Broiler chicken charqui meat-like processing by applying hurdle technology

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Abstract - **A salted broiler breast meat was produced by using the hurdle technology in order to avoiding chemical and microbiological deterioration. Salting, drying, sodium nitrites and packaging were hurdles inhibiting microorganisms growth and lipid oxidation throughout processing and 4 months storage at room temperature. The final meat product presented a proximate chemical composition of 73.0% moisture, 29.5% protein, 21.0% of mineral residue, 1.81% of fat, and Aw of 0.74 after 96h of processing. These values were similar to beef charqui meat classifying this product as an intermediate moisture meat product. Lipid oxidation was monitored and the presence of nitrite inhibited app. 94.0% of oxidation measured by TBARS. As for microorganisms, total coliforms number was completely inhibited and Staphyloccus aureus was inhibited by 70.0% in relation to the control presenting the counts of 1.91 log UFC/g. Texture measured as shear force for the desalted and cooked charqui was 36.16N an increase of 2.8 fold in relation to cooked control samples of 19.78N and nevertheless this value was considered as tender. The calculated processing yield was app 65.0% in weight. Sensory analysis of the product indicated good acceptance as a grade 7.0 with untrained panelists using a hedonic scale. This new intermediate moisture meat product derived from broiler chicken can be considered as a safe food and it is feasible to be stored at room temperature at least for 4 months without losing its safety.**

Keywords **– Chicken Meat, Intermediate Moisture, Hurdle Technology**

I. INTRODUCTION

There are broadly 2 classes of salted meat products in Brazil. First, the intermediate moisture meat products (IMMP), with shelf life for over months at room temperature. Charqui (CH) meat and its derivative Jerked beef (JB) are the main representative of this family. Second, non IMMP with shelf life of days presenting relatively a low content of salt and high moisture and a high water activity (aw). “Carne de sol”, sun meat is the representative for this kind of meat product and known locally under various names as carne-de-sertão, carne-do-ceará, carne serenada, to name a few. The total CH consumed is approximately 206 thousands ton/year, a consumption of 1.0- 1.5 kg/capita equivalent to app. to US$ 1.000 mi annually. According to the Brazilian legislation CH should contain 40-50% moisture and 10-20% salt [1] and 0.75 the final value of its water activity ranking it as an IMMP [2]. On the other hand, Jerked beef (JB) is officially characterized by Brazilian legislation by having maximum moisture 55%, sodium nitrite 50 ppm, salt concentration of 18%, final aw value of 0.78 and should be vacuum packed and technologically is an improvement from CH meat [3]. JB is an excellent example of food product derived from the hurdle technology theory [4] to obtain a safe product [5]. Salting, curing, drying, water activity, vacuum packaging are hurdles sequentially applied in order to avoid pathogenically contamination and the chemical oxidation deterioration is inhibited by the presence of nitrite which act both as botulism inhibitors and as lipid antioxidant [3].

Recently this salting simple technology was applied in spent leghorn hen meat and a feasible economically and nutritive poultry meat product was obtained which shelf life is for months at room temperature [6], Moreover, Brazil stands as the third largest producer of broiler chicken meat with a predicted production for 2011 of around 13.0 million tons of meat and exporting 3.3 million tons and these numbers rank the country as the third in the world for production and the largest exporter [7]. Thus, the aim of this work was to report the physicochemical and microbiological qualities of broiler chickens charqui-like meat product technologically produced by the application of hurdle technology.

