

SPANISH DRY-CURED HAM : PHYSICAL AND PHYSICOCHEMICAL STUDY.

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SUMMARY

Physical and physicochemical parameters in Spanish dry-cured ham were studied (CIE $L^*a^*b^*$), pigment discoloration, pigment nitrosation, pH, water activity, moisture, salt concentration, residual nitrite and fat. The muscles under study were: **Semimembranosus**, **Semitendinosus** and **Biceps femoris**. Only **Semimembranosus** muscle showed different behavior in moisture and water activity. Water activity, moisture and salt concentration showed a gradient between all muscles. Multiple regression analysis were made for L^* , a^* , b^* . L^* was dependent from water activity and moisture with a $r = 0,823$, a^* dependent from residual nitrite level and pigment discoloration with a $r = 0,907$, b^* was dependent of pigment discoloration and water activity with a $r = 0,890$.

INTRODUCTION

The Spanish processed meat industry traditionally made dry-cured products like "Chorizo, Salchichón, but the most important of these products is the dry-cured ham "(DIAZ RUIZ, 1990)", reported that the Spaniards have the highest consume of these product in the world. In 1991 the dry-cured ham industry produced 173 000 Tm. This value gives us an important idea of this sector. It is considered the dry-cured ham as the only meat pork product with the biggest production period. Therefore has originated a technology of economical importance "(NICOLAU, 1985)". The dry-cured process can be divided in three fundamental stages: salting, postsalting and dry-maturation. The salting and postsalting stages take place at low temperatures ($<3,3^{\circ}\text{C}$) "(HUERTA, 1988)", "(NIETO, 1989)". The Spanish dry-cured ham has not been sufficiently studied because this product was a craft industry "(SAYAS et al, 1989)". Nowadays exists a great interest to know all the factors that have influence in this process. The aim of this work was the study of colour, and physicochemical parameters in dry-cured hams with a dry-cured process time of one year.

MATERIALS and METHODS

The present study was carried out with 8 female commercial dry-cured hams (Large White x Pié de Blanc) with a Dry-cured process time of one year. The zone under study were delimited between the central part of the femur bone and the perpendicular zone at that bone. That zone was cut into slices of 1 cm thick, in the obtained slices each muscle was identified (**Semimembranosus SM**, **Semitendinosus** and **Biceps femoris Bf.**) and then the Bf was divided in three zones (Bf1, Bf2, Bf3) as shows figure 1. The physicochemical parameters under study were: pH, water activity (a_w), salt concentration ($\% \text{NaCl}$), and residual nitrite level (NO_2), moisture (W) and fat (F). The physical parameters were CIE $L^*a^*b^*$ values. The results were given in percent reflectance as well as the CIE $L^*a^*b^*$ values. The engaged methods were:

- pH.- Ingold Crison 406 electrode
- a_w .- CX2 Decagon Device. working temperature $25^{\circ}\text{C} +0,5^{\circ}\text{C}$
- $\% \text{NaCl}$.- ISO R 1841
- NO_2 .- ISO/ DIS 2918. Diode Array Spectrophotometer HP 8451 A.
- W .- ISO R 1442
- F .- ISO - 1443

The measurement of colour was conducted as closely as possible in the absence of light to avoid interference at the surface of the sample for pigment measurement " (ACTON, 1977) ".

Analysis of variance was performed on the obtained data, the statistical design for this work consists of two way ANOVA ($P < 0,01$), a Tuckey's Test, and Multiple Regression Analysis.

RESULTS AND DISCUSSION

Table 1 shows the mean and standard deviation for all parameters under study. For each muscle under study SM, ST, BF1, BF2, BF3 table 2 shows the mean and standard deviation of each parameter. Lineal regression analysis was made for all colour parameters with the other parameters and the results of this lineal regression analysis are showed in table 3. No statistically significant differences were found

Table 1.- Means and Standar deviation of all studied parameters

Parameter	mean	standar deviation
L*	32.46	4,768
a*	13,62	4,336
b*	9,17	3,470
R 560/R 500	1,008	0,002
R 570/R 650	1,744	0,320
aw	0,828	0,037
W	0.8830	0,2670
%NaCl	7,06	1,61
NO ₂	9,96	2,32
F	8,95	4,97
pH	6,05	0,18

($P < 0,01$) between all dry-cured hams under study for all parameters except for b^* , a_w and R570/R650. For L^* values statistically significant differences were found between muscles only ST and Bf in all sections presented the same values. For b^* values the SM muscle showed statistically significant differences ($P < 0,01$) meanwhile for ($P < 0,05$) the only muscle that showed differences was Bf muscle between it's sections. The ANOVA results for b^* showed that for this parameter statistically significant differences were found between all muscles, but when using the Tuckey's Test ($P < 0,01$) ST and Bf in all sections has the same behavior. The measurement of reflection spectrum at 560 and 500 nm makes it possible to determine the relative proportion of Fe II native pigments and of the Fe II pigments stabilized by nitrosation "Pigment nitrosation" (GIDDEY, 1966). In all muscles of each dry-cured ham under study no statistically significant differences were found. This shows that pigment nitrosation is muscle independent. The ratio R570/R650 nm allows the estimation of pigment discoloration, this measurement shows the relative proportion of Fe II and Fe III pigments present at the

