STRUCTURAL CHANGES DURING PROCESSING IN NORMAL AND PSE DRY-CURED HAMS

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Background

Some of the main problems on texture in dry cured ham are the inconsistent texture, the pasty or the heterogeneous texture. In this sense, meat of a pale, soft and exudative nature (PSE) is a serious problem in the industry. Previous studies have showed that the weight losses, denaturation, proteolysis and NaCl concentration are higher in PSE than in normal hams (Ordóñez *et al.*, 1998). However, little is known about ultrastructural changes in dry-cured ham even though these are considered of prime importance regarding texture changes (Sayas-Barberá *et al.*, 1990; Aranda-Catalá *et al,* 1991; Monin *et al.*, 1997) and there are not studies about evolution of texture in PSE hams.

Objectives

The aim of this study is to evaluate the changes in structural parameters during processing of dry-cured hams from normal and PSE raw hams.

Methods

16 normal and 16 PSE raw hams weighing between 11-13 Kg were selected according to their pH and electrical conductivity at 2 h *postmortem* (Garrido *et al.*, 1994). The hams were cured with salt and following the traditional methods in Spain. At every sampling time (raw meat, end of salting, 2, 4, 5, 6, 8 and 10 months), 6 normal and 6 PSE hams were sampled, taking out form each one a 2 cm cylinder perpendicularly to the femur axis. *Semimembranosus* (SM) and *Biceps femoris* (BF) muscles were removed and analysed. Electron microscopical analysis was performed at several points along ham cured process. Pieces about 1 mm^3 were taken from internal and external SM and BF muscles and processed for electron microscopy (Monin *et al.*, 1997). SDS-PAGE (12%), according to Claeys *et al.* (1995), was used to examine the proteolytic changes of myofibrillar proteins in SM and BF muscles of PSE and normal hams.

Results and discussion

Electrophoresis: The myofibrillar proteins underwent important changes during processing in normal and PSE hams, in SM and BF muscles (figure 1). The electrophoretograms showed progressive modification in all bands except actin (45 KDa), which underwent little change. In all cases, there was a progressive reduction of the myosin heavy chain (220 KDa). At the same time, bands corresponding to a molecular weight of about 150 KDa, 80 KDa, and 40-20 KDa increased. The most significant decrease in myosin and other myofibrillar proteins has been observed between 4 and 5 months. The changes were similar in both muscles, although they were greater in the earlier processing steps in SM. However, after 10 months, in final product, there was more residual myosin in BF than in SM muscle. Results are in agreement with other authors (Toldrá *et al.*, 1993; Monin *et al.*, 1997). The results obtained suggest that during processing intense phenomenon of proteolysis and denaturation occur. Proteolysis could be owing to the action of muscle proteinases, and denaturation could be due to the action of salt, high temperatures and dehydration.