II. MATERIALS AND METHODS

A. Processing

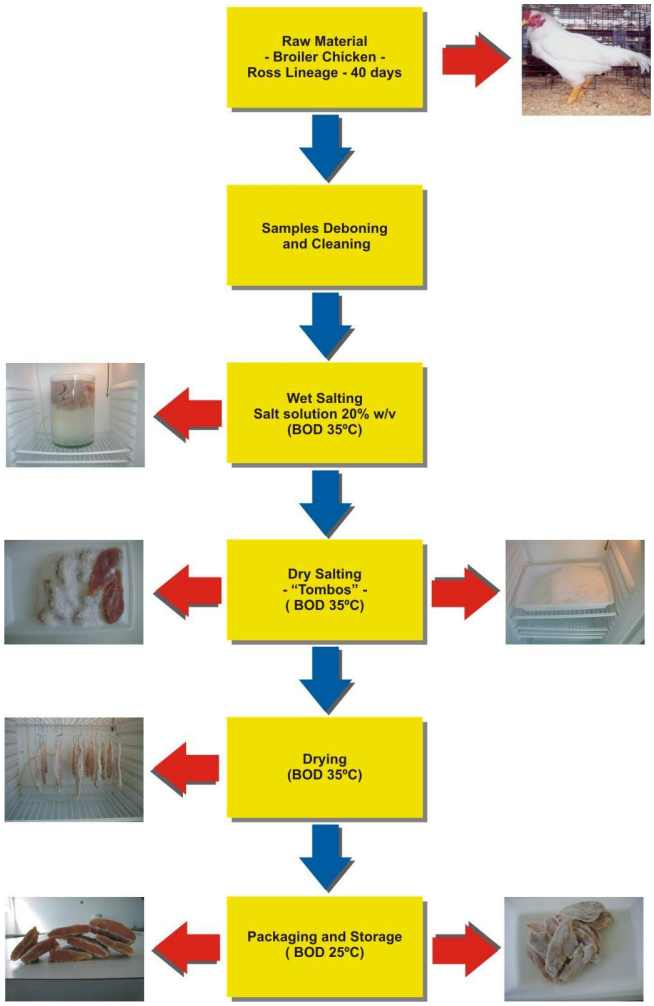

Figure 1 Fluxogram showing broiler breast charqui-like meat processing comprising with the steps of raw material, deboning, wet salting, dry salting , drying, and packaging

Figure 1 shows the broiler chickens charqui-like meat processing based on the production of charqui meat [3] and spent leghorn salted meat [6]. In this case the processing was conducted at two different treatments, with and without the addition of $NaNO_2$ in the proportion of 200 ppm during wet salting step. This step consisted of immersing the broiler breast meat samples in saline solution at 20% (w/v) at a ratio of 2:1 (saline:meat), for a period of 90 min under stirring and controlling the temperature at 35°C. Subsequently, the meat pieces in plastic trays were stacked into piles separated from each other by the layers of coarse marine salt. After about each 8 h, the meat was restacked and the uppermost meat pieces were repositioned at the bottom of the new piles. The maneuver was repeated for five days until the aw reached the value of 0.75. Finally after removing manually the excess of salt from the meat surface, samples were subjected to drying in an oven at 35°C for 48hs and finally vacuum packed and kept stored at 25°C for further analysis.

B. Physicochemical analysis

In each processing step as seen in Figure 1 throughout 60 days experiment, samples were removed for evaluation of the approximate chemical composition and water activity (Aw). The lipid oxidation was monitored in the two treatments with and without the addition of $NaNO_2$ during processing by the Tarladgis method [9]. The texture of uncooked and cooked chicken salted meat, desalted uncooked and cooked, fresh meat and cooked meat as control was assessed by Warner-Bratzler texturometer model TA-XT2i [1].

C. Microbiological analysis

For each processing step and during a period of 60 days of storage, were identified to determine the most probable number of coliforms, Escherichia coli and Staphylococcus aureus, with and without added sodium nitrate ($NaNO_2$).

III. RESULTS

Table 1 shows the proximate chemical analysis of the product and also the resulting value of aw. There was a gradual decrease of moisture and quantitatively substituted proportionally by the ash and by protein fraction. Conversely there was a decrease of aw being a constant value after the dry salting step.

Table 2 shows there was no development of lipid oxidation because of the efficient presence of $NaNO_2$ from the raw material to 60 days of storage while samples without sodium nitrite at 7 days of storage

reached the maximum of lipid oxidation and by 15 days of storage the TBARS showed a half amount then remained constant up to 60 days of storage.

Table 1 Proximate chemical composition following the processing steps (Figure 1) and the resulting aw values throughout processing.

	Raw Material	Wet Salting	Dry Salting	Salted Product
*Moisture (%)**	73.7	66.1	52.2	49.2
*Protein (%)**	21.1	24.8	27.9	29.5
*Ash (%)**	0.72	7.3	18.9	21.0
*Lipid (%)**	1.36	1.44	1.76	1.81
*Water Activity**	0.993	0.967	0.748	0.741

**Mean of a triplicate assay*

Table 2 Effect of the addition of sodium nitrite on lipid oxidation inhibition throughout processing and storage of broiler breast charqui-like meat monitored by TBARS determination [9]

	TBARS (mg of TBA/Kg of sample)	
	Without sodium nitrite	***With sodium nitrite***
Raw Material	0.091	0.086
Wet Salting	0.158	0.087
Dry Salting	0.601	0.076
Salted Product	1.111	0.095
7 days Storage	1.584	0.085
15 days Storage	0.764	0.088
22 days Storage	0.926	0.095
30 days Storage	0.973	0.090
60 days Storage	0.848	0.086

**Mean of a triplicate assay*

Table 3 Values of total coliforms and E. coli to chicken jerky during processing and storage

