EFFECT OF RAW MATERIAL ON TEXTURE OF SPANISH DRY-CURED HAM

Marta Ordóñez, Jordi Rovira, Isabel Jaime.
Department of Biotechnology and Food Science. University of Burgos. Plaza Misael Bañuelos s/n, 09001. Burgos. Spain.

Background

Texture is one of the most important characteristics of dry cured ham. Some of the main problems on texture in dry cured ham are the soft and pasty texture or the heterogeneus texture; making the slicing process more difficult and producing a mouthcoating sensation rejected by consumers. In this sense, meat of a pale, soft and exudative nature (PSE) is a serious problem in the industry and these raw PSE hams used to lead to defective texture hams (Arnau *et al,* 1987). Previous studies have showed that the weight losses, proteolysis and NaCl concentration are higher in PSE than in normal hams (Bañón, 1996). However, few of the previous studies evaluated simultaneously the effect of PSE raw material on physicochemical and texture characteristics of Spanish dry cured ham throughout the drying and aging process and in the different muscles of ham.

Objectives

The aim of this study is to analyse the changes of physicochemical and texture characteristics of normal and PSE hams during the dry curing process, in *Semimembranosus* (SM) and *Biceps femoris* (BF) muscles, representative of the two main different zones usually present in dry cured ham.

Methods

20 normal and 20 PSE raw hams weighing between 9 - 11 Kg were selected according to their pH and electrical conductivity at 1 h *postmortem* (Garrido *et al,* 1994). The hams were cured with salt and nitrite following the traditional methods in Spain. Every month, hams were weighted, and then 6 normal and 6 PSE hams were sampled, taking in each one a 2 cm cylinder perpendicularly to the femur axis. SM and BF muscles were removed and analysed.

The following analysis were carried out: moisture was calculated measuring weight loss at 103 ºC ± 2ºC to constant weight, sodium chloride by Charpentier-Volhard method, total nitrogen by the Kjeldhal method and fat content by Soxleht method. Nitrogen fractions (nonprotein nitrogen or NPN, myofibrilar protein, sarcoplasmic protein, denaturated protein and stroma) were analysed (Astiasarán *et al.* 1988). SDS-PAGE (12%) was performed to examine the proteolytic changes of myofibrilar proteins in the PSE and normal samples (Claeys *et al.* 1995).

Hardness was evaluated, using a texturometer XT2.TA, with a cylindrical probe of 1 cm diameter. Cross-head speed during the test was 1 mm/sec and the level of compression was 70% of the thickness of the sample (1 cm). In each case, consecutive measurements were carried out on 4 portions of the same sample (SM and BF), obtaining the average curve. Hams were evaluated at the end of the process (8 months) by a trained panel. The following characteristics were evaluated: hardness, chewiness, juiciness, fibre and fat perception, saltiness, rubberiness, adhesiveness and pastiness. The intensity of each sensory parameter was scored using a structurated scale from 1 to 9.

Results and discussion

Analysis of raw material showed no differences between PSE and normal hams, except for denatured protein fraction which was higher in PSE hams. Main physicochemical results thoughout ham drying and aging process are shown in table 1. According to results, there is significant diference in moisture between PSE and normal hams in SM muscle (P<0,05), being moisture always higher in normal hams in this muscle. However, in BF muscle, the moisture did not differ significantly between PSE and normal hams. The difference in water content between the external and internal muscles were greater in PSE hams (P<0,05). This results could explain the superficial hardness that is usual in PSE hams. Finally, weight losses were higher in PSE hams. The lower water holding capacity of PSE meat facilitate the dissolution of NaCl on the surface of the meat. NaCl contents over all the sampling times were higher in PSE hams (P<0,05). The NaCl concentration in the SM muscle diminished during drying and aging owing to migration towards the more humid BF muscle. The inversion of NaCl concentration could be explained by the natural tendency of the NaCl / moisture ratio to equilibrate between different zones of ham (Arnau *et al.* 1995). This migration was faster in PSE hams.

On the other hand, PSE hams showed a higher NPN and denaturated protein fraction than normal hams (P<0,05). These results indicate a higher proteolysis level in PSE hams, in agreement with the results of Gil *et al* (1989), Ságarra *et al* (1993) and Bañon (1996). The highest weight losses throughout drying and NaCl contents in PSE hams could explain their highest denaturation level. SDS-PAGE results make evident that there was not important differences in the proteolytic pattern of myofibrilar proteins between PSE and normal samples. The most significant changes in the proteolysis of myofibrilar proteins showed by electrophoresis took place in the last steps of drying period (4 to 5 months, when temperature increases from 22 to 30 ºC). SM and BF proteolytic profile were different, which agree with differences founding in nitrogen fractions, being higher the denaturation fraction in SM muscle and the NPN concentration in BF muscle. The rest of physicochemical parameters analysed, not shown in table 1, did not differ significantly between PSE and normal hams.

With respect to texture, the difference between hardness of SM and BF muscle (figure 1) was higher in PSE hams (P<0,05). Sensory analysis showed that softness, pastiness, adhesiveness and saltiness were higher in PSE hams than in normal hams (P<0,05). This result could be explained by the diferences in physicochemical parameters between normal and PSE hams. According to correlation matrix of different parameters studied, there is a high relationship between some sensory and physicochemical parameters. Moisture was correlated with NaCl (r = - 0,529). As would be expected, there is a significant correlation between moisture/NaCl, NNP and denaturated protein (r> 0,8). Results show that hardness is mainly correlated with moisture (r = - 0,835) and denaturated protein (r = 0,829). NPN is correlated also with hardness (r = - 0,599), but especially with pastiness (r = 0,701). This results confirm that physicochemical, compositional and structural characteristics of muscle have an influence on the meat sensory quality. Finally, concerning to sensory preference, consumer panel preferred the flavor of normal hams, while PSE hams were described as more cured than normal hams, in agreement with the results of Arnau *et al.* (1994)

Conclusions

PSE and normal hams have different physicochemical and sensory characteristics. Morover, the differences existing between SM and BF muscles throughout dry curing process are highest in PSE hams. Ham texture at the end of aging process seems to be determinated by drying process and salt migration into the ham. On this basis, it would be possible to control the texture profile and defective texture in PSE hams if salting, drying and aging process are controlled or modified adequately.

