Proximate Composition and Mineral Contents of Major Muscles in Camel Carcasses

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ABSTRACT

The objective of this study was to determine the chemical composition and mineral contents of major camel muscles. Twelve muscles [*semitendinosus , triceps brachii, recuts femoris, biceps femoris, triceps brachii LH, infraspinatus, gluteus medius, semimembranosus, supraspinatus , psoas major, longissimus lumborum, longissimus thoracis*] were removed from eight young male Najdi camels with similar background and weights (average carcass weight 120 kg). Samples were chilled (2 °C) for 24 h, trimmed all external fat and ground to homogenous. Moisture, crude protein, fat, ash and minerals (Fe, Mn, Ca, K, Na, and Zn) were determined. Significant ($P < 0.05$) differences were found among major camel muscles in moisture percentage with highest in *triceps brachii*, and *recuts femoris* and lowest in *longissimus lumborum*, and *longissimus thoracis*. Fat content ranged between 0.56 to 2.33 % in all camel muscles with the highest in *longissimus lumborum*, and *longissimus thoracis* and the lowest in *Recuts brachii* and *Triceps brachii*. Protein percentages of camel muscles ranged between 19.48 - 20.54% and have no significant differences ($P < 0.05$) among all muscles have been studied. Significant differences ($P < 0.05$) were found in ash content with a range between 1.05 - 1.43%. There were significant differences in all minerals that have been studied with highest element in potassium among all minerals followed by sodium, calcium and zinc. *Psoas major, Longissimus thoracis* and *Longissimus lumborum* muscles were among the lowest mineral contents in all camel muscles under investigation.

Key words: camel, carcass, muscles, proximate composition, mineral contents.

INTRODUCTION

The world population of one –humped desert camel (*Camelus dromedarius*) is estimated to be around 19.4 million animals (WRI, 2005). These animals are unique, having the ability to survive in high ambient temperatures and scarce water and feed areas and have the potential to be a good source of meat and milk in such areas. The demand for camel meat appears to be increasing especially in arid regions. According to Abouheif *et al.* (1989), and Al-Owaimer (1999) camel meats were ranked third or fourth meat of choice after mutton and chicken among Saudi Arabian citizen in Riyadh city. Limited studies have been reported on nutritional

values of Najdi camel meat (El-Faer *et al.*, 1991, Dawood, and Alkanhal 1995 and Kadim *et al.* 2006). Elgasim and Alkanhal (1992) reported that fat content was lower and moisture was higher for camel muscles (leg and loin) than the red meat from other animal species with no significant differences in minerals content. Dawood and Alkanhal, (1995) noted that fat and minerals contents of camel meat differed ($P< 0.05$) by type of cuts with higher fat percentage in ribeye than chuck and leg meat. In beef, Mc Keith, *et al.*, (1985) studied thirteen major beef muscles and reported that a wide range in fat percentage (3 -7.7%) was founded among major beef muscles. Other researchers noted that fat content significantly differed among fifteen of beef muscle (Brackebusch *et al.* 1991). With a good potential of one-humped camel as meat source and the lack of information on the nutritional values of camel major muscles, have promoted this study to determine the chemical composition and mineral content of major camel muscles. Therefore, the purpose of this study was to determine the chemical composition and mineral contents of major camel muscles.

MATERIALS AND METHODS

Eight young Najdi camels of similar background and body weights were slaughtered at Labone farm (Al-kharj, Saudi Arabia), dressed and weighed (average carcass weight 120 kg). The carcasses were suspended by Achilles' tendon and placed in cooler room at 2° C. After 24 h post-mortem, 12 muscles were removed from the right side of each carcasses; namely *semitendinosus , triceps brachii LH, recuts femoris, biceps femoris, triceps brachii, infraspinatus, gluteus medius, semimembranosus, supraspinatus , psoas major, longissimus lumborum, longissimus thoracis*. Thereafter, all muscles were transported in an insulated box to Meat Lab at King Saud University, Riyadh. The external fats of all muscles were trimmed, then the muscles were vacuum-packaged using Turbovac vacuum machine (Model SB45H, hertogenbosch, the Netherlands), and stored at -10 °C for later analysis. Meat was ground in an electric grinder three times to be homogenous and then chemical analysis were determined (AOAC, 2000). Moisture was determined by oven drying at 105 °C for 6 hr. Ash content was determined by ashing samples in a muffle furnace at 580 °C for 3 hr. Crude protein was determined by modification of the Kjeldahl sulphuric acid technique. Ether extract was determined using Soxhlet extraction by subjecting the sample of meat to continuous extraction with petroleum ether for 4 hr. Minerals were determined by adding 2.5 ml of 50% (W/V) magnesium nitrate hexahydrate on sample of meat pre-ashing for 1-2 hr. until the sample is completely charred. The pre-

