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INTERMEDIATE MOISTURE MEAT PRODUCTS (CHARQUI MEATS) TEXTURE AND COLLAGEN CROSSLINKS

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BACKGROUND

Charqui meats are typical Brazilian meat products obtained by hurdle technology (Shimokomaki, et al., 1998). During processing, beef samples are submitted to salting and drying under the sun. The final product is composed of approximately 45.0% moisture and 15.0% salt. Recently, we have demonstrated that NaCl acts as a pro-oxidant agent (Torres et al., 1994) resulting in an increased rancidity of the fats. The intermediate moisture meat product nature has been established, Aw≅0.70-0.75 (Torres et al., 1994) and there is a possibility of being fermented meat product (Shimokomaki, et. al., 1998). In addition, it is well known that intramuscular connective tissue plays an important role towards meat tenderness. Meat becomes tougher with advancing ageing of the animal (Shimokomaki, et al., 1972) due to the presence of collagen intermolecular cross-links intermediated by lysyl oxidase activity. Biologically, dihydroxylysinonorleucine is an aminoacid functioning as intermediate crosslink (Bailey & Shimokomaki, 1971; Shimokomaki et. al., 1972) which in turn originates pyridinoline, a mature collagen crosslink (Fujimoto et al., 1977; Eyre et. al., 1984). Pyridinoline has been shown to play a significant role in meat tenderness (Nakano, et. al., 1985; Bosselmann, et. al 1995).

OBJECTIVE

To determine the influence of charqui meats processing on pyridinoline chemical stability by measuring their texture.

METHODS

Samples: *Vastus lateralis* muscle was obtained from *Bos indicus* approximately 4 years of age. Charqui processing was carried out according to Shimokomaki et al. (1998). Basically, beef samples were treated with NaCl concentrated solution and afterwards with rock salt at least during 6 days and left under sunshine for 3 days with the internal muscle temperature of 30-35°C. **Chemical composition:** Moisture and protein contents were determined following AOAC (1995). **Collagen assay:** According to the method describe by Kolar et al. (1990). **Water activity:** Aw was determined by NOVASINA equipment. **Pyridinoline determination:** Meat samples were treated with KCl 0.6M in order to remove sarcoplasmic and miofibrilar proteins. The precipitate containing collagen was dialyzed and lyophilized under protection of light. Twenty to 50mg of lyophilized samples were hydrolyzed with 6M HCl solution at 105°C for 24 hours. Hydrolyzed samples were eluted in cellulose column in order to remove other aminoacids (Skinner, 1982). Pyridinoline was suspended in 1% heptafluorobutyric acid (HFBA). The quantification of pyridinoline (HP) was performed by HPLC reverse phase according to Eyre et al. (1984). Comparison with pure standard pyridinoline was carried out. Pyridinoline standard was kindly donated by Mr. N. C. Avery, University of Bristol, U.K. Pyridinoline was expressed in mol of HP/mol of collagen (Eyre et al., 1984). **Texture evaluation:** The technique was described in Avery et al. (1996) employing texture analyser using Warner-Bratzler accessory. **Statistical analysis:** Results were statistically analyzed by ANOVA and Tukey test of 5% level of significance. This analysis was carried out using STATISTICA® for Windows version 5.0, STATSOFT (1995).

RESULTS AND DISCUSSION

Moisture and Protein: The contents of moisture and protein in raw meat and charqui meat are shown in Table 1. There was a proportional concentration of protein fraction in approximately 5.0% in charqui meat.

Collagen Determination: Collagen content was 0.69% in raw meat and 1.23% in charqui meat. Collagen fraction was concentrated around 1.5-2 fold in charqui meats. This result would imply that the remaining collagen in charqui meat was mostly insoluble. It is feasible to suppose that processing conditions during 20 days would denature protein fractions.

Pyridinoline assay: The results of pyridinoline determination in raw meat and charqui meat are also shown in Table 1. Raw meat presented 0.1179 mol of HP/mol of collagen and charqui meat presented 0.0453 mol of HP/mol of collagen.

Charqui Meat Texture: Table 1 shows that the texture of charqui meats increased 3-4 fold in relation to raw meat and also it is significantly higher in concentration of collagen. However, charqui meats texture was not directly related to the presence of pyridinoline because this cross-link had much lower value in these samples comparing to raw meat. For raw meat, pyridinoline shows a positive correlation with collagen concentration and in charqui meats this correlation is negative since pyridinoline was app. half in amount in relation to raw meat (Table 2). In fact, the decrease of pyridinoline in charqui meats was app. 1.5-2.0 fold than raw meat. This is in accordance with the assumption that pyridinolines are destroyed by UV-light (Eyre et al., 1984). The harsh conditions applied to process charqui meats must fragment pyridinoline molecules. Therefore,

charqui meats texture cannot be explained by a single factor. It is a result of multifactorial association, which combines collagen fraction, presence of collagen cross-links and in particular to dynamic biochemical events which take place during charqui processing. In our samples, salting and drying steps of raw meat would denature protein fraction, collagen included. By denaturing proteins, meat no longer would retain water and consequently charqui meats lose juiciness originating tougher texture.

CONCLUSIONS

Pyridinoline plays an important role in beef samples texture. However, for intermediate moisture meat products, the combination of biochemical events, which take place during harsh processing, seems to be the major influence for their increasing texture.

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Table 1: Contents of collagen (%), pyridinoline (mol HP/mol of collagen), protein fraction (%) and moisture (%) related to raw meat and charqui meat texture (Newtons) (fresh weight basis).

	Raw meat	*Charqui meat*
Collagen Concentration	0.69 (± 0.06)	1.23 ± (0.12)
Pyridinoline Concentration	0.1179 ± (0.0539)	0.0453 ± (0.0187)
Texture	24.24 ± (4.59)	82.20 ± (4.08)
Protein	22.11 ± (0.58)	27.65 ± (0.76)
Moisture	76.14 ± (0.62)	46.35 ± (2.36)

Means of six samples analyzed with standard deviation in parenthesis.

Table 2. Correlation coefficients among collagen concentration, pyridinoline concentration, protein fraction and moisture

Treatment	*Linear Correlation Coefficients*			
	Raw Meat		*Charqui meat*	
	Texture	*Collagen Concentration*	*Texture*	*Collagen Concentration*
Collagen Concentration	0.61	------	0.26	------
Pyridinoline Concentration	-0.24	0.88	-0.63	-0.36
Protein	0.52	0.46	0.20	ns
Moisture	-0.63	ns	ns	-0.61

There were 18 values for each correlation $p<0.05$ .ns - not significant