BEEF, HORSE AND GOAT MEAT QUALITY: CALORIMETRY, FUNCTIONAL AND ELECTROPHORETICAL ANALYSIS.

Totosaus, A. 1, R. García-Barrientos 1, M-L. Pérez-Chabela 1, F. Mijangos 2, R.M. Cruz-Hernández 3 & I. Guerrero 1.

1. Bioquímica de Macromoléculas, Depto. de Biotecnología, UAM-Iztapalapa, Apdo. Postal 55-535, México City 04230, México.
2. División de Estudios de Posgrado, Especialidad en Farmacia Industrial, FES-Zaragoza, México City, México.
3. Hosch-Celanese Mexicana, S.A., México

Background.

Quality, as it relates to meat, involves a number of properties, which in turn relate to wholesomeness. They are also reflected in acceptability attributes by the consumer, such as texture and aroma (Klettner, 1995). These characteristics are the result of a number of functional properties: water and fat holding capacity, emulsion and foam capacity and gel formation, among others. Functional properties in proteins are related to non-nutritional characteristics, and in various ways determine the application of a protein as a food ingredient or as process aid. The use for a protein, from the functional point of view, is a result of its behavior during processing, storage, preparation and consumption. It is based on the physicochemical characteristics of the system (Wilding et al, 1982; Whiting, 1988). Some authors have reported the effect of different proteins on the functional properties of a food system (Dzudie and Tandem, 1994; Turgut, 1984; Basu et al, 1987). However, as far as contractile proteins are concerned, differences due to animal species and muscle composition (water content, total nitrogen and fat content) deeply affect protein functionality. Other parameters such as ante and post-mortem conditions also produce changes on functional properties of meat proteins (Lawrie, 1977).

Objectives

To correlate meat quality with some physicochemical parameters of contractile proteins, such as calorimetry, electrophoretical patterns and two functional properties (emulsion capacity and gel formation).

Methods

Beef, horse and goat carcasses were sampled at the same post-mortem time (18 hours) from local abattoirs. Meat samples were taken from Psoas major muscles. Meat protein extracts were obtained by homogenizing 50 g of the sample in equal parts of tap water and ice. The mixture was stirred in an ice bath for 10 minutes. Tap water was added (2:3) to the suspension, it was then sieved to eliminate connective tissue. The sample was stirred for 15 minutes and centrifuged at 2 000 g during 15 minutes at 4oC. The pellet was resuspended in salt solution (1.5% phosphate buffer, 3.5% sodium chloride, 0.1% sodium azide). The protein content was adjusted to 20 mg/ml. Emulsion capacity was determined by conductivity and reported as ml emulsified oil per g of protein. Gels were formed by placing the protein suspension in test tubes and heating at 70oC for 20 minutes. Gel strength was evaluated by penetration using an Instron Universal Testing Machine. It was reported as the maximum force required to penetrate the gel. Differential Scanning Calorimetry (DSC) was applied to the protein pellet using a Metler 30 DSC with nitrogen purge (45 ml/min) by heating from 30 to 200oC at 10oC/min. Tmax and enthalpy were calculated. Ten percent SDS-PAGE electrophoresis was carried out for salt soluble proteins.

Results and discussion

Goat meat extracts produced harder gels as compared to the other two species. Emulsion capacity of goat meat proteins was also high, but lower to beef proteins. Conversely, horse meat showed the lowest gel strength and emulsion capacity (Figure 1). Both properties, emulsion capacity and gel strength are important as they participate in fat holding and formation of a gel matrix in cooked meat products. DSC patters were similar for the three species (Figure 2), although goat proteins had the highest Tmax ; horse meat had the highest enthalpy (Table 1). Minor observed differences in transition temperature could be due to species-related variations in myofibrilar protein composition, or to pre- and post-mortem handling. The first peak in the Figure 2 was related to protein unfolding whereas the second and third peaks were due to component combustion during analysis. SDS-PAGE electrophoresis showed that horse meat proteins underwent considerable degradation as compared to goat and beef. However the three species showed the same bands (Table 2). Horse meat degradation seemed to affect protein functionality and Tmax. Beef and goat proteins presented similar degradation patterns as shown by electrophoretical patterns. In these two species, differences in functionality and calorimetry could be due to post-mortem glycolysis, affected by the pH drop.

Conclusion.

Physicochemical and functional properties are reflected on meat quality. Of the three analyzed species, horse meat had the poorest quality due to its low functionality expressed as gel strength and emulsifying capacity. Goat meat seemed to be a good alternative source to beef, from the functional point of view.

Literature

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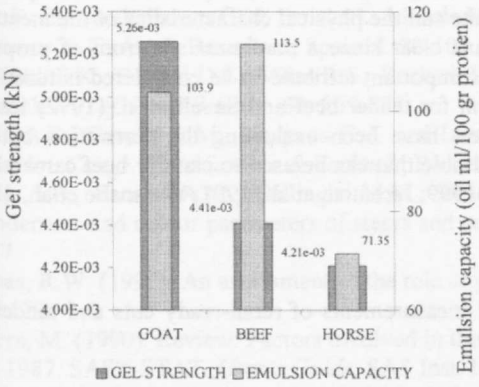

Figure 1. Gel strength and emulsion capacity in protein extracts.

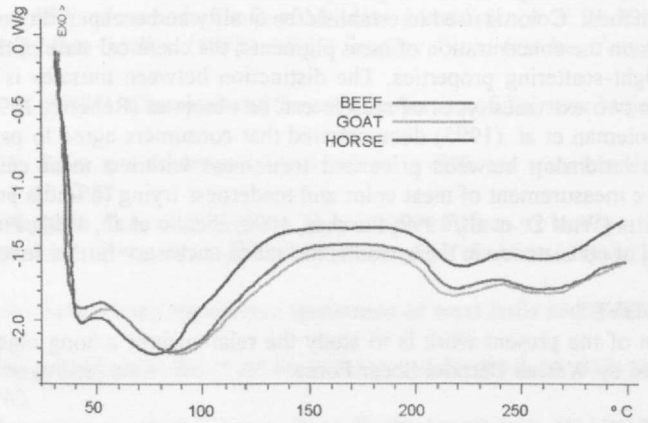

Figure 2. Calorimetry chart for beef, goat + horse proteins.

Table 1. Differential scanning calorimetry for horse, goat + beef proteins.

Specie	Transition Temperature (°C) $T_{max\ 1}$	$T_{max\ 2}$	$T_{max\ 3}$	ΔH (J/g)
Horse Meat	78.7	216.3	270.0	110.8
Goat Meat	90.4	211.7	265.3	128.5
Beef	85.7	214.0	265.3	247.7

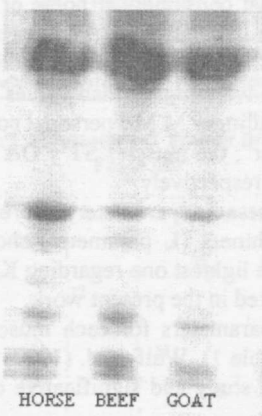

Figure 3. SDS-PAGE for horse, beef, and goat proteins

Table 2. Molecular weight of bands obtained by SDS-PAGE electrophoresis of beef, horse + goat salt-soluble proteins.

Horse	Beef	Goat
191.46	182.14	185.47
163.72	159.50	160.89
104.61	101.91	103.24
96.04	81.78	92.71
82.56	75.86	82.37
69.08	63.87	66.92
64.43	56.28	64.32
58.85	50.61	55.83
46.02	45.16	43.38
28.57	28.38	18.30
25.11	19.32	10.40
12.91		
9.14		