ashed sample ashed at 500°C and wetted with HNO_3 and placed in a muffle furnace about 2 hr. until the ash become white. After ashing the sample were transferred to 10 ml volumetric flask with diluted HNO_3 and the solution diluted to volume with ionized water. Minerals were determined by the atomic absorption spectrophotometer procedure (Perkin Elmer instruments A Analyst 300, Model pu 9100, Philips).

Statistical Analysis

Data were analyzed by using GLM procedure of SAS (1995). The differences between muscles mean values were tested by using Duncan test. Differences were considered significant at *P* level of <0.05.

RESULTS AND DISCUSSION

1- Moisture:

Moisture percentage of camel muscles ranged from 77.01 to 78.93 % (table1). *Longissimus lumborum* and *Longissimus thoracis* muscles have the lowest, whereas *triceps brachii* and *Recuts femoris* have the highest moisture content values. These results were in agreement with El-Faer *et al.* (1991) who demonstrated that the range of moisture percentage of camel meat cuts were between 77.2 to 78.85%. Other report by Dawood and Alkanhal (1995) showed that camel meat moisture affected by different cuts, the rib eye have lower value of moisture content than leg and chuck meat. With comparison to other meat species, Elgasim and Alkanhal (1992) noted that camel meat moisture was higher than beef, goat, lamb and chicken. The higher values of moisture in camel meat may increase the juiciness but have an effect on the shelf life of meat.

2- Fat:

The twelve muscles were ranked by fat percentage (table 1). Fat content ranged between 0.56 to 2.33 % in all studied camel muscles. There were significant ($P < 0.05$) differences among major camel muscles in fat content. *Longissimus thoracis* and *Longissimus lumborum* muscles were the highest in fat content (2.33 and 2.14%, respectively), whereas *Recuts brachii* and *Triceps brachii LH* have the lowest values (0.57 and 0.56, respectively). Other reports in camel meat used either certain muscles mainly *Longissimus* muscles or major meat cuts (Kadim *et al.*, 2006; and Babkier and Yousef 1990). El-Faer *et al.*, (1991) noted that lipid content of various camel meat cuts (shoulder, thigh, ribs and neck) vary within range of 1.24-1.85% with higher fat content for rib muscle than neck, thigh and shoulder muscles. Results of the former study were in agreement with our finding that *Longissimus lumborum* and *Longissimus thoracis*

muscles have the highest fat content among camel muscles. Mc Keith, *et al.*, (1985) used thirteen beef muscles and found that the range of fat muscle content was between 3 to 7.7 %, with highest fat content in *infraspinatus*, *Longissimus lumborum* and *Longissimus thoracis* muscles and the lowest fat content in *supraspinatus*, *semiterdinosus* and *triceps*. Other report by Garrett and Hinman, (1971) noted that *infraspinatus*, *Longissimus lumborum*, *Longissimus thoracis* and *gluteus medius* have higher fat content in beef muscles. The percentage of fat was much lower in each muscle in this study than the results obtained by Mc Keith *et al.* (1985) and Brackebush *et al.* (1991) in beef muscles. Elgasim and AlKanhal (1991) conducted comparative study among meat from other species and found that camel meat have fat content of 2.6%, which was higher than fish (2.3%) but less than goat (3.3%), beef (4.7%), chicken (5.4%) and lamb (6.2%). In this study, it was found that, except the *Longissimus lumborum* and *Longissimus thoracis* muscles, all other muscles that have been studied fall between 0.56 to 1.45 % in fat percentage, these finding indicating that these muscles are suitable for people who had health problems such as cardiovascular disease in comparison with red meat from other animal species. There was negative correlation (-0.52; $P < 0.0001$) between fat and moisture percentage and this supported by Garrett and Hinman (1971) who noted that as fat content increased, the water decreased in beef muscles.

