# EVOLUTION OF VOLATILE ALCOHOLS IN VACUUM-PACKAGED DRY-CURED HAM

ELIAS M.**, SABIO E.*, VIDAL-ARAGON M.C.*, SANABRIA C.*, FALLOLA A.*

* Departamento de Tecnología Agroalimentaria,Spain. ** Escola Superior Agrária de Santarém. Sector da Tecnologia da Carne, Santarém. Portugal.

S-VIA.07

## SUMMARY

The measurement of the amount of alcohols in meat products is interesting because its generation is usually related to microorganism development. The evolution of alcohols in vacuum-packaged ham during storage has been studied. The samples came from Iberian hams dry-cured using: A)Traditional Portuguese method (homemade)(T) and B)Industrial method (I). Other factors analyzed were: 1) sample thickness (slices or pieces. S and P, respectively) and 2) storage time (0, 2, 5 and 8 months). The volatile compounds studied were: ethanol, 2-methylpropan-1-ol, 1-pentene-3-ol and 3-methylbutan-1-ol. The amounts of them were analyzed using dynamic head space method coupled to GC-MS technique.

The results show that the initial values (0 days) of ethanol are much greater in the homemade samples than in the industrial ones; however, there is a continuous increase with time only in the latter samples. 2-methylpropan-1-ol and 3-methylbutan-1-ol concentrations are similar at 0 days in both technologies, but there is again an increment with time only in industrial case. These differences could be due to a major concentration of curing salts and lower $a_w$ in the homemade samples, that make it difficult microorganism development. For 1-pentene-3-ol there are not important differences between both technologies.

## INTRODUCTION

In today's society, packaging is pervasive and essential. Without packaging, moderm consumer marketing would be virtually impossible. Some of the main functions of packaging are (Robertson, 1993):
-Containment.
-Protection of its content from outside enviromental effect (water, gases , odors, microorganisms, etc). The result will be a longer shelf-life of the product.
-Communication. The ability of consumers to instantly recognize products through distinctive branding and labeling enables supermarkets to function on a self-service basis.
-to make it easier the transport.
-convenience.

For these reasons, packaging could be an useful procedure in dry-cured ham marketing. This product has been traditionally sold as a whole piece. This situation is changing nowadays due to its high price (specially in Iberian ham), the reduction of the family unity and changes in the consumer habits. Packaging allows ham to be apportioned to a manageable, desirable consumer size. However, reduction of quality during storage should be avoided.

The aim of this work is to study alcohols evolution in vacuum-packaged Iberian dry-cured ham, during storage, evaluating the influence of the ham processing technology. As far as we know, there is no previous information on this subject. Alcohols are important compounds because its formation pathway usually involve microbial contribution, moreover, they may alter the aroma of the samples yielding changes in quality (Webb, 1963).

## MATERIALS AND METHODS

### Samples

All the samples analyzed were from *Biceps femoris* muscle of Iberian pig hams with 18 months of curing, from traditional and industrial portuguese productions and vacuum packaged up to 8 months. The

samples were packaged in slice and pieces, thus there were 4 groups under study: traditional-slice (TS), traditional-piece (TP), industrial-slice (IS) and industrial-piece (IP). The samples have been analyzed at 2,4,5 and 8 months' storage. For the analysis, the frozen sample was minced with a home mincer and 3g were employed.

Packing conditions

All samples were packaged with plastic film composed of polyetilene, ethylvinilalcohol and polyamide (Permeability to $O_2$ 35 $cm^3/m^2/24h$, to $CO_2$ 150 $cm^3/m^2/24h/bar$, to water vapour 20 $g/m^2/h$), vacuum closed and refrigerated to 6-7°C.

Isolation of volatile compounds

The isolation of volatile compounds has been carried out with a Purge and Cold Trap Injection System (PTI) of Chrompack (Badings et al, 1985). The purge conditions were:

- Sample temperature: 60°C
- Purge flow: 10 ml/min of Helium
- Purge time: 15 min

Separation and identification

GC_MS analysis of the volatile compounds was performed with a Hewlett Packard 5890 SerieII Chromatograph, coupled directly to a Hewlett Packard 5971 mass spectrometer. Mass spectrum were acquired using a vectra Hewlet Packard 386/25 computer, which also controls the running conditions of the analysis.

