 AU/ g dry cured ham). Alcohols, contribute to the aroma of dry-cured ham, with fatty, woody and herbaceous notes [9]. Finally, nitrogenous compounds were the minority family in both muscles, followed by carboxylic acid, in BF muscle, and sulphur

compounds, in SM muscle. Even so, the content among these families showed lower values in SM muscle compared to BF muscle.

Table 1. Effect of muscle type on volatile compounds content (expressed as Area Units (AU) x 10^3 / g dry cured ham

	Muscle		SEM	*P-value*
Compound	**BF**	**SM**		
Total Aliphatic hydrocarbons	21139.90	25837.47	895.46	0.009
Total Aromatic and cyclic hydrocarbons	980.96	822.85	17.91	<0.001
Total Hydrocarbons	22221.57	26721.71	909.95	0.013
Total Aldehyde	24453.02	12220.80	445.98	<0.001
Total Ketone	2518.75	1865.71	34.19	<0.001
Total Esther and ether	2132.46	1945.68	27.66	0.001
Total Alcohol	7563.13	3511.39	143.68	<0.001
Total Carboxilic acid	1804.95	1444.22	37.18	<0.001
Total Nitrogenous compounds	654.25	586.31	10.35	0.001
Total Sulphur compounds	2024.62	946.79	51.85	<0.001
Total Compounds	**70365.46**	**50426.28**	**1367.55**	**<0.001**

Significance: (P<0.05; Tukeý s Test). SEM: Standard error of the mean.
Muscle: BF= *Biceps femoris*; SM= *Semimembranosus*

IV. CONCLUSION

The type of muscle influenced the amount of volatile compounds of dry-cured ham. There is a higher amount of total volatile compounds in BF muscle, as well as higher values in compounds with a low threshold, like 1-Octen-3-ol or hexanal.

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REFERENCES

1. Jurado, Á., García, C., Timón, M. L., & Carrapiso, A. I. (2007). Effect of ripening time and rearing system on amino acid-related flavour compounds of Iberian ham. Meat Science 75(4): 585-594.
2. Morales, R., Guerrero, L., Claret, A., Guàrdia, M. D., & Gou, P. (2008). Beliefs and attitudes of butchers and consumers towards dry-cured ham. Meat Science 80(4): 1005-1012.
3. Bermúdez, R., Franco, D., Carballo, J., & Lorenzo, J. M. (2014). Physicochemical changes during manufacture and final sensory characteristics of dry-cured Celta ham. Effect of muscle type. Food Control 43: 263-269.
4. Lorenzo, J. M. (2014). Changes on physico-chemical, textural, lipolysis and volatile compounds during the manufacture of dry-cured foal “cecina”. Meat Science 96(1): 256-263.
5. Domínguez, R., Gómez, M., Fonseca, S., & Lorenzo, J. M. (2014). Effect of different cooking methods on lipid oxidation and formation of volatile compounds in foal meat. Meat Science 97: 223-230.
6. Bermúdez, R., Franco, D., Carballo, J., & Lorenzo, J. M. (2015). Influence of type of muscle on volatile compounds throughout the manufacture of Celta dry-cured ham. Food Science and Technology International 21: 581-592.
7. Fulladosa, E., Garriga, M., Martín, B., Guàrdia, M. D., García-Regueiro, J. A., & Arnau, J. (2010). Volatile profile and microbiological characterization of hollow defect in dry-cured ham. Meat Science 86: 801-807.
8. Carrapiso, A. I., Martín, L., Jurado, Á., & García, C. (2010). Characterisation of the most odour-active compounds of bone tainted dry-cured Iberian ham. Meat Science 85(1): 54-58.
9. García-González, D. L., Tena, N., Aparicio-Ruiz, R., & Morales, M. T. (2008). Relationship between sensory attributes and volatile compounds qualifying dry-cured hams. Meat Science 80: 315-325.