

Full Length Research Paper

Effect of cooking methods on chemical composition, quality and cook loss of camel muscle (*Longissimus dorsi*) in comparison with veal

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Camels are resistant to severe and dry weather conditions and their potential for meat production in such a situation are unique. However, despite the ability of camel meat to supply nutritional deficiencies (such as iron deficiency), it seems that replacement of veal with camel meat can be cheaper source for providing protein, minerals and energy. On the other hand, excessive consumption of fat and cholesterol associated with the overconsumption of meat and meat products has been linked to health risks such as cardiovascular disease; camel meat can therefore, be considered functionally superior because its fat and cholesterol are lower than those of veal. In this study, *Longissimus dorsi* muscle samples from camels and cows between the ages of one and three ages were selected and studied. Both types of meat were treated under three thermal treatments- microwave, roasting and braising- and proximate analysis and measurement of elements and cook loss were compared with veal. Samples that had undergone each heat treatment were compared with a raw sample as control. The results showed that cook loss affected all studied traits (chemical analysis and elements) and all of them increased after cooking except sodium and iron which showed no significant difference ($p < 0.01$).

Key words: Camel, *Longissimus dorsi*, proximate analysis, minerals, cook loss.

INTRODUCTION

The dromedary camel is one of the most important domestic animals in arid and semi-arid regions, as it produces high quality food at comparatively low cost under extremely harsh conditions (Knoess, 1977; Yagil, 1982; Yousif and Babiker, 1989). The camel has a great tolerance for high temperatures, high solar radiation and water scarcity. It can survive well on sandy terrain with poor vegetation and may chiefly consume feeds not used by other domestic species (Shalash, 1983). Tandon et al. (1988) noted that the camel is likely to produce animal protein at a comparatively low cost in arid zones.

Generally, meat is known as an important source of vitamins B and trace elements and greatly contributes to the daily intake of these micronutrients (Lombradi-Boccia

et al., 2005). Limited evidence suggests that quality characteristics of camel meat are not greatly different from veal if the animals are slaughtered at comparable ages (Elgasim et al., 1987; Khatami, 1970; Knoess, 1977; Tandon et al., 1988). Chemically, camel meat contains more moisture than veal (Kadim et al., 2008). The protein content of the camel meat is significantly greater and intramuscular fat is significantly lower than veal (Kadim et al., 2008).

Cooking of meat is essential to achieve a palatable and safe product (Tornberg, 2005). Microwave ovens are widely used in food-service establishments. The microwave oven has high thermal efficiency in comparison with conventional gas and electric ovens. Approximately, 75% less energy is required for microwave cooking or heating as compared to conventional methods (Quenzer and Burns, 1981).

However, heat treatment can lead to undesirable modifications, such a decrease in nutritional value (mainly due

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Table 1. Proximate composition of *L. dorsi* of veal using various heating methods (mean \pm standard error).

Treatment	Mean			
	Ash	Moisture	Fat	Protein
Raw	0.903 \pm 0.060b	73.453 \pm 0.663a	5.400 \pm 0.556b	20.723 \pm 0.402c
Microwave	1.5 \pm 0a	34.817 \pm 1.303b	8.820 \pm 0.060a	35.500 \pm 0.242a
Roasting	1.00 \pm 0ab	42.553 \pm 1.475b	6.163 \pm 0.524b	29.970 \pm 0.752b
Braising	0.833 \pm 0.166b	38.197 \pm 1.980b	7.22 \pm 0.637b	35.143 \pm 0.638a

For each treatment the letters within each column denote a statistically significant difference.

Table 2. Proximate composition of *L. dorsi* of camel meat using various heating methods (mean \pm standard error).