Table 2.- Means and standar deviations of CIE $L^*a^*b^*$, R560/R500 and R570/R650 data and physicochemical parameters for each muscle

Muscle		L*	a*	b*	R 560/ R 500	R 570/ R 650	aw	W	%NaCl	NO ₂	pH	F
BF1	X	33,923	15,787	10,296	1,023	1,895	0,836	0,983	8,075	10,943	5,978	5266
	SD	1,455	2,162	1,126	0,015	0,150	0,008	0,138	1,051	2,914	0,094	1,229
BF2	X	34,899	16,346	11,329	1,012	1,892	0,844	1,075	7,850	14,372	6,167	5,363
	SD	2,431	2,721	2,160	0,004	0,147	0,016	0,117	0,988	3,625	0,139	1,019
BF3	X	34,935	14,559	9,906	1,005	1,814	0,844	1,034	7,900	11,853	6,096	8,490
	SD	2,467	0,934	0,736	0,003	0,069	0,016	0,102	1,100	3,786	0,164	1,805
ST	X	32,597	12,583	8,826	1,008	1,705	0,834	0,853	7,110	6,949	6,038	11,005
	SD	0,130	1,042	0,344	0,000	0,040	0,007	0,061	0,966	1,519	0,091	2,650
SM	X	25,985	8,849	5,492	0,992	1,417	0,780	0,423	4,896	5,931	5,962	14,637
	SD	2,321	4,776	3,677	0,016	0,328	0,047	0,041	0,640	1,201	0,094	5,032

X= Mean, SD = Standard deviation

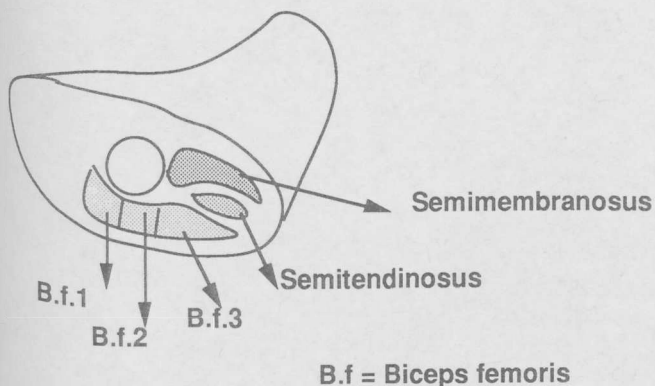
surface of the sample (the ratio of concentration of myoglobin + nitrosomyoglobin / Metmyoglobin). The results showed that exists statistically significant differences between hams, but no differences were found between muscles. This parameter may be characteristic of each dry-cured ham " (GIDDEY, 1966) ". The results obtained for a_w showed that statistically significant differences exists between dry-cured hams, but differences were found between muscles. In BF muscle each zone presents statistically significant differences between them. The results showed that no statistically significant differences were found between dry-cured hams, but differences were found between muscles showed differences between them. % Na Cl.- The results of this parameter showed that no statistically significant differences were found between dry-cured hams, but differences were found between muscles, and all sections of Bf showed the same behavior for this parameter. NO₂.- The results showed that no statistically significant differences were found between dry-cured hams, but differences were found between muscles, and all sections of Bf showed the same behavior for this parameter.

Table 3.- Equations obtained by Lineal Regression analysis

Parameter	Equation	Coefficient of correlation
L*	$111,2 + 27,2(aw) + 11 (W)$	0,823
a*	$-15,7 + 7,1 (R570/R650) + 0,2 (NO_2)$	0,907
b*	$2,3 + 3,1 (R570/R650) + 30,2(aw)$	0,890

(P<0,01)

Fig. 1.- Spanish dry-cured ham cross section



parameter showed statistically significant differences between dry-cured hams under study, but no for muscles. The nitrite residual level is low because chemical changes appear during the dry-cured process "(SAYAS et al, 1989)". Fat.- The results showed only statistically significant differences between muscles. pH.- No statistically significant differences were found between dry-cured hams and muscles under study. The results obtained are in good agree with the results obtained by "(BELLATI, 1983)".

CONCLUSIONS

Only **Semimembranosus** of the three muscles under study shows different behavior for all parameters except to pH, residual nitrite level and pigment discoloration. High correlations were found between CIE L*a*b* and physicochemical parameters (water activity, moisture, residual nitrite level, pigment discoloration). All sections of **Biceps femoris** muscle have the same behavior for the following parameters : CIE L*a*b*, pigment nitrosation, pigment discoloration, residual nitrite level, salt concentration, fat, pH, except water activity and moisture.

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