FROZEN HAM SALTING/THAWING BY BRINE VACUUM IMPREGNATION

Barat, J.M., Grau, R., Pagan, M.J., Fito, P.
Departamento de Tecnología de los Alimentos, Universidad Politécnica de Valencia, Camino de Vera s/n. Box 22012, CP 46071, Valencia, Spain.

Introduction

Over the last few years the use of frozen hams as raw material has become more extended in the industry. Ham freezing enables to store the product enough to obtain homogeneous batches, in weight and fat content, which are highs enough to be industrialized. Another advantage is that ham freezing makes the international trade of raw products easier (Arnau, 1998), and the possibility to control the market prices or make profit from punctual low prices, which are quite frequent in the pork meat sector. The use of frozen ham implies some variation in the traditional Spanish cured ham manufacturing. One of the changes is the addition of a thawing step in a temperature controlled chamber at 3ºC for around 4 - 5 days (Bañon, 1998). Another of the known modifications in the traditional process is the shortening of the salting step because of the faster salt uptake when working with thawed hams (Poma, 1989). The introduction of a thawing step in a cold chamber implies the increase in the processing cost as regards the traditional one, although the reduction in the following processing time is a factor that contributes to reduce the costs.

The traditional way of Spanish cured ham manufacturing can be influenced by two new technologies that have recently been introduced. One of them is the use of brine thawing/salting simultaneously (Barat et al., 1997; Ngapo et al., 1998), which is named to reduce the time needed to do the thawing process in a cold chamber and the following salting step. The other technology with proven results in fastening the salting step is Vacuum Impregnation (VI) (Barat et al., 2001; Fito et al., 2001). Vacuum brine impregnation (VBI) consists of two steps: first a vacuum pressure is applied and maintained in the brine tank during a time t_1 and afterwards the atmospheric pressure is restored while the hams remains immersed for a time t_2.

Objective

The objective of this work was to study the influence of vacuum impregnation on the simultaneous brine salting/thawing process, and compare the results with those obtained thawing in a cold chamber and doing the traditional pile salting.

Methods

12 fresh hams with an average weight of 9.4 ± 0.8 kg were selected in a local slaughterhouse controlling the pH in the 5.7 to 6.3 range. Afterwards, hams were frozen in an industrial freezer at -40ºC and stored for at least 30 days at -20ºC, in order to obtain a frozen raw material which resembles the commercialized. Three of the frozen hams were thawed in a cold chamber at 3ºC for 5 days, similarly to the industrial process (Bañon, 1998), and afterwards pile salted (TPS). The remaining 9 hams were brine thawed/salted for a total of 5 days (the time defined in the previous experiment as the needed to thaw/salt the hams working at atmospheric pressure), by applying one or two vacuum pulses (BTS-VP). All the salting experiments were carried out at 3ºC.

The traditional pile salting was carried out by covering the hams with solid salt in a cold chamber with a 90% of relative humidity. The time employed was 0.96 day/kg of fresh ham, thus reducing the time/kg according to the recommendations from other authors (Bañon, 1998). These ratios lead to a total salting time of 9 days.

The brine thawing/salting experiments were carried out in a stirred and saturated brine solution (24% w/w), in a tank at a controlled temperature and pressure (Barat *et al.*, 2001). Three combinations for the vacuum pulse application were studied: vacuum pulse application just at the beginning of the experiment (BTS-BP), once the most unfavourable point had reach 0ºC (2.3 days of processing) (BTS-TP), and two pulses, one at the beginning and the other after 2.3 days of processing (BTS-BTP). The vacuum pulse consisted in a vacuum period of 3 hours at 60 mbar pressure.

Sampling

After the salting period, hams were taken out, weighed and placed for 24 h in a chamber. Temperature and relative humidity of the chamber were controlled at 3 ºC and 90% to avoid drying and to allow the muscles to absorb the free brine. Afterwards, samples were taken and analyzed.