Treatment	Mean			
	Ash	Moisture	Fat	Protein
Raw	1.1 \pm 0a	76.290 \pm 0.439a	4.377 \pm 0.390c	22.143 \pm 0.947b
Microwave	1.36 \pm 0.067a	39.980 \pm 1.185c	8.820 \pm 0.225a	29.520 \pm 1.066a
Roasting	1.24 \pm 0.144a	46.223 \pm 0.596b	6.433 \pm 0.244b	33.557 \pm 0.782a
Braising	0.867 \pm 0.185a	45.627 \pm 0.529b	5.963 \pm 0.386bc	28.117 \pm 1.366a

For each treatment the letters within each column denote a statistically significant difference.

to vitamin and mineral losses) and changes in the fatty acid composition due to lipid oxidation (Rodriguez-Estrada et al., 1997). Meat is a unique source of iron due to its ability to enhance iron-absorption enhancing factor (Lee and Shimaoka, 1984).

However, this study focus mainly on the effect of cooking method on the quality, chemical components and cook loss of camel meat compared with veal.

MATERIALS AND METHODS

Sample preparation and cooking

Camel and cow meat from animals between one and three years old was purchased from Basimgosht slaughter-house. *Longissimus dorsi* (L.d) muscle was separated by razor blade in both meats in order to determine proximate analysis. Muscle samples were cut cylindrically (5 cm diameter and 10 cm length). Any visible fat was removed from the muscle tissues. They were individually labelled and weighed. The steaks were sealed in nylon/polyethylene bags.

Roasting at 100°C was done in a convection oven Model FT420 made in china. Braising was done in a water bath at 100°C. Microwaving was done in a domestic microwave oven at 2450 MHz and 600 W. The heat treatment was regulated to an internal temperature of 75°C in all cases. A thermocouple was used for temperature control inside the slices.

Chemical analysis

Protein, moisture, fat and ash were determined according to AOAC (2000). Mineral contents, including iron (Fe), Zinc (Zn) and sodium (Na), were measured using an atomic absorption spectrophotometer model AA-670 for Fe and Zn and a flame photometer Model PFP7 (made in the U.K.) for Na.

Cook losses

After cooking, steaks were cooled at room temperature; surface dried with filter paper, and reweighed using an analytical balance (Mettler AE100-0.001). Cook losses were calculated from differences in raw and cooked weight as:

$$\text{Cook loss} = \frac{\text{weight of raw sample} - \text{weight of cooked sample}}{\text{weight of raw sample}} \times 100 \quad (1)$$

Statistical analysis

The experiments were replicated three times and the generated data were evaluated statistically by SAS software (9.1) for camel meat and veal separately in a randomized complete block design (RCBD). Duncan's multiple range tests were used for comparing the means. The least significant difference ($p < 0.01$) is reported. The correlations and regression analysis were performed with SPSS software.

RESULTS AND DISCUSSION

Proximate analysis

Table 1 showed that ash content of cooked veal in microwave was more than the others whereas, the ash content of heat treated camel meat (Table 2) showed that there were no significant difference between the treatments. Determination of correlation coefficients showed that ash has direct correlation with cook loss ($p < 0.01$) and has direct correlation with fat ($p < 0.05$). Heat

