CHANGES IN VOLATILE ALDEHYDES IN SUBCUTANEOUS ADIPOSE TISSUE DURING THE DRYING STAGE OF IBERIAN HAM.

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Background

Dry-cured hams from Iberian pigs are meat products highly valued by consumers. The products obtained by rearing the pigs in the extensive system based on acorn and pasture ("montanera") are the most appreciated and reach the highest price in the market, due to their particular sensory characteristics (García et al., 1996), in comparison to hams from pigs raised in confinement with concentrate feeds ("pienso"). On the other hand, processing conditions of Iberian ham may also be important with regard to the sensory characteristics of the product. The relatively high temperature reached during the drying stage (25-30ºC) stimulates lipolysis and lipid oxidation (Antequera et al., 1992) and proteolysis (Córdoba et al., 1994). These biochemical processes are very important in the typical ham aroma development. Volatile aldehydes are the most abundant volatile compounds reported at the end of processing Iberian hams (García et al. 1991; López et al. 1992) and are indicators of lipid oxidation (Shahidi, 2001). Therefore, lipid oxidation phenomenon plays an important role in development of ham flavour (García et al., 1991; López et al., 1992, Buscailhon et al., 1994). Subcutaneous adipose tissue of dry-cured Iberian hams represents a large percentage of this product, and because of its superficially situation, it is easily accessible. Thus, it could help to determine ham quality and to control the dry-curing process.

Objectives

The objective of this study was to determine the influence of the Iberian ham drying conditions and pig rearing system ("montanera" and "pienso") in the evolution of volatile aldehydes.

Methods

Five Iberian pigs were fed on a traditional extensive system based on acorns and pasture during the fattening period ("montanera") and a further five pigs were raised in confinement with a concentrate feed. The first steps of processing, (salting and post-salting) were performed in a local industry. Drying was carried out under controlled conditions of temperature and relative humidity in a drying room for 80 days. The relative humidity was set at 75-65%. Samples of subcutaneous adipose tissue were taken at five different moments, twenty days after each temperature condition modification. The initial temperature was set at 10-15º C and it was increased 5º C up to reach 30º C, and then decreased 5º C.

The isolation of volatile compounds was carried out by using a Hewlett-Packard G1900 A purge and trap concentrator. Samples (8g) were thermostated at 35º C for 10 min, and subsequently purged during 30 min at 35º C with purified helium and adsorbed on a tenax/silica gel/charcoal trap held at –20º C with carbon dioxide. The compounds were thermally desorbed into the gas chromatograph (Hewlett Packard 5890 series II) by quickly heating at 225º C. The compounds were injected, and trap heating was held for 2 min. Transfer line temperature was set at 200 C. Separation of volatile compounds was performed on a 5% Phenyl-Methyl Silicone (HP-5) bonded phase fused silica capillary column (50m x 0.32 mm i. d., film thickness 1.05µm). Oven program was: 35º C, 10 min; 7º C min^{-1} to 150º C; 20º C min^{-1} to 250º C and held at this temperature for 7 min. The transfer line temperature to mass spectrometer (MS) was 280º C.

Identification of volatile aldehydes was carried out in a mass selective detector (Hewlett Packard 5971A) with electron ionization at 1756 V. The mass detector temperature was set at 280º C. Compounds were tentatively identified by comparing their mass spectra with those contained in the NIST/EPA/NIH and Wiley libraries and by comparison of Kovats indices with those reported in the literature by Kondjoyan and Berdagué (1996). Volatile aldehydes were expressed as percentage of area over the total volatile compounds.

Results and discussion

The following volatile aldehydes were identified during the drying stage: acetaldehyde, propanal, butanal, 3-methylbutanal, 2-methylbutanal, pentanal, hexanal, heptanal, 2,4- nonadienal, octanal. The main precursors of these particular volatile compounds are the unsatured fatty acids (Shahidi, 2000) and amino acids (MacLeod, 1994). Temperature during the drying stage of Iberian ham had a marked influence on the formation of volatile aldehydes, however at the end of drying the volatile aldehydes formation was moderate (figure 1). The limited oxidation produced in the last days of drying may be due to the condensation reactions between the aldehydes formed and to reactions between aldehydes and the free amino acids giving to the formation of Maillard compounds (Ventanas et al., 1992). These results are in agreement with those found in Iberian ham during dry-cured processing (Martin et al., 2000), where a decrease of volatile aldehydes was found at the end stage of maturation. Otherwise, there are important differences in the evolution of aldehydes between the two groups of hams (figure 1). The different evolution of hexanal between "montanera" and "pienso" hams (figure 2) could be due to the presence of a larger amount of antioxidants in "montanera" hams than in "pienso" hams (Cava et al., 1999). On the other hand, it was found an increase in 3-methylbutanal and 2,4- nonadienal during the drying stage, as figure 3 and 4 show. This different evolution of aldehydes between "montanera" and "pienso" hams gives rise to a different concentration of aldehydes at the end of the drying stage (figure 5) that could cause particular aromas in each group of hams. Also it is important to comment that 3-methylbutanal has been reported to be an indicator of dry-curing length because its concentration increase during the elaboration process (Bolzoni et al. 1996; Ruiz et al 1999). 2,4-nonadienal also increased with the curing length and therefore it could be an useful indicator. These results show that the abundance of these compounds in subcutaneous adipose tissue could be used to monitor the dry-cured process.

