# INTERMEDIATE MOISTURE MEAT PRODUCT. EVALUATION OF SORPTION PROCESSES IN SALTED AND DRIED BROILER MEAT, *PECTORALIS MAJOR M.*

CORÓ[1,2], Fábio A. G.; PEDRÃO[1,2], Mayka R.; YAMASHITA[1], Fábio & SHIMOKOMAKI[1], Massami

[1]Department of Food and drugs Technology, Agricultural Sciences Center, Londrina State University, P.O. Box 6001, CEP 86051-970, Londrina, Paraná, Brazil;

[2]UNOPAR – Northern University of Paraná, Food Engineering Department, Av. Paris, 675, CEP 86041-140, Londrina, Paraná, Brazil.

## Background

Hurdle technologies were used in order to preserve broiler fillet meat. Salting, drying and packaging were sequentially applied and the obtaining product has the characteristic of being an intermediate moisture meat product. The so called-charqui chicken meat was the resulting product and presented chemically similar composition as the traditional charqui beef meat with water activity (Aw) of 0.70-0.78 (Shimokomaki et al., 1998, 2003) which is stable microbiologically (Lara et al., 2003). Sorption isotherms (SI) correlate moisture in relation to the Aw of the product. From SI is possible to design processes in order to obtaining products with moisture values to avoid development of undesirable microorganisms and to determine the storage system. Halsey model for water sorption isotherms revealed to be the best model to predict previously the application of hurdle technology to preserve breast chicken meat by salting and drying processes.

## Objectives

To evaluate the dehydration and adsorption processes in salted and dried broiler breast meat and to adjust Halsey model to the experimental data.

## Methods

*Charqui Processing:* Salting and drying of broiler breast meat, *Pectoralis major m.*, were based on techniques described in Shimokomaki et al. (1998). Essentially, samples were immersed in brine, 20.0% solution for 90 min subsequently four manually tumblings (*tombos*) were carried out during drying salting and samples were submitted to oven drying process during 2 days at 35°C and finally the ready charqui meats were vacuum packed.

*Moisture, Aw and NaCl concentration measurements:* were performed according to AOAC (1994).

*Sorption isotherms:* Adsorption and dehydration isotherms were determined according to the gravimetric method (Jowitt et al., 1983). Meat samples were prepared in cubes of 1cm$^3$ and added in hermetically closed plastic flasks containing 25.0 ml of saturated salt solutions, 70 to 100% Relative Humidity Equilibrium (RHE), and kept at 35±0.5°C in BOD oven until constant weights for app. 25 days of processing. Aw was measured by Aqualab model Cx-2. All measurements were carried out in quadruplicate.

*Halsey model:* The dehydration and adsorption experimental data were adjusted by Halsey model using Simplex Quasi-Newton method in Statistica® 5.0 program (Statsoft, 1998) according to the equation:

$$X = \left( - \frac{K}{\ln Aw} \right)^{\frac{1}{r_2}}$$

where:
x = moisture in dry basis   K and $r_2$ = parameters of Halsey model

## Results and discussion

Table 1 shows adsorption and desorption isotherms and for both $R^2$>0.93. $r_2$ value for desorption curve is 1.5x smaller than adsorption curve. According to Rizvi et al. (1995) these values is the consequence of the inverse relationship with the drying phenomena of energetic potential and also with the meat fibers interactions with water. For fresh meat, it is necessary more energy for removing water molecules from their internal structure because they are intact, keeping their functional properties unaltered. However, during adsorption process the necessity of this energy is smaller due to the structural changes promoted by salting. $r_2$ values above 2.5 indicate that these biochemical interactions occur at the meat surface. Other parameters did not present relevant difference between adsorption and desorption models.

Table 2 shows desorption model in which the decrease of moisture and Aw is noticeable. However, the pattern of this diminution is different since a great reduction of moisture is not followed proportionally by the decrease of Aw values at the initial step of processing. Aw values were from 0.988 to 0.933 and moisture values were 73.7 and 66.2% for fresh meat and after brine solution treatment, respectively. This could be explained by the slow movement of free water from the intermiofibrilar compartments to the perymisium sheaths and finally to the outer surface. When drying salting treatment occurs, particularly at tumbling steps, a hursh condition is imposed to meat samples, consequently protein fractions are denatured and their biochemical properties are impaired and water is removed more freely and moisture drops down to 52.9 while aw values go down to 0.759, typical for the intermediate moisture food products (Chang et al., 1996). At the second tumbling Aw and moisture reach the minimal and constant values therefore salting and drying processing is no longer necessary. All these changes can also be seen in the Fig. 1.

## Conclusions

Halsey model for sorption isotherms can be used as predictive model in order to process by salting and drying broiler breast fillet meat bringing up the physico-chemical equilibrium to the meat system.

## References

AOAC, Association of Official Analytical Chemistry. 40th edition, 1994.

CHANG, F. S., HUANG, T. C., PEARSON, A. M. Control of the dehydration process in production of intermediate moisture meat products: a review. *Advances in Food Nutrition Research*, 29, p.71-161, 1996.

JOWITT, R.; ESCHER, F.; HALLSTOM, B.; MEFFERT, H. F. T.; SPIESS, W. E. L.; VOS, G. Physical properties of foods. Applied Science Publishers, London, 1983. 425p.

LARA, J. A. F., SENIGALIA, S. W. B., OLIVEIRA, T. C. R., DUTRA, I. S., PINTO, M. F. SHIMOKOMAKI, M. Evaluation of survival of *Staphylococcus aureus* and *Clostridium botulinum* in charqui meats., *Meat Science*, 65, p. 609-613, 2003.

