FUNCTIONAL AND ULTRASTRUCTURAL PROPERTIES OF CAMEL MEAT

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Introduction

A few studies were carried out concerning the production of comminuted meat products from camel meat. Sadek (1966) reported that using camel meat in sausage manufacture losses its toughness. Heikal *et al.*, (1972) by studying the histological and technological aspects of smoked sausage from camel meat reported that a sausage with high quality could be prepared. Dawood (1995) reported that replacement of lean meat with 5 or 10% fat improved sensory attributes of camburger. However, with regard to the importance of the muscle proteins functionality in the final quality of comminuted meat products, no data has been published concerning functional properties of camel meat. Moreover, freezing can produce profound effects on the structure and functionality of meat whereas no information concerning such criteria has been reported in camel meat. The objective of this study was to investigate functional and ultrastructural changes in camel meat due to freezing, which in functionality compared with beef.

Materials and Methods

Four Iranian Zaboli camels (one approximately 12 months and the others 5 years old) and three hybrid Holstein cows (approximately 5 years old) were randomly selected from two different slaughterhouses. Cows were stunned in the range of 150 to 180 mv before slaughtering. Sample from *M. longissimus dorsi* at the 12th rib was obtained from 12-month old camel within 15-20 minutes after slaughtering and divided into two parts. One part was immediately fixed in glutaraldehyde 2.5% and used to study the ultrastructure of pre-rigor muscle. The other part was frozen stored at -20°C for 5 months and used to investigate the ultrastructural changes due to freezing. For electron microscopy muscle samples were subjected to several treatments (fixation, washing, dehydration, embedding and polymerization) to prepare ultrathin sections (70nm) which were examined with an electron microscope. In order to determine functional properties, intact samples from leg were obtained from 5-year old animals (n=6) within 45 minutes after slaughtering. Samples were refrigerated at 4°C until further sampling at 24h to determine the functional properties of fresh meat. The remaining lot of each sample was frozen stored at -20°C and subsampled after 2 and 5 months to investigate the effects of freezing. Samples were thawed for 24 h at 4°C. Analysis include pH, water holding capacity (WHC) (Jauregui *et al.*, 1981), emulsifying capacity (EC) and emulsion stability (ES) (Swift *et al.*, 1961), foaming capacity (FC) and foam stability (FS) (modification of method described by Lin et al., 1974) and buffering capacity (BC) over the ranges pHu-4.5 and pHu-7. Data was compiled in split plot design and analysed by analysis of variance and Duncan's multiple range test using SAS. Measurements were taken in duplicate.

Results and Discussion

Table 1: Functional properties of meat as influenced by species and frozen storage

	Frozen time (m)	pH	WHC (E.M.[f])	EC (ml/g)	ES (%)	FC (ml)	FS30[g] (%)	FS60[h] (%)	BC[i] (pHu-4.5)	BC (pHu-7)
species(p<)		0.064	0.821	0.018	0.0007	0. 552	0.469	0.305	0.063	0.853
storage(p<)		0.0001	0.514	0.0001	0.0003	0.709	0.019	0.014	0.0001	0.007
camel meat	0	5.81^{a}	39.80^{e}	40.69^{e}	68.16^{cd}	363.3	17.75^{c}	11.17^{c}	4.47^{bc}	3.81^{c}
	2	5.73^{ab}	46.42^{b}	46.75^{b}	74.63^{ab}	373.3	63.10^{ab}	49.63^{ab}	5.12^{b}	4.44^{abc}
	5	5.50^{c}	51.16^{a}	48.93^{a}	76.85^{a}	528.3	76.19^{a}	66.84^{a}	3.55^{d}	5.23^{a}
beef	0	5.61^{b}	41.03^{c}	42.57^{d}	61.99^{e}	355	23.67^{bc}	14.13^{bc}	5.00^{b}	4.02^{bc}
	2	5.55^{bc}	47.23^{ab}	44.11^{c}	65.13^{de}	490	34.72^{abc}	27.61^{bc}	6.56^{a}	4.62^{ab}
	5	5.44^{cd}	49.33^{ab}	44.81^{c}	71.55^{bc}	293.3	52.54^{abc}	37.55^{abc}	3.98^{cd}	4.64^{ab}

[a-e] Means within Columns with different superscripts differ significantly ($p<0.05$) according to Duncan's multiple range test
[f] Expressible Moisture [g] Foam stability after 30 min. [h] Foam stability after 60 min. [i] mmol H^{+} /pH*100g meat

With regard to the functional properties, camel meat and beef were similar in all factors except in emulsifying properties (Table 1). Camel meat showed higher EC (M=45.46) and ES (M=71.23) relative to beef (respectively, M=43.83 and M=66.22); ($p<0.05$). Freezing caused significant differences: EC, ES, FS and BC increased, whereas pH and WHC decreased due to freezing. Although fresh camel meat had lower EC than beef, it showed more EC after 2 and 5 months storage relative to beef ($P<0.05$).

With regard to the ultrastructure, the electron micrograph of camel LD in pre-rigor state (Figure 1), shows parallel myofibrils to be intact with characteristics transverse striations; the sarcomers are clearly bordered by Z-lines. A-, I-, and H-segments, also M-bands are visible. Large mitochondria can be seen between myofibrils. In frozen muscle, electron micrograph (Figure 2) shows compressed myofibrils to be attached parallel with each other. They are relatively thin and dense. These are consistent with the observations of Rahelic *et al.,* (1985) in the LD of beef frozen at -22 °C and Grujic *et al.,* (1993) at the slow freezing rates. This compression is attributed to the pressure of ice crystals. The structure of sarcomer is clearly seen in many places. Mean sarcomer length reduced from 2.02μm to 1.57μm after frozen storage. Fissures inside sarcomers particularly in I-segments and Z-lines are noticeable. In few parts these fissures elongated to A-segments or even M-bands. Rahelic *et al.,* (1985) observed differently shaped gaps in several fibrils, mostly at Z-lines and in the I-bands.

Figure1: Electron micrograph of Camel *Longissimus dorsi* in prerigor muscle, (x 22250).

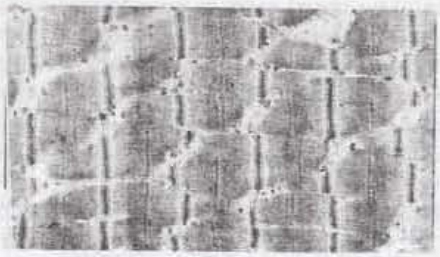

Figure 2: Electron micrograph of Camel *Longissimus dorsi* after 5 months frozen storage, (x 22250).

Conclusions

In general, it seems that functional properties of camel meat are similar to those of beef; freezing also affected functionality of both meats in a similar pattern. So, our findings suggest that camel meat can be used in the manufacture of comminuted meat products; as previous studies regarding technological and sensory aspects of comminuted meat products from camel meat (Sadek, 1966; Heikal *et al.,* 1972; Dawood, 1995) have shown. It also may have an edge for consumers as well as meat products producers over beef due to its lower price. With regard to the ultrastructure, camel LD shows normal structure of a striated muscle. Frozen storage at -20 °C affected the ultrastructure of camel LD similar to that reported by other researchers in beef.

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