The initial and final weight (ΔM^{o}_{t}) of each ham was measured (equation 1), being M^{o}_{0} and M^{o}_{t} the total ham weight at time 0 and t respectively. NaCl and water analyses over each ham were carried out using the whole homogenized ham muscles (R).

$$\Delta M^{o}_{t} = \frac{M^{o}_{t} - M^{o}_{0}}{M^{o}_{0}} \qquad (1)$$

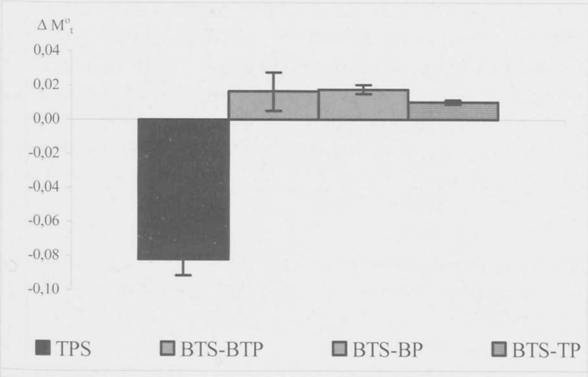
Analytical determinations

Sodium chloride was determined after sample homogenization in a known amount of distilled water at 9000 rpm in an ULTRATURRAX T25 for 5 minutes and centrifuged to remove any fine debris present in the sample. Afterwards, the solution was filtered and exactly 500 µl aliquot sample was taken and tritated in Chloride Analyzer equipment (CIBA Corning Mod. 926) (Guamis et al., 1997). Moisture content was determined by oven drying to constant weight at 100ºC (ISO R-1442).

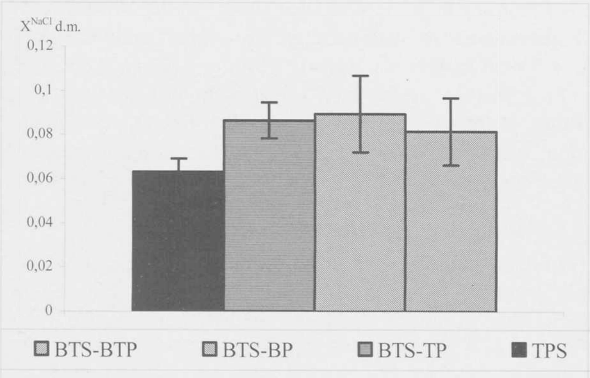
Results and discussion

Total ham weight changes after the salting period (ΔM^{o}_{t}) can be observed in figure 1 (b). It was remarkable the different values of ham weight changes. When the thawed hams were salted with solid salt, the ΔM^{o}_{t} was -0.082. This value includes the corresponding to the drainge during thawing, as a consequence of the disruption of the muscle structure suffered during the freezing and storage period (Girad, 1991; Barreto and Colmenero, 1994), very close to the –0.02 reported by Girad (1991) and the drying process that take place in the salting stage (Prändl, *et. al.*, 1994). The total weight changes for the hams vacuum impregnated at the beginning of the thawing salting experiment (BTS-BP), after 2.3 days (BTS-AP), and at the beginning and after 2.3 days of processing (BTS-BTP) were smaller than thawed hams (TPS) (figure 1 (a)), in fact the weight changes were positive. This weight increase showed clearly, that the vacuum pulse or pulses, implied the uptake of some of the external brine by the Hydrodynamic Mechanism (HDM) (Fito, 1994).

The X^{NaCl} value at the end of the salting process (figure 1 (b)) was 0.063 (±0.006) for the TPS hams. The frozen hams salted with vacuum pulse or pulses (BTS-BP, BTS-AP and BTS-BTP) showed higher X^{NaCl} value (≈ 38 %) than TPS hams. This increase stresses the influence of the Vacuum Impregnation on the salting gain, in relation with those thawed hams. This meant that a 64% reduction in the total time employed traditionally for the frozen hams (5 days for the simultaneous thawing and salting, and 5 + 9 days for the traditional method), a higher NaCl content was obtained, indicating thatt the total time reducction would be much higher than the mentioned 64 %.



