INFLUENCE OF PIG MEAT QUALITY IN THE ROLE OF MICROSOMAL FRACTION ON THE OXIDATIVE PROCESS.

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Background

Lipid oxidation is a phenomenon that affects food quality. Oxidative processes have an influence on sensorial characteristcs of meat and meat products, like dry-cured ham where an intense lipid oxidation is done. Many studies about changes in proteins and lipids produced during manufacturing process of dry-cured ham have been done (Antequera et al., 1991; Córdoba et al., 1990; Diaz, 1993), but it is very difficult to draw definitive conclusions about interactions of the different process conditions, characteristics of raw material and biochemical reactions involved in the development of typical characteristics of dry-cured ham.

Studies in raw and stored meat showed that phospholipids, which are located in the membrane of muscle cells and are characterized by the presence of high percentajes of polyunsaturated fatty acid (PUFA) in their composition, can suffer an intense oxidation (Allen and Foegeding, 1981, Igene et al., 1979).

The lipids oxidation in muscle has been studied by different model systems (Sklan et al.,1983; Tay et al., 1983). Harel and Kanner (1985) proposed the utilization of muscle microsome membrane as an useful model for studying muscle oxidation processes.

Objetives

We evaluated membrane lipid oxidation in order to compare two muscle and two meat qualities of pig by three patways: i) microsome enzymatic lipid oxidation dependent on NADPH; ii) nonenzymatic microsome lipid oxidation initiated by activated metmyoglobin, and iii) sarcoplasmic and microsomal fractions interactions.

Material and methods

Selection of the raw material: *Biceps femoris* (BF) of normal and PSE (Pale, Soft and Exudative) meat quality, and *Longissimus* (LD) of normal meat quality porcine muscles were selected by measuring electric conductivity with a Quality Meater (Digi 550, Wissenschaftlichtechmishe, Weilheim, Germany) at 45 min. postmortem (PSE> 10, normal< 7.0).

The muscles were trimmed of fat and connective tissue and then ground. Portions of about 100gr of ground muscle were vacuum packed in dark bags and then frozen until use to ensure the homogeneity and stability of the samples.

Isolation of the microsomal fraction: Isolation of the microsomal fraction was done by a procedure described previously by Kanner and Harel (1985).

Preparation of sarcoplasmic proteins: A portion of minced muscle was homogenized in 30mM phosphate buffer, pH 7,3 (1/10, w/v), left 15 min at 4ºC and then centrifuged at 10.000xg for 30min. The supernatant was filtered through glass wool and centrifuged for 1h at 100.000xg. The filtered supernatant was the sarcoplasmic protein fraction.

Protein determination: Protein concentration of the different fractions was determined by the method of Lowry et al. (1951) using bovine serum albumin.

Evaluation of the microsomal fraction oxidative activity: The oxidative activity of the microsomal fraction was evaluated by three different procedures:

i) The enzymatic microsomal model system and ii) the microsomal nonenzymatic lipid oxidation were assayed using the methods of Kanner et al. (1988). The two systems were applied to comparing the oxidative capacity of normal meat quality LD and BF muscles. The reactions were done at 37ºC for 30min.

iii) The third pathway was used to measuring the lipid oxidation between the microsomal (0,5 mg prot/ml) and the sarcoplasmic proteins (0,5 mg prot/ml) fractions .

All the systems were assayed on BF muscles from normal and PSE meat qualities. The incubations times were 30 min, 24h, 48h, 72h and 96h; every assay was performed at 3ºC, 10ºC and 20ºC .

The results are means of tripliçate of each microsomal preparation. Thiobarbituric acid reactive substances were determined by the procedure of Bidlack et al. (1973) and the results calculated as nmol of malonodialdehyde (MDA) per mg of protein using an extintion coefficient of $\varepsilon_{532} = 1.55 \times 10^5\ M^{-1}\ cm^{-1}$ (Buege and Aust, 1978).

