International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

A Study in Minerals Concentrations in Red Meat

Dr. Siham, Abdelwhab Alamin[1], Daoud, Alzubair Ahmed[2]

Sudan University of Science and Technology. College of Animal Production Science and Technology,
Department of Meat Science and Technology

Abstract: ***This study was indicated that the mineral concentrations were highly significant (P< 0.01) difference in camel meat compared to that in beef and goat meat. The camel meat has a highest concentrate of calcium compared to beef and goat meat. . Phosphorous concentration high in camel meat compared to that of beef and goat meat. Camel meat contained slightly higher concentration of sodium than the beef and goat meat. Potassium concentration was more in camel meat than that of beef and goat meat. Magnesium concentrate was high in camel meat compared to that of beef and goat meat. Ferrous concentration was high in camel meat compared to beef and goat meat. This study also indicated that the mineral concentrations were highly significant (P< 0.01) in camel meat compared to that in beef and goat meat.***

Keywords: mineral concentrations, calcium, phosphorous, magnesium, sodium (Na) potassium

1. Introduction

Sudan is situated in northeast Africa between latitudes 4^0 and 22^0 north and longitudes 22^o and 38^0 East. The country is traversed by the River Nile and its tributaries which have varying influences on irrigated agriculture and livestock production systems. Nutritionally, meat was a good source of essential amino acids and minerals except calcium. Meat was an important source of iron (Lawrie, 1991). Wan Zabari, *et. al.,* (1985) reported that lean meat is an excellent source of minerals required for normal growth and good health and estimated the mean mineral concentration in meat as (Calcium-11, Phosphorous-155.5, Magnesium -19.7, potassium-350, sodium, 64 and Ferrous -4.37 mg/100gm). Doornenbal and Murray, (1982) stated that lean meat has low calcium level which is insufficient to provide the recommended daily allowance. Adim *et al*., (2008) reported that camel meat like other types of red meat was contained higher level of potassium than the other minerals. Abdon *et al*., (1980) reported that the mineral concentration in camel meat higher compared to beef, probably due to lower intramuscular fat levels. Doornenbal and Murray, (1982) stated that magnesium was required for normal skeletal development as a constituent of bone. Ferrous (Fe) may be supplied from many different foods. Meat is general adds iron and leafy green vegetables have high iron content. Bender, (1992) reported that meat is a good source of iron and zinc. Dawood and Alkanhal, (1995) stated that camel meat as an excellent source of the trace elements Fe and Zn. Siham, (2008) stated that the camel meat has a higher concentration of calcium, phosphorus, potassium, Sodium, copper, manganese and magnesium compared to beef. Wan Zahari *et al.,* (1985) reported that goat meat has Na concentration as (55 - 77 mg/100gm). USDA, (2001) reported that the goat meat has higher levels of iron (3.2 mg/100gm) when compared to a similar serving size of beef (2.9 mg/100gm), pork (2.7 mg/100gm), lamb (1.4 mg/100g), and chicken (1.5 mg/100g). Comparatively, goat meat contains higher potassium concentration with lower sodium. According to USDA, (2007) goat meat has higher levels in iron and potassium but less sodium than red meat. Abdon *et al.,* (1980) reported that goat meat had iron concentration as 2.1 mg/100gm. The objective of this study is to evaluate the nutritive value of fresh camel, beef and goat meat.

2. Materials and Methods

This study was conducted in the laboratory of meat, College of animal Production Science and Technology in Sudan University of Science and Technology (SUST) and in meat laboratory in Khartoum University.

Meat samples: Twenty one kg of fresh deboned camel, beef and goat meat were obtained. Camel meat was purchased from "Soug Elnaga" local market, west Omdurman, beef from kuku research centre, and goat meat from local market.

Determination of minerals in camel, beef and goat fresh meat: For the determination of minerals concentration, the samples were initially homogenized in a food processor and dried in a drying oven at 100 ºC. The meat samples subjected to complete digestion in muffle furnace with a maximum temperature of 450c° to constant weight. A mixture of concentrated HNO3 and 30% H2O2 was used for the complete digestion of samples. A Spectrometer (Optima 3000 DV, Perkin Elmer – 1350 W) was used with the specific wavelengths.