References

-Arnau, J., Maneja, E. and Monfort, J.M. (1987). Estudio de la influencia de la carne PSE en el proceso de curación del jamón. *Cárnica 2000* 48, 77-84.

-Arnau, J., Guerrero, L., Casademont, G. and Gou, P. (1995). Physical and chemical changes in different zones of normal and PSE dry cured ham during processing. *Food Chemestry 52*, 63-69.

-Astiasaran, I., Beriain, M., Melgar, J.M., Sánchez-Monge, R. and Bello, J. (1988). Estudio comparativo de las caracteristicas de jamones curados de cerdo balco elaborados con distinta tecnología. *Rev. Agroquím. Tecnol. Aliment. 28* (4), 519-528.

-Bañon, S.J. (1996). Calidad tecnológica de la carne destinada a la elaboración de jamón curado en la región de Murcia y consecuencias de su transformación. *Thesis*. Dpto. anatomía patológica comparada y tecnología de los alimentos. Universidad de Murcia.

-Claeys, E., Uytterhaegen, l., Buts, B., and Demeyer, D. (1995). Muantification of beef ,yofibrilar proteins by sds-page. *Meat Science* 39, 177-193.

-Garrido, M.D., Pedauye, J., Bañon, S. and Laencina, J. (1994). Objective assessment of pork quality. *Meat Science 37*, 411-420.

-Gil, M., Arnau, J., and Sárraga, C. (1989). Proteinase activities in spanish dry-cured ham manufactured with meat of different quality. *35 th ICMST 3*, 734.

-Sárraga, C., Gil, M., García-Regueiro, J.A. (1993). Comparison of calpain and cathepsin (B, L and D) activities during dry cured ham procesing from heavy and light large white pig. *Journal Science Food Agriculture* 62, 71-75.

Table 1. Main physicochemical results throughout drying and aging process

time	ham	muscle	(%) Moisture	NaCl (D.M)	nitrogen fraction (mg N/ g D.M.) NPN	Myofibrilar	Denaturated
postsalt	normal	SM	$66,6^a$	$18,2^a$	$12,8^a$	$47,7^a$	$5,7^a$
postsalt	PSE	SM	$67,4^b$	$15,7^b$	$10,4^a$	$44,1^a$	$10,2^b$
postsalt	normal	BF	$73,1^c$	$3,6^c$	$11,2^a$	$53,0^b$	$3,1^a$
postsalt	PSE	BF	$72,4^c$	$3,3^c$	$14,0^b$	$48,5^a$	$8,7^b$
2 months	normal	SM	$65,6^a$	$14,1^a$	$15,5^a$	$45,2^a$	$6,5^a$
2 months	PSE	SM	$64,8^a$	$15,7^b$	$19,6^b$	$45,4^a$	$17,2^b$
2 months	normal	BF	$68,7^c$	$12,3^c$	$19,4^b$	$43,5^a$	$7,8^a$
2 months	PSE	BF	$68,6^c$	$10,7^d$	$19,9^b$	$46,4^a$	$12,8^c$
4 months	normal	SM	$60,4^a$	$16,1^a$	$17,9^a$	$48,7^a$	$6,6^a$
4 months	PSE	SM	$59,8^a$	$13,9^b$	$20,9^b$	$45,8^a$	$18,8^b$
4 months	normal	BF	$63,1^b$	$14,7^b$	$17,4^a$	$43,8^b$	$8,3^a$
4 months	PSE	BF	$64,4^b$	$14,3^b$	$20,5^b$	$42,7^b$	$12,8^c$
drying end	normal	SM	$59,2^a$	$16,3^a$	$21,4^a$	$29,0^a$	$21,4^a$
drying end	PSE	SM	$52,2^b$	$14,3^b$	$23,6^b$	$29,1^a$	$26,2^b$
drying end	normal	BF	62,9c	$18,3^c$	$22,7^b$	$21,4^b$	$8,4^c$
drying end	PSE	BF	$58,9^a$	$17,8^c$	$25,5^c$	$18,6^c$	$17,3^d$
7 months	normal	SM	$51,4^a$	$13,2^a$	$27,7^a$	$31,9^a$	$25,3^a$
7 months	PSE	SM	$49,2^b$	$14,1^b$	$30,8^b$	$29,4^b$	$28,6^b$
7 months	normal	BF	$59,8^c$	$16,5^c$	$31,3^b$	$27,8^b$	$12,2^c$
7 months	PSE	BF	$57,9^d$	$18,8^d$	$34,9^c$	$18,5^c$	$18,3^d$
8 months	normal	SM	$47,9^a$	$12,6^a$	$29,1^a$	$32,7^a$	$26,5^a$
8 months	PSE	SM	$45,8^b$	$13,7^b$	$30,9^b$	$26,8^b$	$30,9^b$
8 months	normal	BF	$57,9^c$	$18,4^c$	$35,5^c$	$23,6^c$	$13,8^c$
8 months	PSE	BF	$57,2^c$	$20,0^d$	$36,6^d$	$21,7^d$	$18,4^d$

a,b,c,d: at each sampling time means within a column with different superscripts are significantly different P<0,05

Figure 1. Evolution of instrumental hardness throughout drying and aging process