Results and discussion

Microsomal fraction recovered from BF showed higher protein concentration (6,35 ± 1,35 mg prot/ml) than microsomal fraction from LD (3,89 ± 0.98 mg prot/ml). However, the oxidation susceptibility was higher in LD muscle for both, the enzymatic and the nonenzymatic microsomal model systems; the values obtained in LD were 0,63 nmol MDA/mg prot and 0,92 nmol MDA/mg prot respectively. BF showed only 0,27 nmol MDA/mg prot and 0,5 nmol MDA/mg prot. These results suggest that LD is more susceptible to oxidation despite of the lower concentration of microsomal fraction obtained. BF could contain larger quantities of inhibitors of the lipid oxidation or lower pro-oxidants concentrations.

Biceps femoris is one of the biggest muscles of dry-cured ham. Lipid oxidation of microsomal fraction obtained from BF of different meat qualies was evaluated at some temperatures used in a typical process of dry-cured ham. Figure 1 shows the results of microsomal enzymatic lipid oxidation. PSE muscles showed a higher oxidation level than normal ones at all the temperatures studied. In the other hand, microsomal nonenzymatic lipid oxidation did not present significant differences at 3ºC and 10ºC of temperature, but PSE muscles showed lower oxidation capacity than normal muscles at 72 hours and 20ºC (Fig. 2). Protein content of microsomal fraction was lower in PSE muscles (3,36 ± 0.5 mg prot/ml) than in normal ones (6,22 ± 0,88 mg prot/ml).

Changes in soluble proteins fraction have a great incidence on the development of sensorial characteristics of dry-cured ham (Hortós, 1995). Since, the study of the possible interactions between sarcoplasmic and micrososmal fraction components could contribute to clarify the role of lipid oxidation in the product. The results obtained showed an increase in MDA concentrations only after 72 hours of incubation. PSE muscles had lower MDA concentration than normal at 3ºC (0,047 nmol MDA/mg prot, PSE; 0,43nmol MDA/mg prot, normal) and 10ºC (0,042 nmol MDA/mg prot, PSE; 0,13 nmol MDA/mg prot, normal); contrary to the results observed after 72 hours at 20ºC that were: 1,17 nmol MDA/mg prot PSE and 0,67 nmol MDA/mg prot normal.

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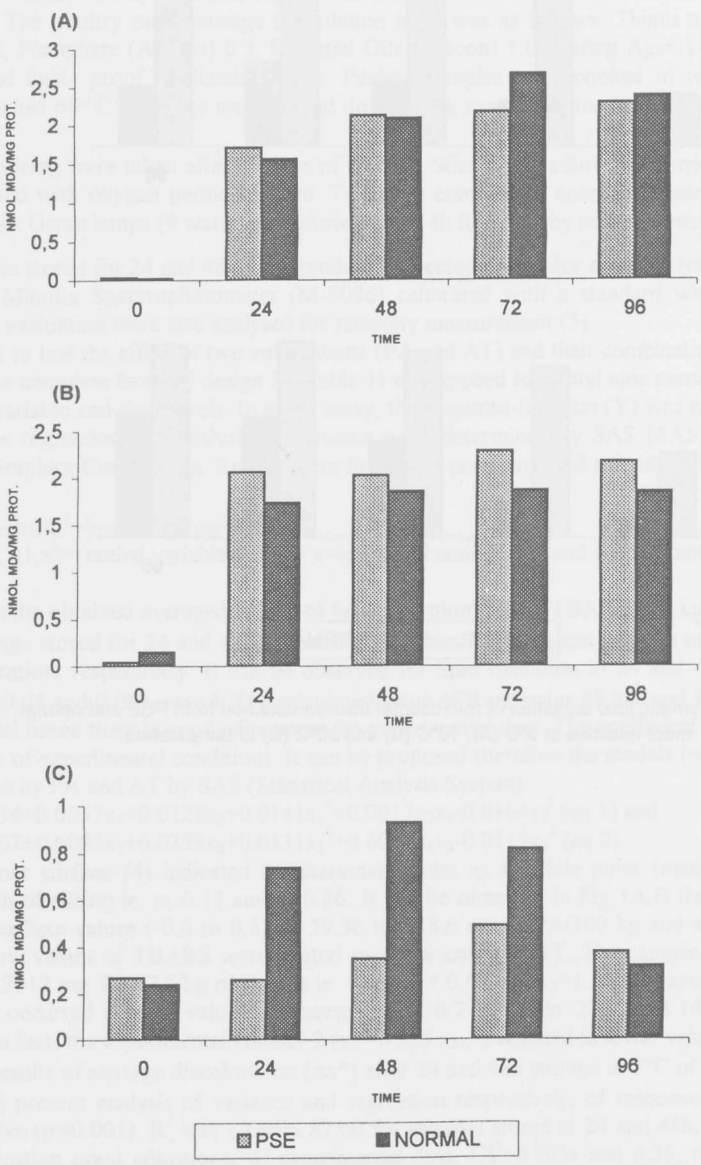

