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A study in mineral composition of camel meat and beef

Siham, A. A., Elshafia, S. A. and Huda, M. Z.

Sudan University of Science and Technology, College of Veterinary Medicine and Animal Production Department of Animal Production

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This study indicated that the mineral concentrations were highly significant (P< 0.01) in camel meat compared to that in beef. The camel meat has a high concentrate of Calcium (Ca) compared to beef. Phosphorous (P) concentration high in camel meat compared to that of beef. Camel meat contained a slightly higher concentration of magnesium (Mg), sodium (Na) Potassium (K), copper (Cu), iron (Fe), zinc (Zn) and Manganese (Mn) than that in beef.

Keywords: Mineral concentrations, calcium, phosphorous, magnesium, sodium (Na) potassium, copper, iron, zinc, manganese, camel meat, beef.

INTRODUCTION

Camel meat is preferable by the people who live in Gulf Countries, Saudi Arabia, and Libya. Many variables and alternatives can be exploited to bridge the gap between the world population need and the available resource of red meat. Camel meat is a popular and cheaper source of red meat in arid and semiarid areas that can compensate beef shortage to a large extent. Minerals or inorganic compounds are necessary in the diet. Most of the essential minerals except calcium are found in the lean. Mineral elements can be divided into two groups based on the relative amounts needed in the diet, namely, macro minerals and micro or trace minerals. 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 and Wahid, (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 a 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 generally 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.

The Objective of this study is to evaluate the camel meat and to know more details about camel meat.

Materials and Method

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

Meat samples

Twenty one kg of fresh deboned camel, beef and goat meat was 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 meat and beef

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 a muffle furnace with a maximum temperature of 450c_o 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.

Corresponding Author: sihamlmn666@gmail.com

Calcium determination

The level of Ca in meat was determined according to the method Trinder (1960). A stock solution was prepared by dissolving 0.25 g of calcium carbonate in 0.1 N HCl (hydrochloric acid) and made up to 100 ml with the acid. The working standard was prepared by diluting 4 ml of the stock solution with 100 ml distilled water (D.W). 0.5 ml working standard 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 tube; 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, allowed to stand for 5 minutes, read at wavelength 500 nm, ferric nitrate used as blank. Ca concentration in the meat sample was calculated as follows:

Reading of unknown – reading of blank	X 100
Reading of standard – reading of blank	

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

Or

Reading of unknown x 5.0	mg/100 ml
Reading of high standard	

Phosphorus determination

P was determined by the method described by Varley (1967). 0.2197 g of potassium dehydrogenate phosphate was dissolved, and made up to 1 liter in distilled water, few drops of chloroform were then added. To 0.5 ml of this 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 sample was added to 9 ml of 10% TCA and the mixture were filtered, and then 5 ml from the supernatant was taken in a test tube. To all tubes 1 ml of ammonium molybdate solution was added, mixed, then 1 ml of metal solution added, mixed and allowed to stand for 3 minutes at room temperature, finally read in a colorimeter at wavelength 680 nm. Camel meat& beef inorganic phosphate was calculated as follows:

Reading of the unknown	X 5 = mg/100 ml
Reading of standard	

Magnesium determination

Mg was determined by the method described by Norbert (1982). 8.358 g of analytic grade magnesium chloride were dissolved and made up to1 liter with distilled water; 1 ml of this solution was diluted up to 200 ml with DW and used as working standard. Two concentrations of standard were made, low standard by diluting 1.0 ml of working standard with2 ml D.W and high standard 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 was 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 the unknown and standard were read at wavelength 540 nm and the zero absorbance was set of blank. The meat sample magnesium was calculated as follows:

Determination of sodium and potassium concentration in meat

Sodium and potassium concentration in meat 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 0.373 g of Na and K respectively. High Na and K standard solution were prepared by dissolving 9.35 and 0.522 g of Na and K respectively. 0.1 ml of sample was diluted with distilled water (9.9 ml) in a stopper demineralized 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) concentration was calculated as follows:

Reading of the diluted meat sample	X 140 = meg/L
Reading of the low Na standard	

Meat potassium concentration was calculated as follows

Reading of the diluted meat sample	X 5 = meg/L
Reading of the low K standard	

Zinc determination

Zinc (Zn) in meat was determined using an atomic absorption spectrophotometer (Unicam 929 AA spectrometer), Unicam Instrument Ltd. Cambridge, England, according to the method described in the atomic absorption method Pye Unicam Sp. 90.

