3.I - P 22

INTERMEDIATE MOISTURE MEAT PRODUCT. EVALUATION OF DEHYDRATION AND ADSORPTION PROCESSES IN CHARQUI MEAT

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BACKGROUND

It has established that Charqui meat is an intermediate moisture meat product derived form a hurdle technology (Leistner, 1987, Shimokomaki et al., 1998). Addition of salt to the concentration between 10-20% NaCl followed by drying under the sun process give as consequence, a final Aw value of 0.70-0.75 which classifies it as an intermediate moisture meat product (Shimokomaki et al., 1998). Several studies have been conducted to enlarge the knowledge of charqui at different aspects. Physicochemical and microbiological parameters (Torres et al., 1994, Franco et al., 1987) ultrastructural characteristics (Biscontini et al., 1996), texture evaluation due to collagen crosslinks (Youssef, et al., submitted), and its fermented nature (Pinto et al., 1998) have been considered. The Guggenheim-Anderson-deBoer (GAB) model (Rizvi, 1986) is considered to be the most versatile equation for describing food products sorption isotherms. In this opportunity we are reporting the determination of adsorption properties as consequence of the salting and dehydration processing.

OBJECTIVES

To evaluate the dehydration and adsorption process in charqui meat and to adjust GAB model to the experimental data

MATERIALS AND METHODS

Charqui preparation: Samples were taken from *Vastus lateralis* m. from bovine zebu breed of app. 5 years old processed at FRIPAR, Londrina, PR. It was based on the processing techniques described elsewhere (Shimokomaki et al., 1998). Essentially, salting was carried out as the so-called humid salting which consisted of submitted part of carcass in a saturated salt solution (25° Baumé) for 10 hours. Manual four tumblings (*tombos*) were carried out during drying salting and subsequently samples were submitted to a sun drying process during 4 days and finally the ready charqui meats were vacuum packed.
Adsorption measurement: Adsorption was determined by gravimetric technique according to Price & Wolf (1983). Basically 1-cm cube samples were submitted to five relative humidity of equilibrium (RHE) (75, 84, 90, 97 and 100%) at 25°C. Samples were weighted weekly until constant weight was reached. Moisture was determined according to AOAC (1995) and Aw was measured by Aqualab-Decagon Devices Inc., model CX-2, at 25°C.
GAB model: The dehydration and adsorption experimental data were adjusted by GAB model using Simplex Quasi-Newton method in Statistica® 5.0 program (Statsoft, 1998).

$$X = \frac{(C-1).K.Aw.Xm}{1+(C-1).K.Aw} + \frac{K.Aw.Xm}{1-K.Aw}$$

X - moisture (dry basis); Aw - water activity; C - Guggenheim constant; K - equation constant; Xm - water monolayer value

RESULTS AND DISCUSSIONS

Table 1 shows water activity, salt concentration and moisture changes throughout charqui processing. During humid salting was observed a major moisture and Aw reduction in a relatively short time indicating free water or weakly bound water movement out to the meat surface into the brine. During the 2nd *tombo* the Aw value already reached the final value of 0.75, that means there is no need to process further the *tombos* maneuver saving charqui processing time. Therefore the first two *tombos* would be enough for the product to have microbiological stability given by 0.75 (Senigalia et al., in preparation; Lara et al., submitted). However in order to accomplish the official legislation for moisture (45±5% w/b) content it is necessary to process up to 2nd sun drying.
The charqui samples submitted to RHE values from 75 to 100% during adsorption experiment the moisture varied from 51 to 67% (w/b) and Aw varied from 0.75 to 0.90. These experimental data and dehydration results were adjusted by GAB model and their parameters are described in Table 2. The Xm value for dehydration was app. 2.5 times higher than adsorption this explained by the proteins structural and spatial conformation. In the raw material the proteins keep their integral properties untouched and need higher energy in order to remove water from their structure and conversely during adsorption the necessary energy is lower because the proteins structural changes promoted by salting and sun drying processes.

CONCLUSIONS

The GAB model adjusted well the moisture variation as function of Aw for both dehydration and adsorption of charqui meat. Thus it can be applied as tool to predict changes during charqui processing and storage.

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REFERENCES

AOAC, Association of Official Analitical Chemistry. *Official methods of analysis of AOAC International.*, 1995.