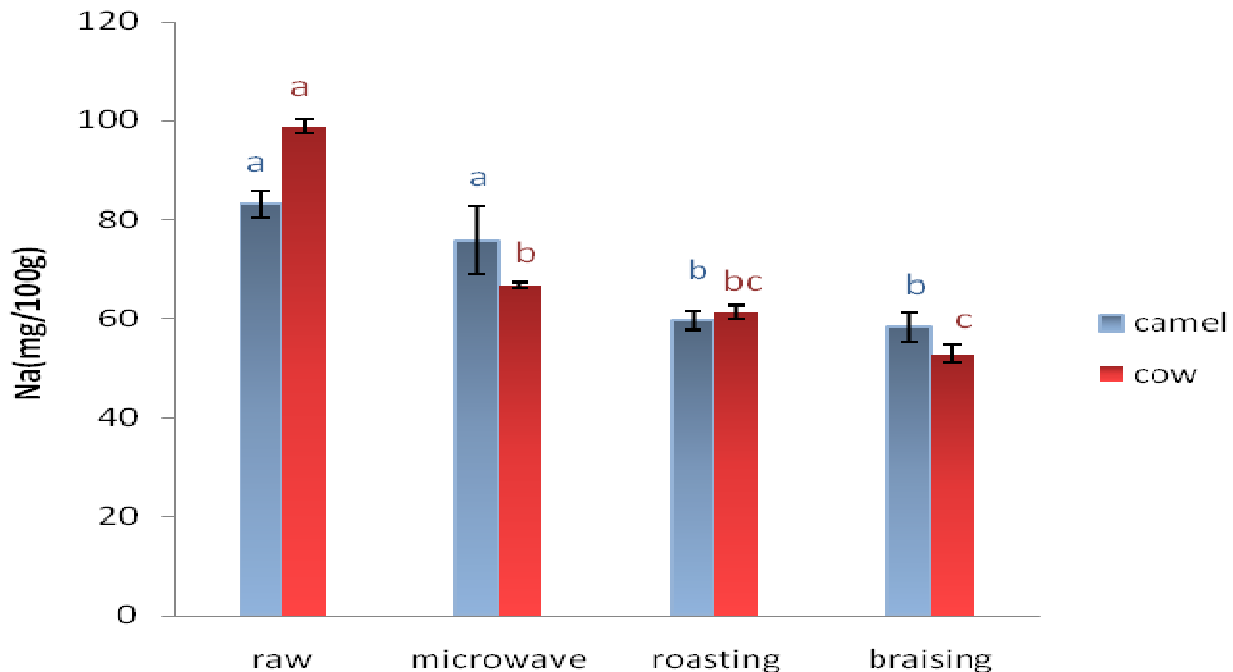


Figure 1. Amount of Na in L.d muscle of camel and cow, raw and cooked by microwave, roasting and braising.

treatment caused a significant drop in moisture content. There was a significant difference between raw and cooked L.d muscle of camel (Table 2). The moisture content of camel meat was in range (70 to 77%) (Dawood and Alkanhal, 1995). Results were in agreement with previous studies.

Cooking method has an influence on the magnitude of fat losses: The longer cooking time (roasting) had higher fat loss. Similar results were found by Sheard et al. (1998): for veal brisket (boiled for one hour) the losses due to cooking were expected to be higher because of the long cooking time. Comparison of the fat content of camel meat and veal showed that in both types of meat, the fat in microwave treatment was higher, most likely due to greater cook loss and shorter cooking times.

Also, protein in veal L.d muscle (Table 1) showed that microwave and braising had the highest mean and showed significant difference ($p < 0.01$) with other treatments. Protein in camel L.d muscle (Table 2) showed that the raw sample had the lowest mean protein and had significant differences with other treatments. In general, protein percentage increases in cooked meat than raw, because of reduced weight. The results of this study suggest that the long heating required for roasting causes greater amounts of sarcoplasmic proteins to seep out of the meat than other thermal treatments. However, unlike roasted veal, roasted camel meat retained a higher protein percentage than the other heat treatments. As sarcoplasmic proteins are sensitive to long cooking time, this suggests that camel meat has lower levels of sarcoplasmic proteins than veal. Babiker and Tibin (1986)

support this assumption, having found that camel meat has significantly lower sarcoplasmic proteins than veal.

Mineral content

Cooking processes seemed to affect the various minerals in different ways. In general, the mineral losses were due to the leaching of minerals into the broth. Therefore, cooking processes involving water, such as steaming and boiling are the most effective methods on mineral content (Gerber et al., 2009).

Figure 1 revealed that the level of Na in veal L.d muscle in raw sample had significant difference ($p < 0.01$) with other treatments whereas, level of Na in L.d muscle of camel (Figure 1) showed that raw and microwaved samples had the highest means and they had significant differences with roasting and braising.

The amount of sodium in all thermal treatments decreased; this indicated that sodium, which is a water-soluble element, would be incorporated into the cook loss associated with soluble proteins. Indeed, this drop in sodium was greater in braising than in the other two heat treatments. It was observed that despite significant fluid loss in microwave treatment, more sodium was lost during the braising treatment, in which water was used as an auxiliary liquid for cooking.