Calcium determination in meat samples: The concentration of calcium in meat was determined according to the method of Trinder, (1960). A stock solution was prepared by dissolving 0.25 gm of calcium carbonate in 0.1 N HCl (hydrochloric acid) and made up to 100 ml with the acid. The standard was prepared by diluting 4 ml of the stock solution with 100 ml distilled water (D.W). 0.5 ml of standard was added to 1.0 ml of 0.5% chloronillic acid in a tube, used as standard. 0.5 ml of sample was placed in a centrifuge tubes, 1.0 ml of 0.5% chloronsillic acid was added. All tubes were allowed to stand for 15 minutes, and centrifuged at 3000 rpm for 5 minutes. The supernatant was decanted, and tubes were drained on a filter paper. The precipitate was washed with 0.5 ml D.W., and centrifuged again, the supernatant decanted and the tubes drained on a filter paper. The precipitate was dissolved in 4 ml of 4% ferric nitrate and allowed to stand for 5 minutes and then read at wave length 500 nm, ferric nitrate was used as blank. Calcium concentration in the meat sample was calculated as follows:

Reading of unknown – reading of blank Reading of standard – reading of blank	X 100= mg/100 gm

Phosphorus Determination in Meat Samples

Phosphorous concentration was determined by the method described by Varley (1967). 0.2197 gm of potassium dehydrogenate phosphate was dissolved in distilled water and made up to 1 liter. Few drops of chloroform were then added to 0.5 ml of the solution. 4.5 ml of 10% trichloroacetic acid (TCA) was added and used as standard. Five ml of 10% TCA was used as a blank. One ml of the sample was added to 9 ml of 10% TCA and the mixture was filtered, then 5 ml from the supernatant was taken in a test tube. One ml of ammonium molybdate solution was added to all samples and mixed then one ml of metal solution added, mixed and allowed to stand for 3 minutes at room temperature, finally read in a colorimeter at wave length 680 nm. Meat inorganic phosphate was calculated as follows:

Reading of unknown Reading of standard	X 5

Magnesium determination in meat samples: Magnesium concentration was determined by the method described by Norbert (1982). 8.358 gm of analytic grade magnesium chloride were dissolved in D.W. and made up to 1.0 liter. 1 ml of this solution was diluted in D.W. up to 200 ml and used as standard. Two concentrations of standard were made low standard by diluting 1.0 ml of standard with 2 ml D.W and high standard was made by adding 1.0 ml D.W. to 2 ml working standard. For the blank 3.0 ml D.W. was used. 0.2 ml of meat samples were diluted with 2.8 ml of D.W. To all tubes 0.5 of polyvinyl alcohol, 0.5 ml titan yellow and 1.0 ml 7.5 w/v sodium hydroxide solutions were added in the above stated order with mixing after each addition. All tubes were allowed to stand for 5 minutes, the absorbance of unknown and standard were read at wave length 540 nm and the zero absorbance was set by blank. The meat samples magnesium level was calculated as follows:

Reading of unknown x 2.5 Reading of high standard	mg/100 gm

Determination of sodium (Na) **and potassium (k) in meat samples:** Sodium and potassium concentration in meat samples were determined by a flame photometer (Corning 400) as described by Wootton (1974). Low Na and K standard solution were prepared by dissolving (8.1 and 0.373g) of Na and K in D.W to 1.0 liter respectively. High Na and K standard solution were prepared by dissolving (9.35 and 0.522g) in D.W respectively. One ml of sample was diluted with distilled water (9.9 ml) in stopper dematerialized test tube and mixed. The knob of light filter was adjusted to Na or K, then the power was connected and the Galvanometer light switched on, the gas switch was ignited. The high standard was adjusted to 100 (full scale), then the diluted sample and the low standard were read. Meat Sodium (Na) Concentrations were calculated as follows:

Reading of the diluted meat sample Reading of the low Na standard	X140

Meat Potassium concentrations were calculated as follows:

Reading of the diluted meat sample Reading of the low K standard	X 5

Ferrous determination (Fe): Ferrous concentrations were determined according to the method described in atomic absorption methods Pyunicam Sp. 90 using an atomic absorption spectrophotometer.