Fig 1. Enzymatic lipid oxidation of microsomal fraction obtained from PSE and normal *Biceps femoris* meat qualities at 3ºC (A), 10ºC (B) and 20ºC (C) of temperature.

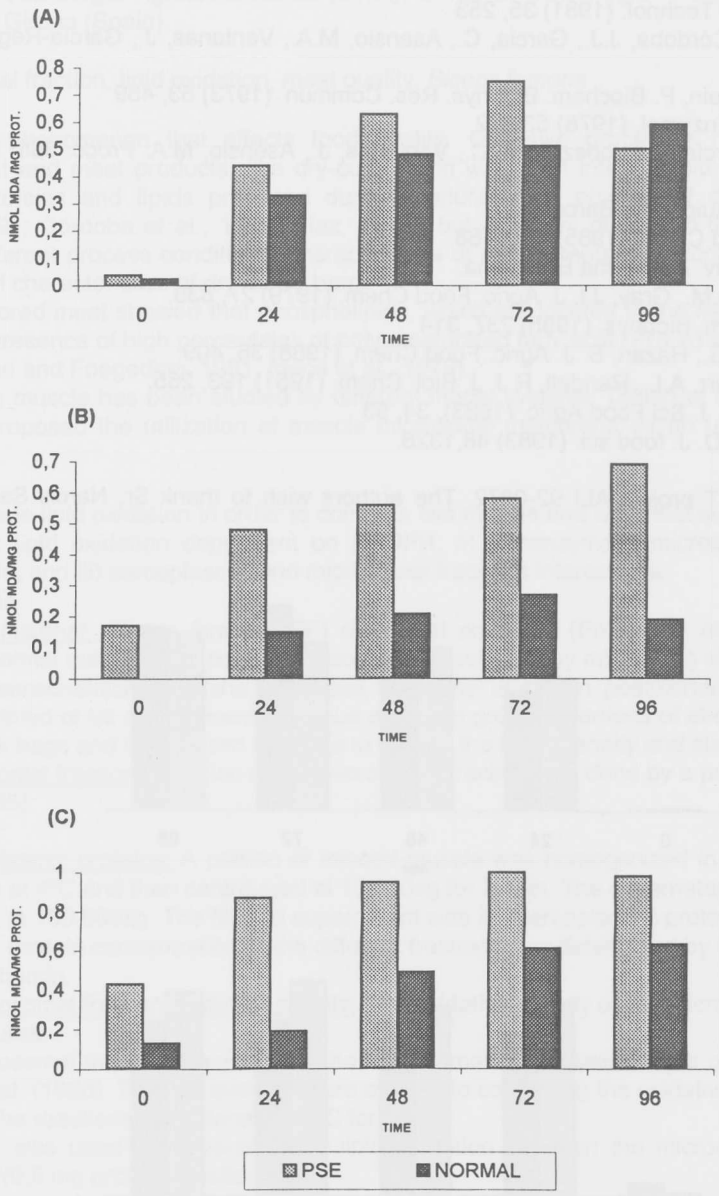

Fig. 2. Nonenzymatic lipid oxidation of microsomal fraction obtained from PSE and normal *Biceps femoris* meat qualities at 3ºC (A), 10ºC (B) and 20ºC (C) of temperature.