Badiani et al. (2002) reported that the concentration of nutrients increases with moisture loss after cooking. Significant losses in microwave cooking are more evident than with the two other cooking methods due to a

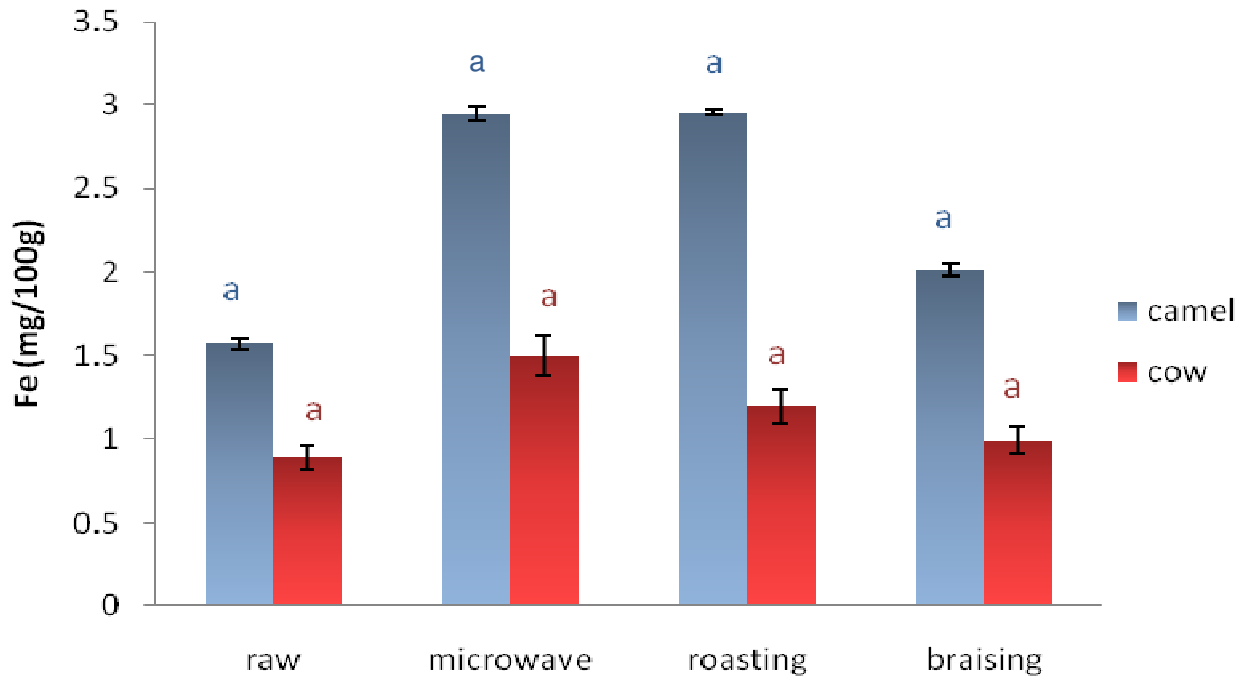


Figure 2. Amount of Fe in L.d muscle of camel and cow, raw and cooked by microwave, roasting and braising.