Statistical analysis: The data collected were subjected to statistical analysis by using complete randomized design used to analyze the results obtained from this study and subjected to ANOVA followed by Least significant difference test (LSD) using the (SPSS, Version 17.0, 2008).

3. Results

Calcium (Ca), phosphorous, sodium (Na), magnesium (Mg), potassium (K) and Ferrous (Fe) concentration in camel, beef and goat meat were shown in table (1) and figure (1).

Calcium (Ca): Calcium concentration was not significantly ($P>0.05$) different among camel, beef and goat meat. The camel meat has a highest concentrate of calcium compared to beef and goat meat.

Phosphorus (P): Phosphorus concentration was highly significant different ($P< 0.001$) between camel, beef and goat meat. Phosphorous concentration high in camel meat compared to that of beef and goat meat.

Sodium (Na): Sodium concentration was highly significant ($P< 0.01$) different among the three types of meat. Camel meat contained slightly higher concentration of sodium than the beef and goat meat.

Potassium (K): Potassium concentration was highly significant ($P< 0.001$) among the three types of meat. But no significant different ($P>0.05$) in the potassium concentration between beef and goat meat. Potassium concentration was more in camel meat than that of beef and goat meat.

Magnesium (Mg): Magnesium concentration was highly significant ($P<0.01$) between the three types of meat studied. There was no significant difference ($P> 0.05$) in magnesium concentration between beef and goat meat. Magnesium concentrate was high in camel meat compared to that of beef and goat meat.

Ferrous (Fe): Ferrous concentration was highly significant ($P< 0.01$) between the three types of meat. Ferrous concentration was high in camel meat compared to beef and goat meat.

Table 1: Mean values (±SD) of minerals content of camel, beef and goat meat in Mg/ 100gm:

	Camel meat	Beef	Goat meat	Level of significant
Calcium (Ca)	12.56 ±1.78	11.36 ± 0.35	11.21 ± 0.35	NS
Phosphorus (P)	176.0 ± 4.30[a]	155.0 ± 5.79[b]	154.5 ± 3.82[b]	**
Sodium (Na)	114.40±4.98[a]	89.08 ± 6.40[b]	76.0 ± 3.54[c]	**
Potassium (K)	411 ± 29.89[a]	323.2 ± 12.44[b]	310.2 ± 8.76[b]	**
Magnesium (Mg)	90.16 ± 5.03[a]	37.6 ±11.01[b]	27.31 ± 4.57[b]	**
Ferrous (Fe)	5.0 ± 0.49[a]	2.96 ± 0.32[b]	3.50 ± 0.45[b]	**
Parameters	Camel meat	Beef	Goat meat	Level of significant
Calcium (Ca)	12.56 ±1.78	11.36 ± 0.35	11.21 ± 0.35	NS
Phosphorus (P)	176.0 ± 4.30[a]	155.0 ± 5.79[b]	154.5 ± 3.82[b]	**
Sodium (Na)	114.40±4.98[a]	89.08 ± 6.40[b]	76.0 ± 3.54[c]	**
Potassium (K)	411 ± 29.89[a]	323.2 ± 12.44[b]	310.2 ± 8.76[b]	**
Magnesium (Mg)	90.16 ± 5.03[a]	37.6 ±11.01[b]	27.31 ± 4.57[b]	**
Ferrous (Fe)	5.0 ± 0.49[a]	2.96 ± 0.32[b]	3.50 ± 0.45[b]	**

NS = No significant difference between the two means.
* = (P< 0.05) ** = (P< 0.01) a, b and c = Means within the same row with different superscripts differ (P < 0.05).