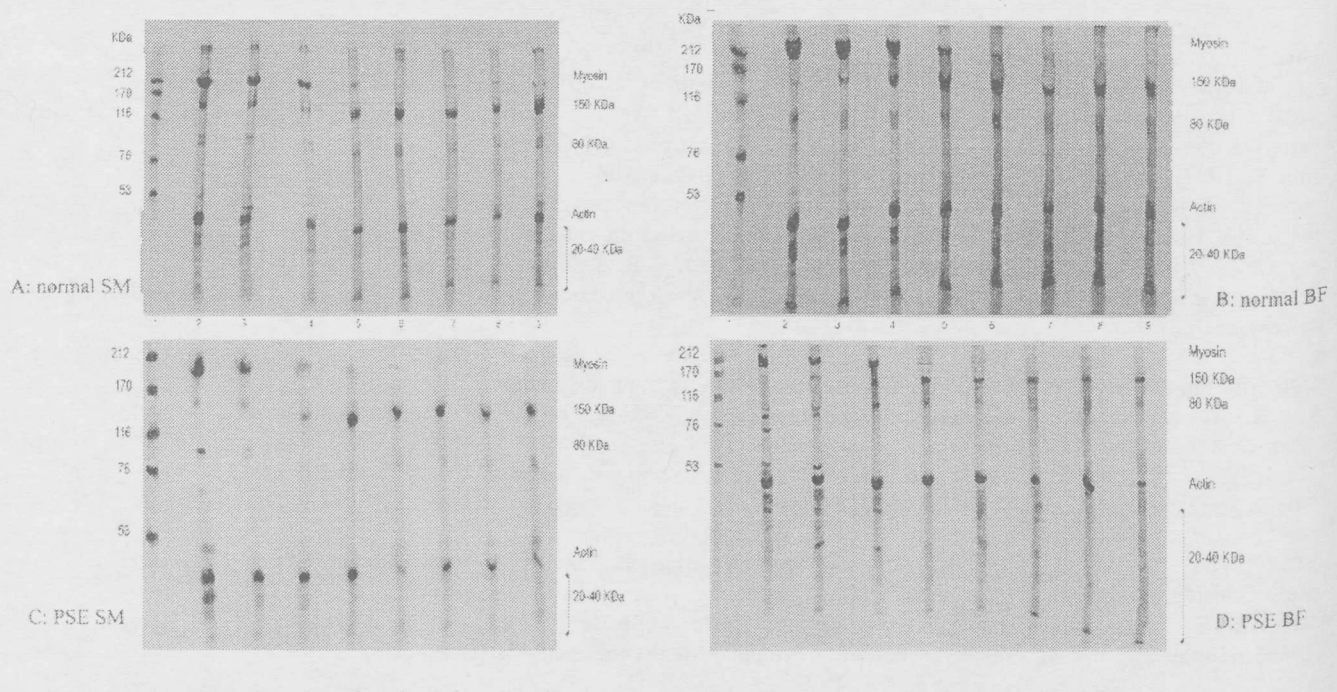

Figure 1. Electrophoretograms of myofibrilar protein of normal (A and B) and PSE hams (C and D), in *Semimembranosus* (SM) and *Biceps femoris* (BF) muscles. 1: MW standard; 2: raw meat; 3: postsalting; 4: 2 months; 5: 4 months; 6: 5 months; 7: 6 months; 8: 8 months; 9: 10 months.

On the other hand, results indicate the electrophoretic profiles differ significantly between normal and PSE meat. Which is in agreement with other authors (Tabilo *et al.* 1999). The changes were similar in both hams, but were more pronounced in PSE hams. Myosin band intensity decreased before in PSE hams and in final product the band corresponding to myosin was no visible. However, the intensity of bands in the range 40-20 KDa was higher in this type of hams. Thus, the proteolysis and denaturation processes seem to be more severe in PSE hams than in normal hams.

Microscopy: In fresh hams the myofibrillar structure was clearly visible in normal and PSE hams and was similar in SM and BF muscles (figure 2). However, the difference between hams and muscles increased during the ripening.

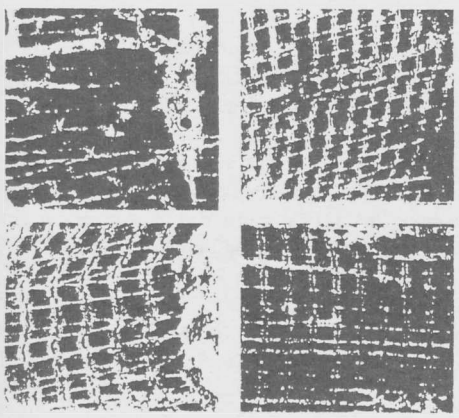

Figure 2. Electron micrographs of normal (left pictures) and PSE hams (right pictures) in *Semimembranosus* (A and C) and *Biceps femoris* muscles (B and D) in raw meat. x 2100.

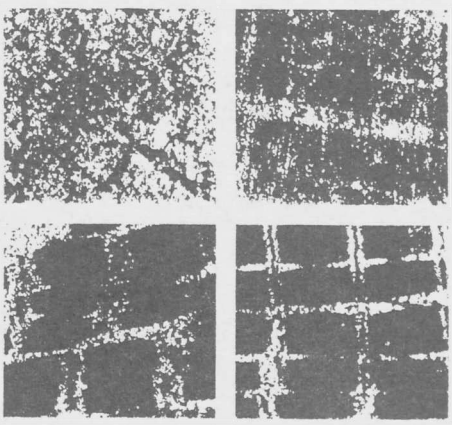

Figure 3. Electron micrographs of PSE hams in external and internal *Semimembranosus* (A and B) and external and internal *Biceps femoris* muscles (C and D) at the end of salting. X 10.000.

At the end of salting, fibre disruptions appeared (figure 3). The M band, Z line, the myofilaments and the transversal striation were more distinguishable in BF than in SM muscle. After 2 months, ultrastructural features were no possible to distinguish in SM muscle. The faster changes in the myofibrillar electrophoretic profiles of SM during the first steps of processing agree with the fact that ultrastructural changes were seen earlier in this muscle, according to Sayas-Barberá *et al.* (1990), Aranda-Catalá *et al.* (1991) and Monin *et al.* (1997). The increase in salt concentration in SM and the dehydration were the causes of the denaturation and ultrastructural disorganisation. In PSE hams these processes were more intensity than in normal hams. After 4 months, the Z line was still visible in the BF muscle and zones with different density were present, probably due to the proteolysis of myosin. In its turn, the density in BF was lower in PSE hams because of the more severe degradation of myofibrillar structure. At the end of processing, ultrastructural features were difficult to distinguish in both muscles (Figure 4).

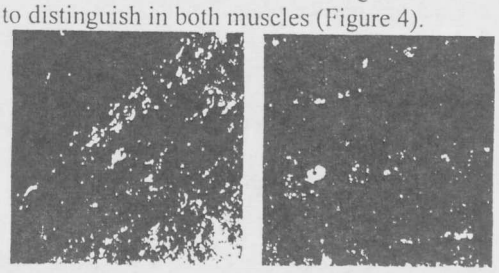

Figure 4. Electron micrographs of PSE hams in *Semimembranosus* (A) and *Biceps femoris* (B) muscles at 8 months. X 5.000.

Conclusions

Electrophoretic and ultrastructural data indicated that protein degradation in SM and BF is different. In SM muscle the increase in salt and dehydration could be the principal cause of the ultrastructural disorganisation and protein denaturation. Indeed, proteolysis appeared more active in BF muscle. On the other hand, in PSE hams denaturation and proteolysis processes are more intense than in normal hams. In conclusion, the structural changes are higher in PSE hams and, as a consequence, the texture will be different.

References

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