Stock zinc solution (1000 ppm)

One gram pure zinc metal was dissolved in a few drops of concentrated nitric acid and the volume was made up to one liter with distilled water.

Standards Zinc solution

0.25, 0.5, 1, 1.5, 2 and 3 ppm standard Zn solution was prepared from the stock solution by dilution.

Analysis procedure

The instruments were blanked with distilled water. According to the theory of the atomic absorption spectrophotometer as described in Unicam - atomic absorption spectrometry method manual, when the instrument is put to work sample are drawn into a nebulizer by a flexible polythene capillary tube by the vacuum created by the high velocity of airflow. Samples and air, then pass to a spray chamber where acetylene gas, air and sample are completely mixed. Air/gas mixture, carrying, the evenly mixed sample is drained to the air acetylene burner where the very fine drops are completely burned and changed to free atoms. A hollow cathode zinc lamp emits radiation that passes through the flames. Free atoms of zinc absorb some of the light emitted according to their concentration in the sample in order to raise their electrons from low energy to a high energy state, i.e. excited atoms. Light that is not absorbed is focused to monochrometer where it excludes radiation of wavelength other than the resonance line of the source. From there, the light passes to photomultiplier, an amplifier and finally gives the reading on the meter scale. Absorption of different concentration of working standards mentioned above was read at a wavelength of 213.9 nm airflow 300 liter/min and acetylene gas flow 1.2/min. The diluted sample under test were aspirated in the machine exactly like standards and meat zinc concentration was then read.

Copper determination

Copper levels in meat were determined using an atomic absorption spectrophotometer according to the method described in the atomic absorption method Pyunicam Sp. 90. The following reagent is used:

1. Stock copper solution (1000 ppm): One gm pure copper metal was dissolve in few drops of concentrated nitric acid and the volume completed to 1 litre with distilled water.
2. Copper standards: Series of standard copper solution 0.25, 0.5, 1.0, 1.5, 2, 3 and 4 ppm were prepared from the stock solution by dilution. Analysis procedure: As in case of zinc, the instrument was blanked with distilled water and the absorption of different concentration of the standard solution was measured in the machine in the same way as previously used for zinc analysis but at a wavelength of 324.80 nm air flow 3.0 liter/min and acetylene gas flow 1.2/min. A hollow cathode copper lamp was used as the light source. Diluted sample under test were similarly aspirated and meat Cu concentration was then read.

Manganese determination

Manganese (Mn) level was determined according to the method described in atomic absorption methods Py Unicam Sp. 90 using an atomic absorption spectrophotometer.

Iron determination (Fe)

Fe levels 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 a least significant difference test (LSD) using the (SPSS, Version 17.0, 2008).

Results

Calcium (Ca), phosphorus (P), sodium (Na), magnesium (Mg), Potassium (K), copper (Cu), iron (Fe), zinc (Zn) and Manganese (Mn). Concentration in the camel meat and beef meat were shown in table (1). Calcium concentration apparently had significant ($P< 0.01$) difference among camel meat and beef, also camel meat has a high amount of calcium as (11 mg/100gm) than that of beef (8 mg/100gm). The phosphorus concentration was highly significantly different ($P< 0.001$) between camel meat and beef. Also the phosphorus concentration in camel meat (176 mg/100gm) more than that of beef (150 mg/100gm). The magnesium concentration was more on camel meat than that of beef as (28 and 24 mg/100gm) respectively. Also, there was significant different ($P< 0.05$) between camel meat and beef. Camel meat contained slightly higher concentrations of sodium than that of beef as (198 and 165 mg/100gm).

Also the sodium concentration was highly significant ($P< 0.01$) difference among the two types of meat. Potassium concentration higher in camel meat compared to beef (5.6 and 3.5 mg/100gm)respectively, as well as potassium level was highly significant ($P< 0.001$) difference among the two types of meat. The copper concentration was significantly ($P< 0.01$) difference between camel meat and beef. Also copper concentration in the two species was almost similar as (0.4 and 0.06 mg/100gm) for camel meat and beef respectively. Camel meat contains a higher Zinc concentration compared to beef as (5.3 and 4.2) respectively. Also, there was no significant ($P> 0.05$) difference between camel meat and beef in zinc content. Camel meat showed a slight increase in manganese concentration than beef as (1.04 and 0.46 mg/100gm) respectively. The Mn content was highly significant ($P< 0.001$) difference between camel meat and beef. Ferrous concentration apparently more content in camel meat than that of beef. Also Fe level was significantly ($P< 0.01$) difference between the two types of meat.