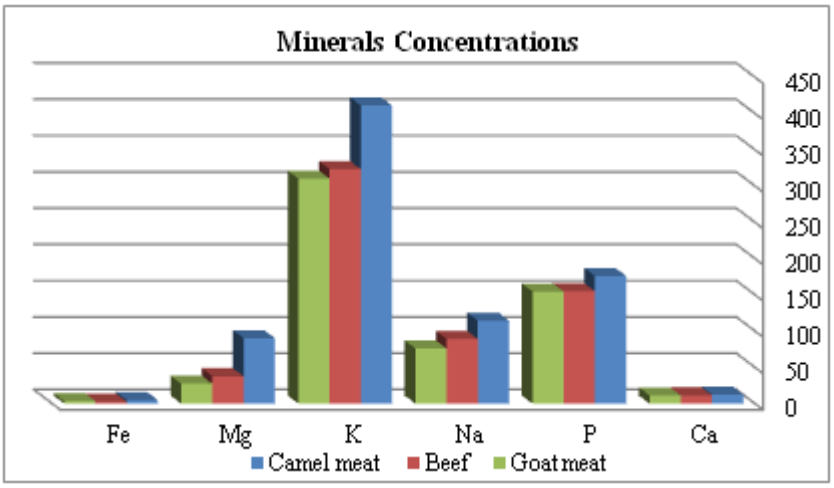

Figure 1: Minerals content in camel, beef and goat meat

4. Discussion

In this study the mean concentration of minerals mg/100gm was highly significant different (P< 0.01) in the three types of meat except calcium. In general, minerals concentration in camel meat was higher compared to that in beef and goat meat. The present results disagree with the findings of Gheisari, et. al., (2009) who reported that camel meat has similar mineral concentrations to beef (K, Ca, Fe, P and Mg). In the present result camel meat has a highest concentration of calcium (12.56mg/100gm) compared to beef and goat meat as (11.36 and 11.21mg/100gm) respectively. The result in this study slightly more than the findings of Wan Zahari and Wahid, (1985) and Siham, (2008), who stated that Calcium concentration in camel meat, was (11mg/100gm) and more than the result of Mohammad and Abubakar (2011) who reported that the calcium concentrations of camel meat were ranged between (5.59 and 8.27 mg/100gm). The present result in line with the result of Kadim, et. al., (2006) who reported that the calcium concentrations in camel meat ranged from (9.2 to 46.6 mg/100gm). Also the result in this study in line with the findings of Faer *et al*., (1991); Elgasim and Alkanhal, (1992); Dawood and Alkanhal, (1995); Rashed, (2002); Badiei *et al*., (2006); El- Kadim *et al* (2009) who reported that the calcium concentrations in camel meat ranged from (1.33 to 11.48 mg/100gm). The result in this study more than the result of Gulzhan *et al.,* (2013) who reported that the calcium concentration in longissmus dorsi of camel meat was (5 mg/100gm). The present result less than the values reported by Tariq, *et. al*., (2011) who reported that camel meat has calcium concentration as (27mg/100gm). This study showed that the calcium concentration in beef was (11.36 mg/100gm), this result more than the result of Sadler, *et. al*., (1993); Sinclair *et. al*., (1999) and Williams, *et. al*., (2007) who reported that calcium concentration in beef was (4.5mg/100gm) and (Siham, 2008) as (8 mg/100gm) and McCance and Widdowson, (1960) as (5.4 mg/ 100gm). The present result less than the findings of Abdon *et. al.,* (1980) who reported that the calcium concentration in beef (96 mg /100 gm). In this study calcium concentration in goat meat was (11.21mg/100gm), this result in line with the findings of Wan Zahari et al., (1985) who reported that the calcium concentration in goat meat was (11mg/100gm) and Abdon *et. al*., (1980) as ranged from (11 to 12 mg/100 gm). The result in this study less than the findings of USDA, (2007) who reported that the calcium concentration in goat meat was (13 mg/100gm). In the present study phosphorous concentration higher in camel meat as (175.6 mg/100gm) compared to that of beef and goat meat as (155 and 154.5 mg/ 100gm) respectively. The result in this study more than the findings of Wan Zahari, *et. al*., (1985), who stated that phosphorous concentration in camel meat, was (155.5 mg/100gm). The result in this study less than the findings of Kadim, *et. al*., (2006) who reported that the phosphorous concentrations in camel meat ranged from (249.9 to 584 mg/100gm) and