Acknowledgements

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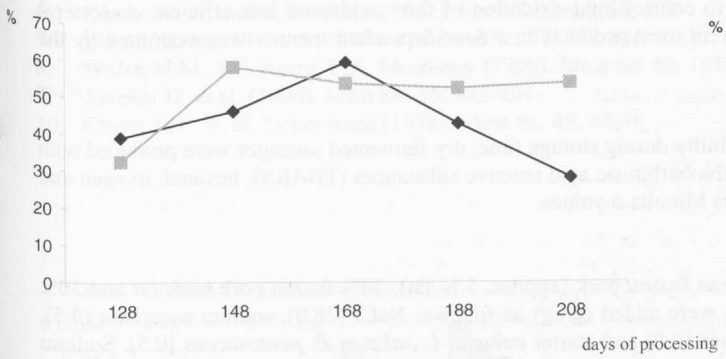

Fig. 1 Evolution of aldehydes during the drying stage

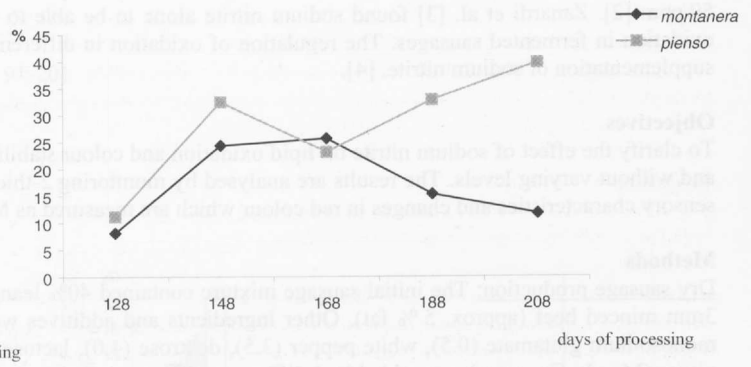

Fig. 2 Evolution of hexanal during the drying stage

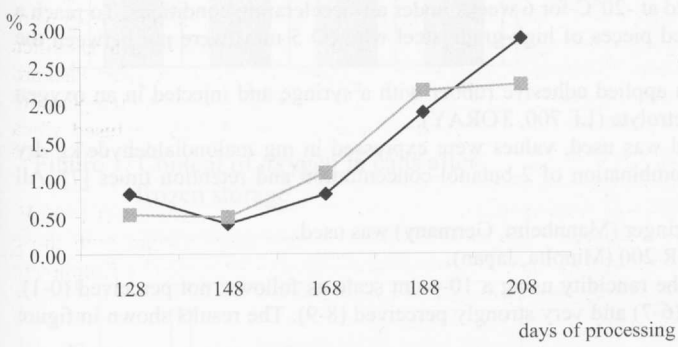

Fig. 3 Evolution of 3-methylbutanal during the drying stage

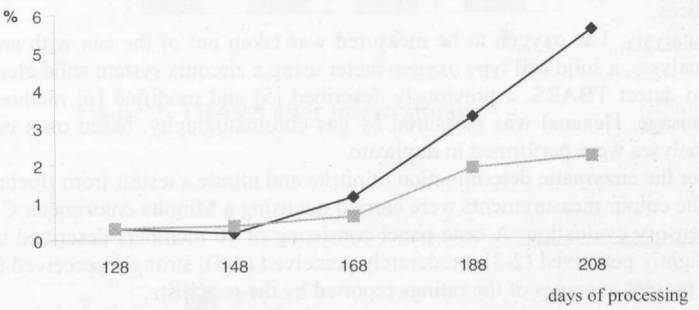

Fig. 4 Evolution of 2,4-nonadienal during the drying stage.

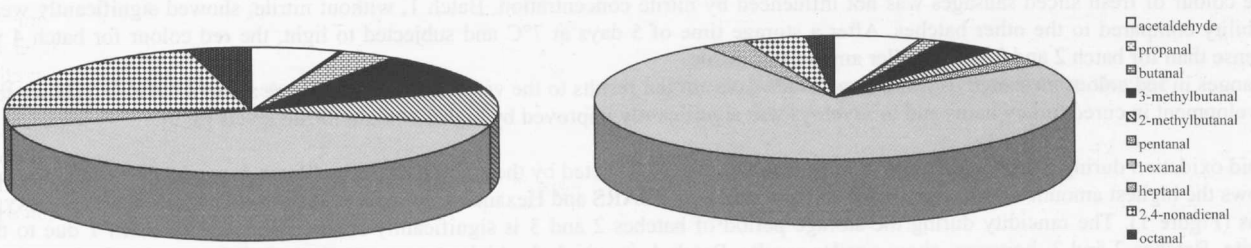

Fig. 5. Proportion of volatile aldehydes at the end the drying stage.