USE OF COMPUTED TOMOGRAPHIES (CT) IN *IBERICO* HAM NaCl CONCENTRATION ANALYSIS.

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BACKGROUND

The knowledge of NaCl concentration in each point of a ham is very important because it affects water activity (Aw) and ham conservation during the drying process. It also affects the organoleptic properties of the final product.

In the traditional elaboration of *Ibérico* ham the salt addition is made following the "dry salt addition" method, where all the salt is incorporated through one face of the ham and must reach the core. In an opposite direction there is a flux of water to the exterior of the ham as a consequence of the superficial water loss produced in the drying process.

An important fact is that salt absorption and water loss take place, due to fat impermeability to NaCl solutions and water, almost entirely through a fat free side of the ham.

These two physical phenomena of mass diffusion (NaCl and water) are produced simultaneously in opposite direction fluxes. Both phenomena are related: when water is eliminated from the surface there is an increase of NaCl concentration in this zone, augmenting its diffusion to the core of the ham.

The ham structure, formed by independent muscles separated by fat makes more difficult the diffusion phenomena. In the *Ibérico* ham the difficulty is increased with the infiltrated fat present in the muscle.

All the mentioned reasons make very complicated the study of the NaCl diffusion in the *Ibérico* ham.

Under a physical perspective, a temperature increase facilitates the drying process but it also facilitates the growth of microorganisms that, if the Aw conditions are favourable, cause alterations in the ham.

This study has been made, traditionally, with samples of different muscles and many hams were necessary to make a complete study during the process. The difficulty is increased taking into account the so great differences existing among hams. The use of non-destructive methods will make diffusion studies in the ham easier.

The computed tomography has the necessary conditions to become itself in an appropriate tool for this kind of studies.

OBJECTIVES

The main objective of this study is the validation of a non-destructive analysis method to analyse the evolution of the NaCl diffusion during the drying process of the *Ibérico* ham.

The selected non-destructive method is the computerised tomography and for the sake of its application, the study of the relationship between percentage of NaCl and X-ray absorption in different components of the ham is needed.

Following the mentioned objectives, it is necessary an image processing program that permits the display of the results in colours.

The drying process of the *Ibérico* ham has been studied with the mentioned non-destructive tool.

METHODS

The study was conducted using a state of the art, non helical, CT manofacture (Phillips Tomoscan CX, Neederland) located at 12 de Octubre University Hospital in the Radiologic Department.

Technical factors performed were continuous slice acquisition through the samples, using 120 KV peak absorption, 200 mamps/s, field of view (FOV) 200 and slice thickness 5mm. Calibration and automatically adjustment were made previously to each study.

The NaCl Analysis has been made with a selective chloride electrode (Orion Mod. 720) in the Engineering Department of the Instituto del Frío.

As the first step for the scanner calibration, various TC with known NaCl solutions between 0% and 11% have been made. Analysing these TC the X-ray absorption as a function of the NaCl solution grade has been obtained, considering that the absorption medium (water) is very close to null absorption.

A 2% Agar solution is a first more complex model used. The Agar stability permits the dry salt addition process to be similar to the ham salting process. Increasing concentration samples have been prepared. The NaCl concentration of the mentioned samples was obtained with the selective electrode after the TC analysis.

Similar analyses with TC and selective electrode have been done with pig meat.

TC in various hams have been made at different drying process periods. After TC, the analysed ham has been cut and prepared for the selective electrode analysis.

Finally, successive TC during their drying process have been made to a group of hams. The suitability of the mentioned technique to analyse the salt diffusion process has been tested with these TC.

A data format change supplied by the Phillips Scanner has been needed for the data computed analysis. A program for image processing (to maintain the Hounsfield absorption unit information) has been coded.

RESULTS AND DISCUSSIONS

In Figure 1 NaCl solutions tests are presented. A perfectly linear relationship (correlation index r=0.999) can be observed. The null interference of water present in the dissolution is confirmed.

The results in Agar tests are shown in Figure 2. There is a perfectly linear relationship (r=0.997) with small differences with respect to the values of the NaCl solution.

The results in meat tests are shown in Figure 3, having a bigger dispersion than the previous tests. The correlation index is r=0.968. For a same concentration of NaCl in mea,t exists a bigger degree of absorption. This fact indicates that meat has an important absorption. The possible infiltrated fat has also an important degree of absorption.