	Control		***Sodium Nitrate***	
	Total Count (MPN)	**E.Coli (CFU/ml)**	**Total Count (MPN)**	**E.Coli (CFU/ml)**
Raw Material	33.8	Nd	***	***
Wet Salting	12.3	Nd	10.9	Nd
Dry Salting	Nd	Nd	Nd	Nd
Salted Product	Nd	Nd	Nd	Nd
7 days Storage	Nd	Nd	Nd	Nd
30 days Storage	Nd	Nd	Nd	Nd
60 days Storage	Nd	Nd	Nd	Nd

In Table 3 is shown the results of coliform total counts and E Coli in broiler breast charqui-like meat and the hurdles represented by the salt, nitrite, the resulting aw and vaccum packaging efficiently inhibited the microorganisms development during processing

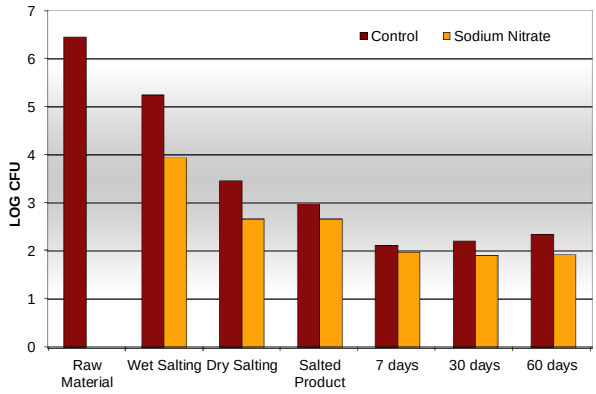

Figure 2 Total Count of *S. aureus* throughout processing with and without nitrite and storage of broiler breast charqui-like meat kept for 60 days at room temperature

There was a gradual decrease of S aureus counts throughout salting with and without sodium nitrite processing and stored for 60 days of broiler breast charqui-like meat. The raw material presented a S aureus count of 6.45 log UFC/g and the salted product had the count of 3.0 log UFC/g finally from 7 days storage onward remained constant at the value of 2.0 log UFC/g (Figure 2).

IV. DISCUSSION

During processing the product showed a significant variation in the amounts of moisture, protein, lipid and ash as the result of a water loss substitution by the addition of salt (Table 1). At the third day of processing, the aw reached its final and constant value of about 0.741 irrespective of longer processing. It can be speculated that it is the resultant of the equilibrium among three factors which were in dynamic conditions: water-protein-salt within the meat system. After these factors reached constant values, there was no variability in the aw value therefore either leaving longer the processing or adding more salt would not change its value. The results reported herein

demonstrated that the harsh processing conditions, high salt concentration, relative high temperature, aw values, inhibited the growth of microorganisms. However under our experimental conditions, *S. aureus* would survive throughout the sequence of salting steps. As pointed out several times elsewhere, beef charqui meats are a safe food intermediate moisture meat product derived from the application of hurdle technology being the steps salting, drying, nitrite, aw, vacuum packaging, hurdles inhibiting pathogenic bacteria and selecting those with fermentative properties enhancing the typical taste and flavor. In fact, the presence of halo tolerant bacteria, where *Staphylococcus* spp. was the predominant species acting as starter cultures during processing. Samples of jerked beef, prepared separately with exogenous *S. carnosus* and *S. xylosus* as starter cultures resulted in high proteolysis and were preferred by the sensory panel. These results corroborated the suggestion of jerked beef and charqui meats are in fact fermented meat products [10]. Probably similar behavior happened for the broiler charqui meat as shown in the Figure 2. There was a selection of bacteria which presented the fermentative role and the pathogenic microorganism growth was inhibited (Table 3) by the application of the hurdles.

Regarding to lipid oxidation was found that the addition of $NaNO_2$ in wet salting inhibited the formation of oxidative compounds by up to 94% over control samples (Table 2). A substantial increase can be seen within 7 days of storage reaching a peak of oxidation of 1.584 mg TBARS/kg of sample. This increase was 18.4 times greater than the amount of TBARS in samples containing sodium nitrite for the same period, an effect characteristic of his propagation step, ending the lipid oxidation. The same pattern was not observed for samples nitrite, which reached a peak of 0.095 mg TBARS/kg sample, only 22 days of storage which further enhances the ability of the pro-oxidative and antioxidant salt of sodium nitrite. Another factor that contributes to the occurrence of lipid oxidation is the use of salt in salted products, containing metals such as copper and iron that accelerate rancidity [2].

V. CONCLUSIONS

The new product like salty chicken jerky can be classified as food UI and considered a safe food.

VI. REFERENCES

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