Gulzhan *et al*., (2013) as (229.0 mg/100gm) as reported by. The result in this study less than the findings of Tariq, *et. al.,* (2011) who reported that the phosphorus concentration in camel meat was (549 mg/ 100gm). The result in this study in line with the findings of Siham, (2008) who stated that the phosphorus concentration in camel meat was (176 mg/100gm). The present result showed that the phosphorus concentration in beef was (155mg/100gm), this result slightly more than the result stated by Siham, (2008) as (150mg/100gm) and less than the findings of Mc Cance et. al., (1960) who reported that the phosphorus concentration in beef was (334 mg/100 gm) and less than the result of Sadler, *et. al*., (1993); Sinclair *et. al*., (1999) and Williams, *et. al*., (2007) who reported that the Phosphorus concentration in beef was (215mg/100gm). In the present result the phosphorous concentration in goat meat was (154.5mg/100gm), this result in line with the findings of Wan Zahari *et al*., (1985) who reported that the phosphorous concentration in goat meat was **(**155.5 mg/100gm). The result in this study less than the findings of USDA, (2007) who reported that the phosphorus concentration in goat meat was (180mg/100gm). The present result showed that camel meat was contained slightly higher concentration of sodium as (114.4 mg/100gm) compared to beef and goat meat as (89.08 and 76 mg/100gm) respectively. The result in this study in line with the findings of Kadim, *et. al*., (2006) who reported that the concentration of sodium in camel meat ranged from (104.7 to 257 mg/100gm). The result in this study far than the findings of Wan Zahari, *et. al*. (1985), who stated that sodium concentration in camel meat, was (64 mg/100gm) and less than the findings of Tariq, *et.al*., (2011) who reported that the sodium concentration in camel meat was (252mg/100gm) and less than the result of Siham, (2008) as (198mg/100gm). In this study the sodium concentration in beef was (89.08 mg/100gm), this result more than the result reported by McCance *et al.,* (1960) as (69 mg/ 100 gm) and more than the findings of Sadler, et. al., (1993) ; Sinclair et. al., (1999) and Williams, *et. al.,* (2007) who reported the sodium concentration in beef was (51 mg/100gm) and Mc Cane *et. al*., (1960) as (69 mg/100gm). The present result less than the result reported by Siham, (2008) who stated that the sodium concentration in beef was (165mg/100gm). In this study goat meat has sodium concentration of (76 mg/100gm), this result similar to that mentioned by Wan Zahari *et al*., (1985) who reported that goat meat has sodium concentration ranged between (55 and 77 mg/ 100gm). The result in this study in line with the findings of Wan Zahari *et al*., (1985) who reported that the sodium concentration in goat meat ranged from (55to 77 mg/ 100gm). The present result less than the result reported by USDA, (2007) as (82 mg/100gm) and USDA, (2001) as (92mg/100gm).This study showed that goat meat contain less sodium compared to camel meat and beef, this result in line with the result mentioned by USDA, (2007) who reported that goat meat less sodium than beef. In the present study the Potassium concentration higher in camel meat as (411mg/100gm) compared to beef and goat meat as (323.2 and 310.2 mg/100gm) respectively. The result in this study in line with the result of Kadim, *et. al.,* (2006) who reported that the potassium concentration in camel meat ranged from (471.4 to 1053mg/100gm). The result in this study more than the findings of Wan Zahari, *et. al*. (1985) who stated that potassium concentration in camel meat was (350 mg/100gm) and Gulzhan *et al.,* (2013) who reported that the potassium concentration in longissmus dorsi of camel meat was (369 mg/100gm). The present result less than the findings of Tariq, *et.al*., (2011) who reported that the potassium concentration in camel meat was (1008mg/100gm) and less than the findings of Muhammad and Abu-bakr, (2011) who reported that the potassium concentrations in camel meat was ranged from (559 to 827 mg/100gm) and Siham, (2008) as (560mg/100gm). the result in this study showed that the Potassium concentration in beef was (323.2mg/100gm) this result slightly similar to that reported by McCance et al., (1960) as (334 mg/100 gm) and Sadler, *et. al*., (1993); Sinclair *et. al*., (1999) and Williams, *et. al*., (2007) as (363 mg/100gm) and Siham, (2008) as (350mg /100gm). This study showed that the potassium concentration in goat meat was (310.2mg/100gm), this result slightly less than the findings of Wan Zahari *et al.,* (1985) who reported that the potassium concentration in goat meat was (350 mg/100gm) and USDA, (2007) who reported that the Potassium concentration in goat meat was (385 mg/100gm). The present result showed that the potassium concentration in goat meat less than in beef, this result disagree with the findings of USDA, (2007) who reported that goat meat higher potassium concentration than beef. The present result less than that reported by USDA, (2001) as (436 mg/100gm). In this study result showed that the magnesium concentration was higher in camel meat as (90.16 mg/100gm) compared to that of beef and goat meat as (37.6 and 27.31mg/100g) respectively. The result in this study more than the findings of Wan Zahari, *et. al.,* (1985), who stated that magnesium concentration in camel meat, was (19.7 mg/100g) and more than the findings of Kadim, *et. al*., (2006) who reported that the magnesium concentration in camel meat ranged from (24.7 to 57.3 mg/100gm) and Tariq, *et. al*., (2011) as (56.7 mg /100gm) and Siham, (2008) as (28 mg/100g). The present result less than the result reported by Gulzhan *et al.,* (2013) who stated that the magnesium concentration in longissmus dorsi of camel meat was (251.0mg/100gm). This result slightly more than the result of Muhammad and Abu-Bakr (2011) who reported that the magnesium concentrations in camel meat were ranged from (79.4 to 80.6 mg/100gm). The present study showed that the magnesium concentration in beef was (37.6mg/100gm), this result more than the findings of Sadler, *et. al*., (1993); Sinclair *et. al*., (1999) and Williams, *et. al*., (2007) as (25 mg/100gm) and Siham, (2008) as (24 mg/100gm). The present result showed that the magnesium concentration in goat meat was (27.31mg/100gm), this result more than the result reported by Wan Zahari *et al*., (1985) who stated that the magnesium concentration in goat meat was (19.7 mg/100gm). In the present study result showed that the ferrous concentration was higher in camel meat as (5.0 mg/100gm) compared to beef and goat meat as (2.96 and 3.5mg/100gm) respectively. The result in this study in line with the findings of Wan Zahari, *et. al*., (1985), who stated that ferrous concentration in camel meat, was (4.37 mg/100gm). Also this result agreed with the findings of USDA, (2001) who mentioned that goat meat has higher levels of iron (3.2 mg/100gm) when compared to beef as (2.9 mg/100gm). This result in line with the findings of Gulzhan *et al*., (2013) who reported that the ferrous concentration in camel meat as (5 mg/100gm). The present result disagrees with that reported by Tariq, *et. al*., (2011) who stated that the ferrous concentration of camel meat as (16 mg/100gm). The