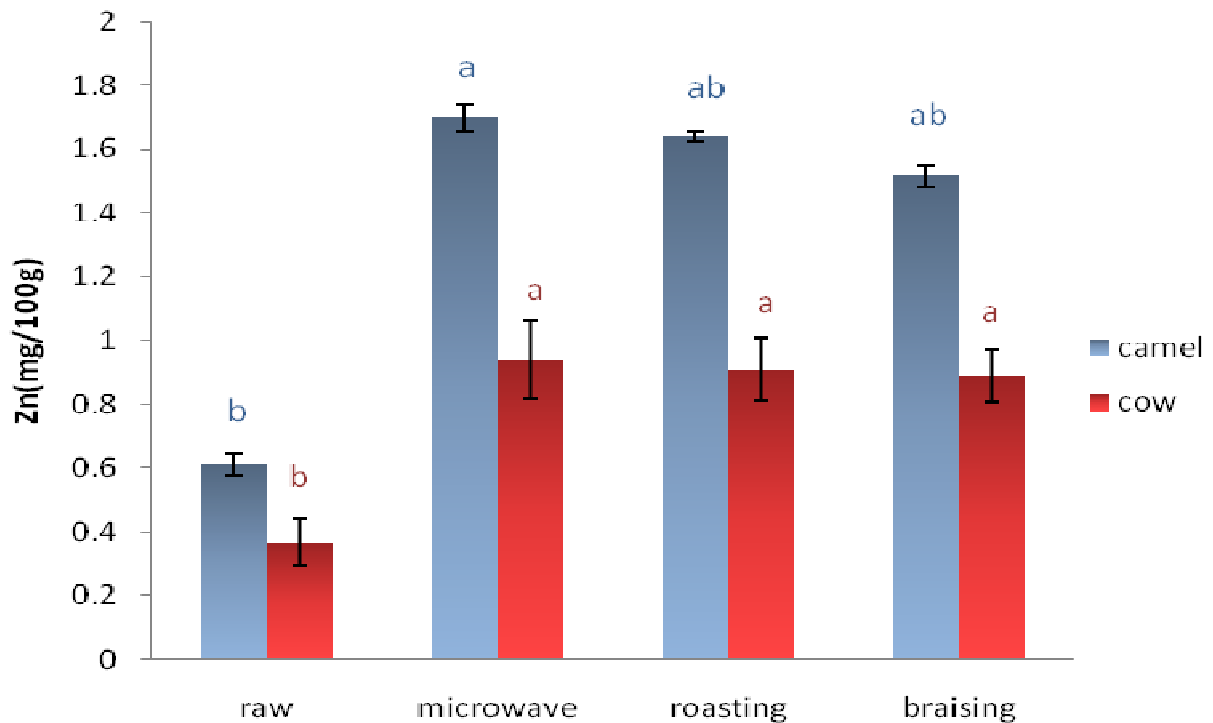


Figure 3. Amount of Zn in L.d muscle of camel and cow, raw and cooked by microwave, roasting and braising.

significant loss in humidity. Figure 2 revealed that treatments of both meats had no significant difference in the level of Fe. The cooked steaks of both meats had Zn

value that was significantly higher ($p < 0.01$) than the values corresponding to the raw samples (Figure 3). However, insoluble mineral materials like iron and zinc