RIZVI, S. S. H. Thermodynamic properties of dehydrated foods. In: Engineering Properties of Foods, (M. A. RAO; S. S. H RIZVI, eds). Academic Press, New York, p. 223-309, 1995.

SHIMOKOMAKI, M., FRANCO, B. D. G. M., BISCONTINI, T. M., PINTO, M. F., TERRA, N. N. & ZORN, T. M. T. Charqui meats are hurdle technology meat products. *Food Reviews International* 14, p. 339-349, 1998.

SHIMOKOMAKI, M., YOUSSEF, E. Y., TERRA, N. N., Curing. In: Encyclopedia of Food Sciences and Nutrition, 2nd edition, Academic Press, New York, p. 1702-1707, 2003.

STATSOFT. Statistica for Windows v5.0. Statsoft Inc. Tulsa, OK, USA, 1995.

Table 1: HALSEY model parameters for salted and dried chicken meat sorption isotherms at 35ºC.

| Parameter | Desorption | Adsorption |
|---|---|---|
| K | 0.363 | 0.297 |
| $r_2$ | 1.798 | 2.776 |
| $R^2$ | 0.97 | 0.93 |
| $(OBS\text{-}PRED)^2$ | 0.534 | 0.316 |
| N | 52 | 20 |
| p | 0.05 | 0.05 |

$R^2$ = coefficient of determination    N = number of experimental points    p = level of the adjusted model significance

Table 2: Water activity (Aw), salt concentration (NaCl) and moisture content, in wet basis, change throughout salted and dried broiler fillet meat processing.

| Processing Steps | Time (h) | Aw | Moisture (w/b) | NaCl |
|---|---|---|---|---|
| | | | (g/100 g) | |
| Raw material | 0 | 0.988 (± 0.02) | 73.7 (± 0.48) | 0.72 (± 0.12) |
| Brine Salting | 2 | 0.933 (± 0.01) | 66.2 (± 0.88) | 5.9 (± 0.37) |
| Drying Salting | | | | |
| 1st Tombo (Tumbling) | 26 | 0.759 (± 0.008) | 52.9 (± 0.36) | 18.9 (± 0.38) |
| 2nd Tombo (Tumbling) | 50 | 0.748 (± 0.001) | 52.1 (± 0.50) | 18.5 (± 0.41) |
| 1st Oven Drying (35ºC) | 74 | 0.741 (± 0.005) | 49.2 (± 0.34) | 21.2 (± 0.24) |

Values between parenthesis means a standard deviation among samples

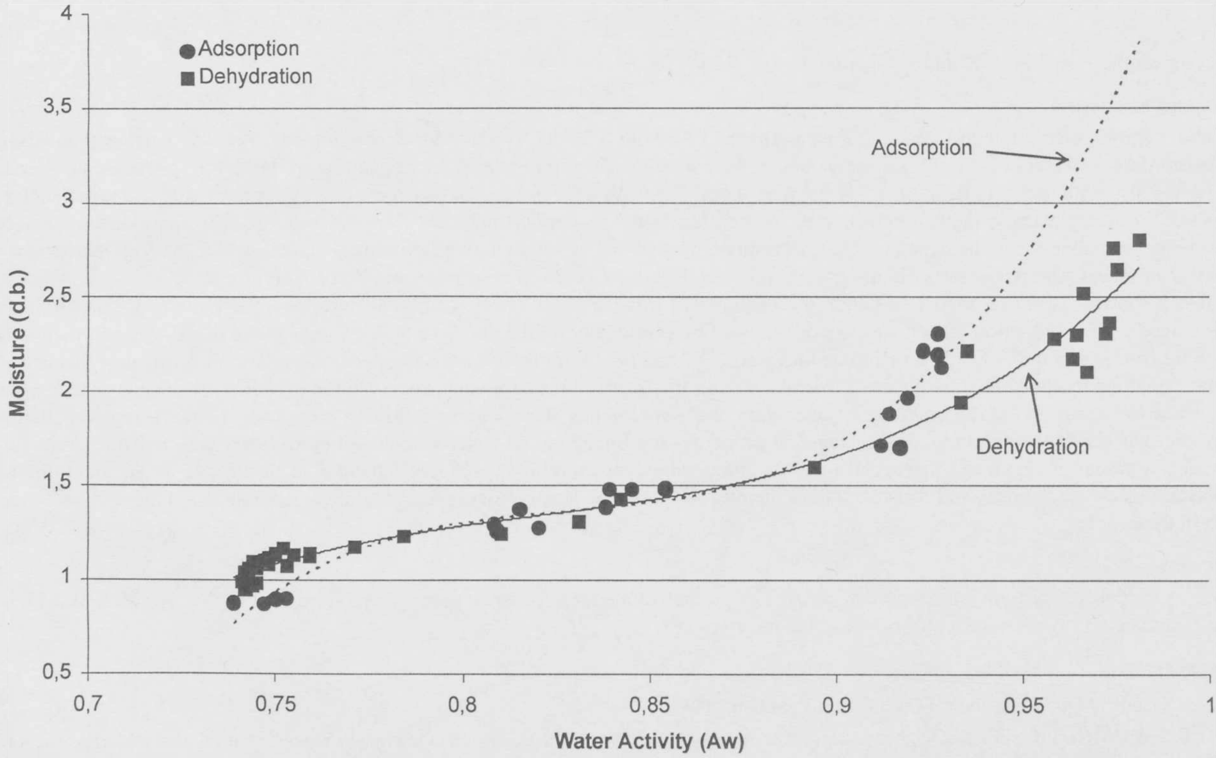


Figure 1: Sorption isotherms for salted and dried chicken broiler fillet meat at 35ºC