result in this study higher than that reported by El-Faer *et al*., (1991); Dawood and Alkanhal, (1995) and Rashed, (2002) as value ranged from (1.16 to 3.39 mg/100gm), which was expected that due to the different physiological requirements of myoglobin of different muscles. The present result less than the findings of Mohammad and Abubakar, (2011) who reported that the ferrous concentrations of camel meat were ranged between (78 and 156 mg/100gm). This result more than the result of Dawood and Alkanhal, (1995) that measured the ferrous concentration of camel meat and reported a value of (3.24 mg/100gm). The present result in line with the findings of Siham, (2008) who reported that the ferrous concentration in camel meat was (5.6mg/100gm). The present result showed that the iron concentration of beef was (2.96mg/100gm), this result in line with the result reported by Siham, (2008) who stated that the ferrous concentration in beef was (2.8 mg/100gm). The present result more than the result reported by Sadler, *et. al.*, (1993); Sinclair *et. al*., (1999) and Williams, *et. al*., (2007) as (1.8 mg/100gm). The present result showed that the camel meat contain more iron than beef, this result agreement with the result of Nafiseh, *et. al.*, (2010) who reported that the amount of iron was significantly higher in camel meat, therefore camel meat better source of iron compared to beef. The present result showed that the iron concentration in goat meat was (3.5mg/100gm), this result more than the result reported by Abdon *et al*., (1980) as (2.1 mg/100gm) and USDA, (2007) as (2.83 mg/100gm). The present result less than the result of Wan Zahari *et al*., (1985) who reported that iron concentration in goat meat (4.37mg/100gm). The present result showed that the iron concentration in goat meat higher than that in beef, this result agreement with the result found by USDA, (2007) who reported that goat meat higher iron concentration than beef. In general ferrous concentration in the three types of meat studied showed small amount compared to other mineral content. The differences in these results may be due to the differences in species of animal, genetic factors, environmental factors and nutritional.