3- Protein and ash content:

Table (1) showed that protein content of major camel muscles have no significant differences between various muscles under investigation ($P < 0.05$). The percentages of protein content values were ranged between 19.48 to 20.54 %. This result was similar to those reported by Babiker and Yousif (1990), Elgasim and Alkanhal (1992), and Kadim *et al.* (2006). A study by Dawood and Alkanhal (1995) reported that protein contents of camel meat have no significant differences ($P > 0.05$) among major cuts (chuck, ribeye, and Leg). This range of protein level indicates that the camel meat is high source of protein especially in harsh climate arid regions.

Ash content was affected significantly ($p < 0.05$) by different camel muscles with range of 1.05-1.43%. These results were supported by Dawood and Alkanhal (1995) who noted that ash content was affected significantly ($p < 0.01$) by type of camel meat cuts. The range of ash content in this study was similar to other reports by El-Faer *et al.*, (1991), Elgasim an Alkanhal (1991) and Kadim *et al.*, (2006).

4- Minerals content:

Table (2) showed the ranking of major camel muscles by mineral contents (mg/100g). There were significant ($p < 0.05$) differences among camel muscles in all elements under investigation. According to Kotula and Lusby (1982) and Marchello *et al.* (1984), there were differences in the amount of minerals in individual muscle of beef meat. Potassium was the most abundant element in all determined minerals followed by sodium, calcium and zinc. Generally, *Psoas major, Longissimus thoracis*, and *Longissimus lumborum* muscles were among the lowest in mineral contents of camel muscles. This result was supported by Dawood and Alkanhal (1995) who reported that potassium was the highest mineral among the major camel carcass cuts. Iron concentration was the highest in *Semimembranosus, Gluteus medius, Triceps brachii LH*, and *Biceps femoris* and lowest in *Longissimus thoracis, Longissimus lumborum* and *Psoas major* muscles. This finding agreed with Dawood and Alkanhal (1995) who noted that leg meat was higher in iron concentration than chuck and rib eye meat. The higher muscles in iron are consider to be a tonic contraction and important to animal posture and this required more oxygen supply carried by iron (Judge *et al.*, 1989). Other factors such as breed, age, weight and diet significantly affected mineral concentrations of camel meat cuts (Elgasim and Alkanhal 1991).

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Table 1. Rank of 12 camel muscles by fat, protein, ash, and moisture percentages.

Muscle rank	Moisture	Fat	Protein	Ash
1	*Triceps brachii*[a] 78.93	*Longissimus thoracis*[a] 2.33	*Biceps femoris* 20.54	*Semimembranosus*[a] 1.43
2	*Rectus femoris*[a] 78.61	*Longissimus lumborum* 2.14	*Rectus femoris* 20.43	*Biceps femoris*[ab] 1.30
3	*Triceps brachii LH*[ab] 78.48	*Infraspinatus*[a] 1.45	*Semitendinosus* 20.33	*Longissimus lumborum* 1.27
4	*Biceps femoris*[abc] 78.27	*Gluteus medius*[bc] 1.24	*Semimembranosus* 20.33	*Psoas major*[abc] 1.21
5	*Semimembranosus*[abc] 78.11	*Supraspinatus*[bc] 1.19	*Supraspinatus* 20.12	*Semitendinosus*[abc] 1.17
6	*Semitendinosus*[abc] 78.04	*Psoas major*[bc] 1.08	*Gluteus medius* 20.04	*Triceps brachii*[abc] 1.15
7	*Psoas major*[abc] 77.98	*Semimembranosus*[bc] 0.89	*Longissimus lumborum* 19.90	*Longissimus thoracis* [bcd] 1.13
8	*Infraspinatus*[abc] 77.81	*Biceps femoris*[bc] 0.89	*Psoas major* 19.78	*Triceps brachii LH* [bcd] 1.11
9	*Gluteus medius*[abc] 77.81	*Semitendinosus*[bc] 0.87	*Longissimus thoracis* 19.71	*Rectus femoris*[abc] 1.08
10	*Supraspinatus*[abc] 77.78	*Triceps brachii* [c] 0.64	*Triceps brachii* 19.58	*Gluteus medius*[abc] 1.08
11	*Longissimus thoracis*[bc] 77.10	*Rectus femoris*[c] 0.57	*Triceps brachii L H* 19.49	*Supraspinatus*[cd] 1.07
12	*Longissimus lumborum* 77.01	*Triceps brachii* LH 0.56	*Infraspinatus* 19.48	*Infraspinatus*[cd] 1.05

[abcd] means in the same column followed by different superscripts are significantly different (p<0.05).