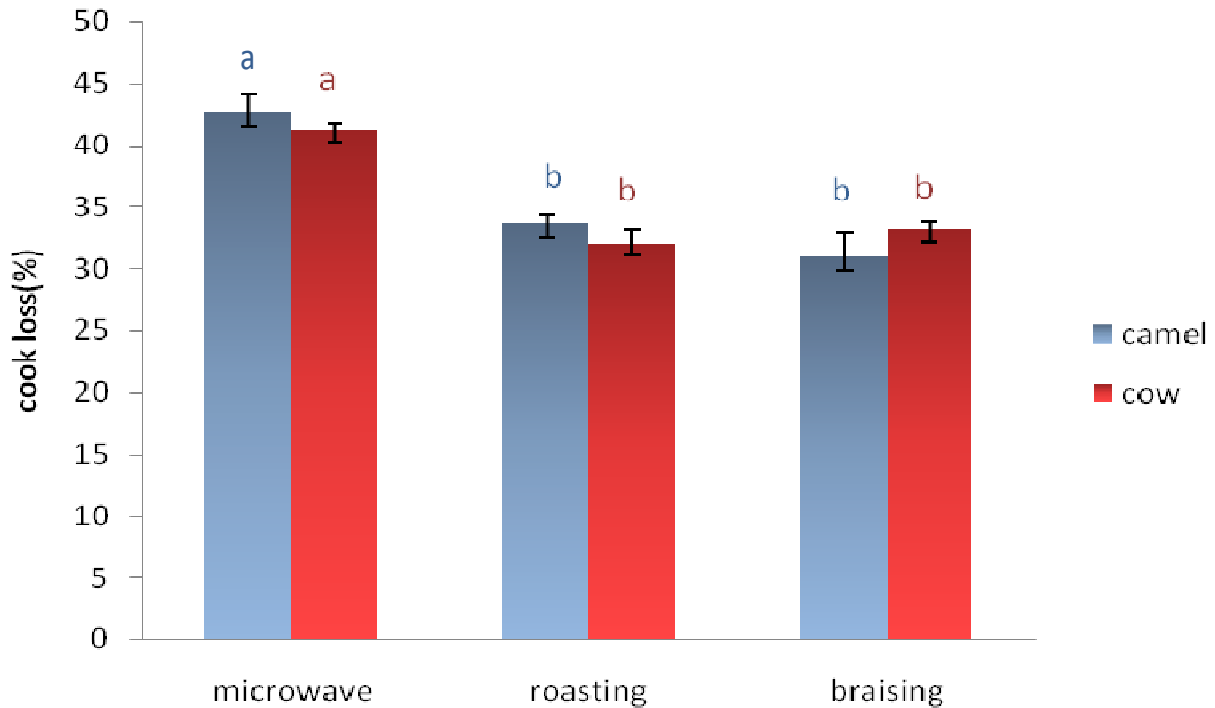


Figure 4. Cook loss (%) of L.d muscle of camel and cow cooked by microwave, roasting and braising.

are connected to proteins. The results showed that Fe and Zn concentration in cooked samples was increased. Results agree with those commonly found by Gerber et al. (2009) working on cooked meat.

Cook losses

Figure 4 showed that cooking loss in microwaved veal and camel L.d muscle had the highest mean and showed significant difference ($p < 0.01$) with other treatments. The overall percentage loss due to cooking for meat cooked by microwave is more than conventional methods, so results were in agreement with previous studies (El-Shimi, 1992; Cipra et al., 1970; Ruyack and Paul, 1972; Janicki and Appledorf, 1974; Yarmand and Homayouni, 2008).

Cook loss for camel and veal was 42.46 and 41.20% for microwave heating, 33.55 and 32.08% for roasting and 30.85 and 33.14% for braising, respectively. These results were close to previous studies and suggested that microwave cooking results in lower-quality texture in the cooked meat. It is likely that the high electromagnetic field, high power and short time to final temperature associated with microwaving cause protein denaturation, disintegration of the texture matrix, rapid protein destruction caused by heat shock to the proteins and finally, liberalization of large amounts of water and fat. In contrast, braising and roasting require a long time to reach final temperature, which does not shock proteins

and limits the amount of cook loss. Roasting increases the opportunities for dissolving intracellular materials into the cooking liquid. This causes increasing of viscosity of the seeping liquid and makes its exit more difficult. Moreover, roasting gradually creates an external hard layer around the sample that also slows the exit of seeping liquid.

Laroche (1988) showed that the cooking juices produced during heating were composed of water containing myofibrillar or sarcoplasmic proteins, collagen, lipids, salt, polyphosphates, aroma components, etc. These substances increase in the cooking juices with cooking temperature and time, humidity and the fat content of the meat (Bradford et al., 1984).

Conclusion

In camel meat, like veal, the percentage of fat and protein and ash that result from microwave treatment is more than that of other treatments because of the greater cook loss.

In camel and veal L.d muscle, cooking methods decreased the amount of sodium, showing that sodium is lost with water-soluble proteins. This is supported by the fact that sodium loss with braising was more than with the other two cooking methods. Zinc as an insoluble mineral is linked to proteins and tend to remain in the meat during cooking. The percentage of cook loss in the microwave treatment for camel and veal samples was higher than the

two other treatments and this is considered a disadvantage of microwave.

However, cooking influences the content of several nutrients in meat depending on the cut and the cooking process (time, medium and temperature). To determine how much of the respective nutrients were gained or lost, it is important to compare the contents in absolute terms based on an initial 100 g of raw meat.

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