5. Conclusion

Minerals concentration was highly significant (P< 0.01) in camel meat compared to beef and goat meat. In this study the concentration of Ca, P, Na, K, Mg and Fe was high in camel meat compared to beef and goat meat.

6. Acknowledgements

After giving thanks and prayers to Allah for his great blessing, I would like to express my sincere appreciation and deep gratitude to my supervisor Prof. Daoud Alzubair Ahmed Daoud for his excellent supervision and continuous interest which have made this work possible.

References

[1] **Abdon, I. ; Del Rosario, l. F.; and Olga, L.G. (1980)**. Food Composition Table's Recommended for Use in the Philippines. Handbook 1,5th revised ed. Food and Nutrition Reseat Institute, Manila Philippines.

[2] **Adim, I. T.; Mahgoub, O. and Purchas, R.W., (2008)**. A review of the growth,and of the carcass and meat quality characteristics of the one-humped camel (Camelus dromedaries). Meat Science. 2008; 80(3): 555-569. ISSN: 0309- 1740.

[3] **Badiei, K.; Mostaghni, K.; Pourjafar, M.; and Parchami, A., (2006).** Serum and Tissue Trace elements in Iranian camels (*Camelus dromedarius*). Comp. Clinical Pathological 15:58-61.

[4] **Bender, A. (1992).** Meat and Meat products in Human Nutrition in Developing Countries. FAO Food and Nutrition Paper 53. Rome.

[5] **Dawood, A. and Alkanhal, M. A (1995)**. Nutrient composition of Najdi- camel. Meat Science. 39(1): 71 – 78.

[6] **Doornenbal, H. and** Murray, A. C. (1982), Journal of Food Science, 47, 55.

[7] **El-Faer, M. Z.; Un-cooked, 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 Chemistry. 42 (2): 139-143.

[8] **Elgasim, E A. and M.A. Alkanhal (1992)**. Proximate Composition, Amino Acids and Inorganic Mineral Content of Arabian Camel Meat. Comparative Study. Food Chemistry. 45(1): 1- 4.

[9] **Gheisari1, H. R., M. Aminlari and S. S. Shekarforoush. (2009)**. A comparative study of the biochemical and functional properties of camel and cattle meat during frozen storage. Vet. Arhiv. 79:51-68.

[10] **Gulzhan, R.; Bernard, F.; Assya, S.; Gaukhar, K.and Isam T. Kadim (2013).** Chemical composition of Infraspinatus, Triceps brachii, Longissimus thoraces, Biceps femoris, Semitendinosus, and Semimembranosus of Bactrian(Camillus Bactrian's) camel muscles. Emir. J. Food Agric. 2013. 25 (4): 261-266.

[11] **Kadim, I. T.; Mahgoub, O.; Al-Marzooqi., W.; Al-Zadjali, S.; Annamalai, K. and Mansoor, M.H. (2006)**. Effects of Age on composition and Quality of Muscle Longissimus thoracis of the Omani Arabian Camel (*Camelus dromedarius*). Meat Science 73(4): 619-625.