REFERENCES

Abouheif, M. A., Abdo, G. A., Basmaeil, S. M., and Al-Sobayel, A. A. 1989.
Identification of the preference patterns of different breeds of sheep for consumption in Saudi Arabia. Asian-Australian J. Anim. Sci., 2, 129-132.

Al-Owaimer, N. A. 1999. Changes in the preference of Saudi citizen for different kinds of meat and sheep breeds. Alex. Sci. Exch., 20, 235-241.

AOAC. 2000. Association of Official Analytical Chemists, Official methods of analysis, International, Gaithersburg, MD, USA

Babiker, S. A., and Yousif, K. H. 1990. Chemical composition and quality of camel meat. Meat Sci. 27, 283-287.

Brackebusch SA, Mc Keith FK, Carr TR, Mc Laren DG. 1991.
Relationship between longissimus composition and the composition of other major muscles of the beef carcass. J. Anim Sci. 69 :631-40

Dawood, A. A., and Alkanhal, M.A. 1995. Nutrient composition of Najdi - camel meat. Meat Sci. 39:71-78.

El-Faer, M. Z., Rawdah, T. N., Attar, K. M., and Dawson, M. V. 1991.
Mineral and proximate composition of the meat of the one-humped camel *(Camelus dromedarius)*. Food chem. 42, 139-143.

Elgasim, E. A. and Alkanhal, M. A.1992. Proximate composition, amino acids and inorganic mineral content of Arabian camel meat: comparative study. Food chem. 45, 1-4.

Kotula, A. W. and Lusby, W. R. 1982. Mineral composition of muscles of 1-6 year-old steers. J. Anim. Sci., 54, 544-8.

Marchello, M. J., Miline, D. B. and Slanger, W. E. 1984. Selected macro and micro minerals in ground beef and longissimus muscles. J. Food Sci. 49, 105-6.

Garrett, W. N. and Hinman. 1971. Fat content of trimmed beef muscles as influenced by quality grade, yield grade, marbling score and sex. J. Anim. Sci. 33:948.

Judge, M., Aberle, E., Forrest, J., Hedrick, H. and Markel, R. 1989.
Principles of Meat Science: IA; Kendall/ Hunt Publishing Comp.

Kadim, I. T., Mahgoub O. Al-Marzooqi, W., Al-Zadjali, S., Annamalai, K., and Mansour, M. H. 2006. Effects of age on composition and quality of muscle *Longissimus thoracis* of the Omani Arabian camel (*Camelus dromedaries*). Meat Sci. 73, 619-625.

Table 2. Rank of 12 camel muscles by mineral contents (mg/100g)

Muscle rank	Fe	Mn	Cu	K	Na	Zn
1	*Semimembranosus*[a] 2.15	*Triceps brachii*[a] *LH* 0.007	*Triceps brachii*[a] 14.98	*Rectus femoris*[a] 371.43	*Supraspinatus*[abc] 60.69	*Infraspinatus*[a] 6.11
2	*Gluteus medius*[ab] 2.04	*Psoas major*[a] 0.007	*Rectus femoris*[ab] 14.37	*Triceps brachii*[ab] *LH* 337.56	*Gluteus medius*[ab] 55.67	*Supraspinatus*[a] 4.33
3	*Triceps brachii*[abc] *LH* 1.90	*Biceps femoris*[a] 0.007	*Semimembranosus*[abc] 13.58	*Semimembranosus*[ab] 337.03	*Infraspinatus*[abc] 56.24	*Gluteus medius*[a] 4.29
4	*Biceps femoris*[abc] 1.86	*Longissimus lumborum*[a] 0.006	*Biceps femoris*[abc] 12.61	*Longissimus lumborum*[a] 331.88	*Rectus femoris*[abc] 54.84	*Triceps brachii LH*[b] 4.20
5	*Supraspinatus*[abc] 1.84	*Infraspinatus*[a] 0.006	*Longissimus lumborum*[abc] 11.71	*Triceps brachii*[a] 329.21	*Triceps brachii LH*[abc] 52.27	*Longissimus lumborum*[a] 4.16
6	*Infraspinatus*[abc] 1.83	*Triceps brachii*[a] 0.006	*Triceps brachii LH*[abc] 10.71	*Biceps femoris*[a] 328.77	*Semimembranosus*[abc] 52.16	*Rectus femoris*[a] 4.13
7	*Semitendinosus*[abc] 1.80	*Semitendinosus*[a] 0.006	*Supraspinatus*[abc] 10.16	*Psoas major*[a] 324.71	*Triceps brachii*[abc] 50.91	*Semimembranosus*[a] 4.07
8	*Triceps brachii*[abc] 1.62	*Supraspinatus*[a] 0.006	*Gluteus medius*[abc] 9.76	*Longissimus thoracis*[a] 318.17	*Semitendinosus*[a] 49.17	*Triceps brachii*[a] 4.01
9	*Longissimus lumborum*[ab] 1.60	*Longissimus thoracis*[a] 0.006	*Semitendinosus*[a] 9.44	*Gluteus medius*[a] 308.17	*Longissimus lumborum*[ab] 47.80	*Biceps femoris*[ab] 3.76
10	*Rectus femoris*[abc] 1.47	*Semimembranosus*[ab] 0.006	*Infraspinatus*[abc] 8.83	*Semitendinosus*[a] 303.91	*Biceps femoris*[abc] 47.56	*Longissimus thoracis*[ab] 3.49
11	*Psoas major*[abc] 1.42	*Gluteus medius*[ab] 0.006	*Psoas major*[a] 8.22	*Infraspinatus*[a] 300.01	*Psoas major*[ab] 45.03	*Semitendinosus*[ab] 2.99
12	*Longissimus thoracis*[a] 1.22	*Rectus femoris*[a] 0.006	*Longissimus thoracis*[a] 7.95	*Supraspinatus*[a] 296.84	*Longissimus thoracis*[a] 43.04	*Psoas major*[a] 2.45