(a)



(b)

Figure 1. Total ham weight changes (ΔM^o_t) (a) and X^{NaCl} value (b), with standard deviation at the end of the pile salting at 3ºC for the fresh (FPS) (13 days) and thawed hams (5 days of thawing at 3ºC and 9 days of salting) (TPS) and with a vacuum pulse at the very beginning, after 2.3 days, and at the very beginning and after 2.3 days of processing (BTS-BP, BTS-TP and BTS-BTP).

Since the final X^{NaCl} value was higher in hams thawed/salted in brine with vacuum pulse than thawed ham, salting according to the traditional method (solid salt), a more accurate study of the salting process when using vacuum impregnation must be made, in order to determine the needed salting time, which would be lower than 5 days in our case, and the knowledge that the use of a vacuum pulse contributes to reduce the total processing time.

Conclusion

The experimental results showed that a faster way of salting/thawing was achieved by brine vacuum impregnation than with the traditional method (lower than 5 days and 14 days respectively). A more intense dehydration was promoted by pile salting, while brine salting promoted the salt uptake in a greater extent (≈ 38 % higher than thawed hams), mainly favoured by the action of the hydrodynamic mechanism promoted by the vacuum pulse. The total processig time needed with the new salting / thawing method would be shortened ore than a 64 %.

References

Arnau, J. (1998). Tecnología del jamón curado en distintos países. En: El jamón curado. Tecnología y análisis de consumo. Simposio Especial 44th ICoMST. Ed. Estrategias Alimentarias. Barcelona. Pp: 10-21.
Bañon, S., Cayuela, J. M., Granados, M. V., Garrido, M.D. (1998). Pre-cure freezing affects proteolysis in dry – cured hams. Meat Science. Vol 51. p.11- 16.
Barat, J.M.; Grau, R.; Montero, A.; Chiralt, A.; Fito, P. (1997). Procedimiento de descongelación y salado simultaneo de piezas de carne o pescado. Spanish patent. Number P9701702.
Barat, J.M.; Grau, R.; Montero, A.; Chiralt, A.; Fito, P. (2001). Salting time reduction of Spanish hams by brine immersion. Food Preservation Technology Series.Osmotic Dehydration & Vacuum Impregnation.Application in Food Industies. Ed. Technomic Publishing Co., Inc. Lancaster, USA.
Barreto, G. and Colmenero, J. (1994). Conservación de la carne por frío. Eurocarne, 29: 71-79
Fito, P. (1994). Modeling of vacuum osmotic dehydration of food, J, Food Eng. 22:313-328.
Fito, P.; Chiralt, A.; Barat, J.M.; Andrés; A.; González-Martínez, C.; Escriche, I; Camacho, M.M. (2001). Use of Vacuum Impregnation in Food Salting Process. Journal of Food Engineering. 49, 141-151.
Girard, J.P. (1991). La deshidratación. En: Tecnología de la carne y de los productos cárnicos. Ed. Acribia. Zaragoza.
Guamis B, Trujillo JA, Ferragut V, Chiralt A, Andres A, Fito P. 1997. Ripening control of Manchego type ewe's cheese salted by brine vacuum impregnation. Int Dairy J 7:185-192.
ISO Norms, International Standards Organisation. 1979. Determination of Moisture (R-1442).
Ngapo, T.M., Babare, I.H., Mawson, R.F. (1998) Simultaneous thawing and curing of whole porcine muscle. Driesde, A., Monfort, J.M. Eds. In: Meat consumption and culture. Congress proceedings 44th International Congress of Meat Science and Technology. Vol I. Madrid. Estrategias Alimentarias.S.L.EUROCARNE. pp. 406-407.
Poma, J.P. (1989). La fabricación de jamón curado. Importancia de la congelación de la materia prima. En: Avances en la tecnología del jamón curado. II Jornadas Técnicas sobre el jamón curado. Valencia. Pp: 29-36.
Prändl, O., Fischer, A., Schmihofer, T., Sinell, H. J. (1994). Tecnología de la carne e higiene de los alimentos. Ed. Acribia. Madrid.