[12] **Kadim, I. T.; Mahgoub, O.; Al-Marzooqi, O.w. and Khalaf**. **S.**K. B., (**2009**). Journal of Camelidae Science, 2, 30.

[13] **Kadim, I. T.; Mahgoub, O.; Al-Marzooqi, W.; Khalaf, S. K.; Mansour, M. H.; Al-Sinawi, H. and Al-Amri. I. S. (2009).** Effect of electrical stimulation on histochemical muscle fiber staining, quality and composition of camel and cattle longissimus thoracis muscles. J. Food Sci. 74:S44-S52.

[14] **Lawrie, R.A. (1991)**. Meat science 5th ed., Pergamum Press, oxford.UK.

[15] **McCance, R.A. and Widdowson, E.M. (1960).** M.R.C. Special Report. No. 297, HMSO, London.

[16] **Mohammad, B.F. and Abubakar, F.M. (2011)** . Chemical Composition of Raw and Cooked Camel (Camelus dromedarius) Meat Cuts. Department of Animal Science, Bayero University, PMB 3011, Kano-Nigeria. Volume 6(2);

[17] December, 2011. Faculty of Agriculture, Bayero University Email: bmfagge2000@yahoo.com.

[18] **Nafiseh, S.; Mahdi, K.; Javad, K.; Hooshang, B. & Fatemeh, P. (2010).** Camel cocktail sausage and its

physicochemical and sensory quality. International Journal of Food Sciences and Nutrition, March 2010; 61(2): 226–243.

[19] **Norbert, W. (1982).** Fundamentals of clinical chemistry. W.B. Sounders Company, Philadelphia, USA, 919-920.

[20] **Rashed, M. N., (2002)**. Trace elements in camel tissues from a semi-arid region. The Environ. 22: 111-118.

[21] **Sadler, M.; Lewis, J. and Buick, D., (1993)**. Composition of Trim Lamb. Food August 1993; 45 (Suppl.): S2-12.

[22] **Siham,A.A.,(2008).** A comparative Study of Chemical Composition and Eating Quality Attributes of Camel meat and Beef. MSc. College of Veterinary Medicine and Animal Production Sudan University of Science and Technology.

[23] **Sinclair, A., Mann, N. and O'Connell, S., (1999).** The Nutrient Composition of Australian Beef and Lamb. Melbourne: RMIT.

[24] **SPSS, (2008).** Statistical Package for the social sciences. Version 17.0 SPSS Inc. Chicago.

[25] **Tariq Mahmud ; Rabia, R. ;Jamil, A., Sakhwat, A. ;Aadil, A. and Mohammad, S. (2011).** Minerals and Nutritional Composition of Camel (Camelus dromedarius) Meat in Pakistan. J. Chem. Soc. Pak., Vol. 33, No. 6, 2011 835. Institute of Chemistry, University of Punjab, Lahore, Pakistan.

[26] **Trinder (1960).** Calorimetric Micro-determination of calcium analysis, 85: 889-894.

[27] **USDA, (2001).** Nutrient database for standard reference, release 14. U.S. Government Printing Office, Washington, D.C.

[28] **USDA NASS. (2007).** Sheep and Goats. Washington, DC: USDA National Agricultural Statistics Service. Available from: http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1145

[29] **Varley, H. (1967).** Practical Clinical Biochemistry, 4th Edition, William Heinamam (Ed), Medial books, ltd, and Master of Science Books. Inc. New Yoke, 802.

[30] **Wan Zahari, W.M. and Wahid, S.A. (1985)**. Mineral concentrations in the blood plasma and various tissue of local crossbred goats. MARDI Research Bulletin 13: 333.40.

[31] **Williams, P.; Droulez, V. and Levy, G., (2007).** Composition of Australian red meat 2002. 3. Nutrient profile. Food Aust. 2007; 59: 331-41.

[32] **Wootton, I.D.P. (1974).** Plasma sodium and potassium, In: Micro - Analysis in medical Biochemistry, 5th Edition.