BISCONTINI, T.M.B., SHIMOKOMAKI, M. OLIVEIRA, S.F, ZORN, T.M.T. An ultrastrutural observation on charquis, salted and intermediate moisture meat products. *Meat. Sci.*, **43**: 351 - 358, 1996.

BRASIL. Ministério d Agricultura. Departamento Nacional de Inspeção de Produtos de origem Animal. *Regulamento de inspeção industrial e sanitária de produtos de origem animal.* Rio de Janeiro, 1962.

CHANG,S. F.; HUANG, T.C.; PEARSON,A.M. Control of the dehydration process in production of intermediate-moisture meat products: A Review. IN: Pearson, A. M. *Advances in Food and Nutrition Research*, **39**: 71 – 161. 1996.

FRANCO, B.D.G.M.; LANDGRAF, M.; SHIMOKOMAKI, M.; AZEVEDO, C.H.M. Condições higiênico sanitárias do charque comercializado em São Paulo, Brasil. *Rev. Microbiol.*, **18**: 98-102, 1987.

LEISTNER, L. Shelf stable product and intermediate moisture foods based on meat. In: ROCKLAND, L. B. BEUCHAT, L. R., eds. *Water activity*: theory and application to food, p. 295 - 328, 1987.

PINTO, M. F. *Culturas iniciadoras - STARTERS - no processamento de Jerked beef, um derivado do charque*. São Paulo, 1996, 93 p. Tese de Doutorado. Departamento de Alimentos e Nutrição Experimenta;. Faculdade de Ciências Farmacêuticas. Universidade de São Paulo.

RIZVI, S. S. H. Termodynamic properties of foods in dehydration. *Engineering Properties of Foods, (M. A. Rao e SS. S. H. Rizvi, eds.)* p. 155-165, 1986.

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 Rev. Int.* **14**: 339-349, 1998.

PRICE, W.E.L.; WOLF, W.R. The results of the COST 90 Project on water on activity. In: Jowitt, R., Escher, F., Hallstrom, B., Meffert, H.F.Th., Price, W.E.L. e Vos, G. (Eds.). Phisysical properties of food. London: Applied Science publishers, 1983. p. 65 - 87.

STATSOFT. *Statistica for Windows*, v. 5.0, Statsoft Inc. Tulsa, OK, USA, 1995.

TORRES, E.A.F.S.; SHIMOKOMAKI, M.; FRANCO, B.D.G.M.LANGRAF, M., CARVALHO Jr. B. C., SANTOS, J. C. Parameters determining the quality of charqui, an intermediate moisture meat product. *Meat Science*, **38**: 229-234, 1994.

TABLE 1. Water activity (Aw), salt concentration (NaCl) and moisture in wet basis changes throughout charqui processing

Charqui Processing Steps	Time (h)	Aw	Moisture (w/b) (g/100 g)	NaCl (g/100 g)
Raw material	0	0.991 (± 0.001)	76.07 (± 0.56)	0.69 (± 0.06)
Humid Salting	10	0.871 (± 0.006)	66.29 (± 1.31)	13.21 (± 0.75)
Drying Salting				
1st Tombo	34	0.772 (± 0.008)	59.85 (± 1.13)	16.75 (± 0.26)
2nd Tombo	58	0.755 (± 0.003)	57.55 (± 1.35)	17.86 (± 0.23)
3rd Tombo	82	0.755 (± 0.002)	56.44 (± 0.88)	18.23 (± 0.60)
4th Tombo	106	0.755 (± 0.001)	55.61 (± 0.98)	18.86 (± 0.60)
Washing	130	0.761 (± 0.001)	58.48 (± 1.31)	17.25 (± 0.71)
1st Sun Drying	150	0.752 (± 0.001)	52.95 (± 1.70)	21.12 (± 0.96)
2nd Sun Drying	178	0.750 (± 0.003)	46.35 (± 0.16)	22.87 (± 0.30)

TABLE 2. Obtained adjusted GAB model constants for charqui dehydration and adsorption processing.

	Dehydration	**Adsorption**
Temperature	35 - 42°C	25°C
C	0.026	0.044
K	0.64	0.70
Xm	27.33	10.91
R^2	0.91	0.95
N	81	45

N - samples number
R^2 - coefficient of determination