Gas Chromatography was performed on a 50m x 0.32mm id fused silica column coated with a Phenyl-methyl-silicone of 1.05 µm. Helium was the carrier gas. The column was held at 50°C during transferring of the headspace components; after 5 min the oven temperature increased 5°C/min until 210°C, and then it was held for 1 min. The mass spectrometer was scanned from 10 m/z to 400 m/z. The ion source was maintained at 280°C and the spectra were obtained by electron impact (70ev). The spectrum were identified by comparison with a Wiley library.

## RESULTS AND DISCUSSION

Figure 1 shows the ethanol concentration during the storage time; it can be observed higher values of it for the traditional samples than industrial ones, except for the IS at 8 months, which shows a really high value. There are not significant changes between pieces and slices in both artesanal and industrial samples. The ethanol amount presents a smooth drop at two month but after there is an increase in all cases except in TP at 8 months. The ethanol could be produce by some microorganism (Marshall, 1984) by reduction of acetaldehyde.

The evolution of 2-methylpropan-1-ol and the 3-methylbutan-1-ol is shown in figures 2 and 3. There is a great different behavior between industrial and traditional samples in both cases. The industrial hams experiment a important ascent in concentration after 2 months. There are not significant differences between slices and pieces, except for 3-methylbutan-1-ol in industrial samples at 8 months. These two compounds probably came from the catabolism of valine and leucine amino acids. It is very likely that microorganism action is involved in this degradation (Fernandez & Frutos, 1988). In fact, there is a relationship between microbial population and the evolution of these compounds. Table 3 shows that there is higher count of mesophyles and psicrophyles microorganisms in industrial samples than in traditinal ones. Moreover, there is an increment of microorganism with time. The microbial population differences between both technologies could be explained by the physico-chemical parameter found in these products (tables 1 and 2). The traditional hams have lower $a_w$ and higher $Cl^-$ concentration, and this make it difficult the microorganisms growth (Leitstner, 1986, Palmia, 1982).

Finally, the 1-pentene-3-ol does not have a clear pattern, but in general there is a important increase at 2 months and then the concentration remains more or less constant. The patway for the biosynthesis of this compound might involve microbiological degradation of polyunsaturated fatty acids (Karahadian et al., 1985).

## CONCLUSIONS

It can be observed a different behavior of alcohols concentration in both traditional and industrial technologies, and it depends on alcohol nature. In general, the ethanol is higher in artesanal samples. 2-methylpropan-1-ol and 3-methylbutan-1-ol are in higher amount in industrial hams, where the concentration

rises with time. The 1-pentene-3-ol concentration increases at 2 months and then it does not have a clear pattern.

## REFERENCES


BADINGS, H.T., JONG DE, C. & DOOPER, R.P.M. (1985). Automatic system for rapid analysis of volatile compounds by purge and cold trapping/capillary gas chromatography. Joudrnal of High Resolution Chromatography, 8, 755-763.

FERNANDEZ & FRUTOS, M. (1988). El aroma del queso. Composición y análisis. Alimentación, equipos y tecnología. Julio-Agosto. 95-102.

KARAHADIAN, C.; JOSEPHON, D.B. & LINDSAY, R.C. (1985). Contribution of Penicillium sp. to the flavors of Brie and Camembert cheese. J. Dairy Sci., 68, 1865-1877.

LEITSNER, L. (1986). Allgemeines über Rohschinken. Fleischwirtsch., 66, 496-510.

MARSHALL, W.M.E. (1984). in Advances in the Microbiology and Biochemistry of Cheese and Fermented Milk, edited by F.L. Davies and B.A. Law, Elsevier Applied Science, London.

PALMIA, F. (1982). Determinazione dell'attivita dell acqua ($a_w$) de prosciutti crudi stagionati in funzione del contenuto di acqua e sale. Ind. Conserve, 57, 69-72.

ROBERTSON, G. L. (1993). Introduction to food packaging. In: Food packaging. Principles and practice. Marcel Dekker, Inc.

WEBB, A.D. & INGRAHAM, J.L.. (1963). Fusel oils. In: W.U. Wayne (Ed.), Advances in Applied Microbioly, Academic, New York, 5: pp. 317-353.