Data shown in Figure 3 are the origin of the coloured presentation of Figures 4 to 6. Changes in NaCl concentration during the ham drying process are shown in these figures.

CONCLUSIONS

The Computerised Tomography is a useful tool for the non-destructive determination of the NaCl concentration in the *Ibérico* ham. It permits the global study of salt diffusion, providing a concentration map at the muscle section with its exact morphology which will be very useful for its modelling.

With a group of very close images (or using an helical scanner) three-dimensional representation can be made. These representations will be very helpful in the analysis of theoretical cuts through each of the axes.

PERTINENT LITERATURE

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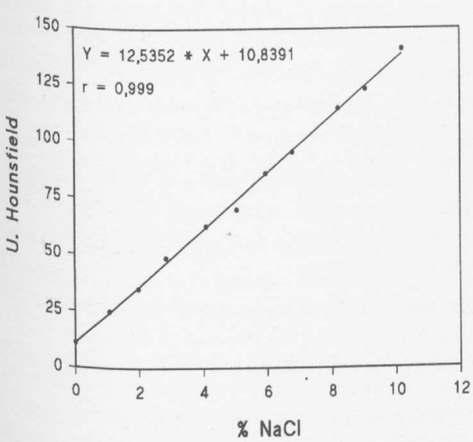

Fig. 1: NaCl Solution in Water

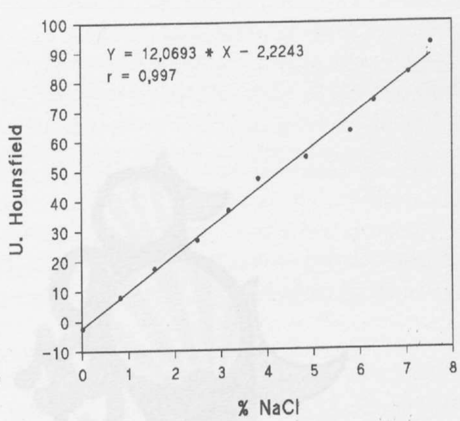

Fig. 2: NaCl Solution in Water/Agar

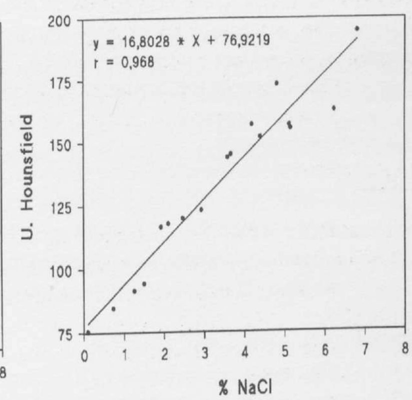

Fig. 3: NaCl Concentration in Meat

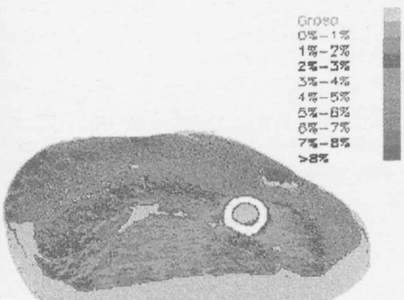

Fig.4: 32 Days of Drying

Fig.5: 165 Days of Drying

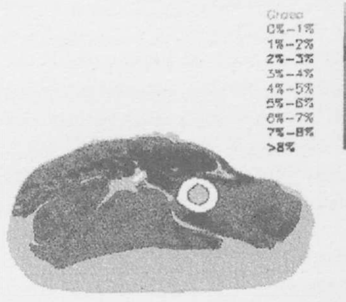

Fig.6: 384 Days of Drying

NOTES

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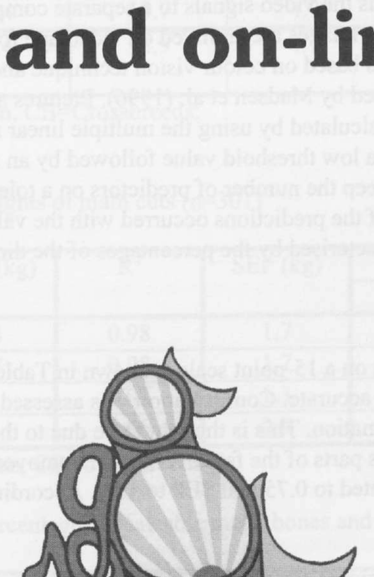
Poster session and workshop 12

Automation and on-line methods



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