[abc] means in the same column followed by different subscripts are significantly different ($p<0.05$).

Mc Keith, D.L. De Vol, R.S. Miles, P. J. Bechtel and T.R. Carr, .1985. Chemical and sensory properties of thirteen major beef muscles. J. Food Sci. 50, 869–872.

SAS 1995. User's Guide statistics SAS Institute Inc. Cary, NC.

World resource institute (WRI) 2005. Available on http://www.wri.org/pubs/.

الملخص العربي

التركيب الكيماوي ومحتوي المعادن للعضلات الرئيسة في ذبائح الإبل

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تهدف هذه الدراسة إلى تقييم التركيب الكيميائي ومحتوى المعادن في عضلات الإبل الرئيسة . أخذت اثنتي عشر عضله من ٨ ذكور من الحوالي النجدي [*semitendinosus , triceps brachii, gluteus recuts femoris, biceps femoris, triceps brachii, infraspinatus, , psoas major, longissimus medius, semimembranosus, supraspinatus lumborum, longissimus thoracis*] متقاربة في العمر والوزن (متوسط وزن الذبيحة ١٢٠ كجم) . تم تخزين العينات على درجات حرارة ٢°م لمدة ٢٤ ساعة وتم إزالة جميع الدهون الخارجية ثم فرم العينات إلى أن أصبحت متجانسة. تم تقدير محتوى الرطوبة، البروتين، الدهون والرماد ومحتوى المعادن (Fe, Mn, Ca, K, Na, and Zn) في جميع العضلات. أوضحت نتائج هذه الدراسة أن هناك اختلافات معنوية ($P< 0.05$) بين عضلات الإبل الرئيسية لنسبة الرطوبة وكانت عضلات *triceps brachii, recuts femoris,* الأعلى و عضلات *longissimus lumborum, longissimus thoracis* الأقل نسبة. كان معدل نسبة الدهون بين ٠,٥٦ إلى ٢,٣٣ % في عضلات الإبل وكانت أعلى نسبة دهن في عضلات *longissimus lumborum, longissimus thoracis* وأقلها في عضلات *Recuts brachii and Triceps brachii*. نسبة البروتين تراوحت بين ١٩,٤٨ – ٢٠,٥٤ % و لم يكن هناك فروقات معنوية ($P< 0.05$) بين العضلات المدروسة. وجد أن هناك فروقات معنوية ($P< 0.05$) في نسبة الرماد بين عضلات الإبل الرئيسية تحت الدراسة وكان معدل نسبة الرماد بين ١,٠٥ إلى ١,٤٣%. في جميع المعادن المدروسة كان هناك فروق معنوية ($P< 0.05$) بين العضلات المختبرة وكان البوتاسيوم أعلى معدن تلي بالصوديوم والكالسيوم والزنك. عضلات *Psoas major Longissimus thoracis* and *Longissimus lumborum* كانت اقل العضلات في محتوي المعادن المدروسة في عضلات الإبل الرئيسة.