Table 1: The minerals content of camel meat and Beef mg/100gm

Parameters	Camel meat	Beef	Standard error (SE)	Level of significance (L.S)
Calcium	11	8	0.645	**
Phosphorus	176	150	0.258	**
Sodium	198	165	4.203	**
Magnesium	28	24	1.291	*
Potassium	5.6	3.5	0.157	***
Copper	0.4	0.06	0.042	**
Iron	5.6	2.8	2.708	**
Zinc	5.3	4.0	0.622	*
Manganese	0.42	0.037	9.9323	****

N.S. = No significant differences between the two means
* = (P< 0.05)
** = (P< 0.01)
*** = (P< 0.001)
**** = (P< 0.0001)

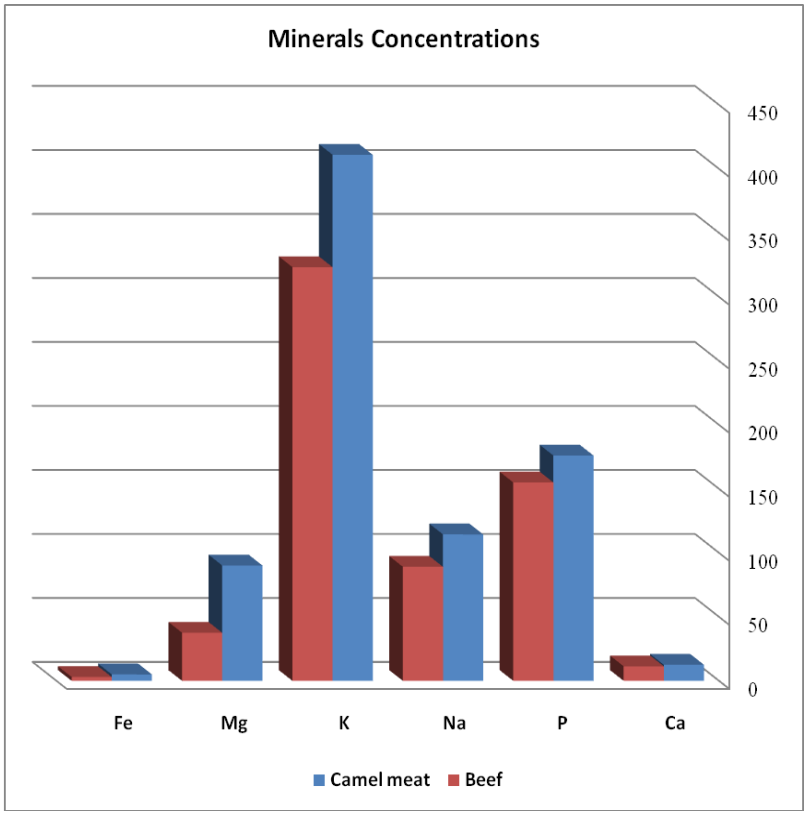

Figure 1: Mineral concentrations in camel meat and beef

Discussion

In the present study, the mean concentration of minerals mg/100gm was highly significant different (P< 0.01) in the two types of meat except calcium. In general, mineral concentration in camel meat was higher compared to that in beef. The present results disagree with the findings of Gheisari, *et al*., (2009) who reported that camel meat has similar mineral concentrations in beef (K, Ca, Fe, P and Mg). In the present result camel meat has a high concentration of calcium (11mg/100gm) compared to beef as (8mg/100gm).

The result in this study in line with the findings of Wan Zahari and Wahid, 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 (8mg/100gm), this result more than the result of Sadler, *et al*., (1993); Sinclair *et al*., (1999) and Williams, *et al*., (2007) who reported that the calcium concentration in beef was (4.5mg/100gm). In the present study phosphorous concentration higher in camel meat as (176mg/100gm) compared to that of beef as (150 mg/ 100gm.

The result in this study more than the findings of Wan Zahari and Wahid, (1985), who stated that the 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 present result showed that camel meat contained a slightly higher concentration of sodium as (198 mg/100gm) compared to beef as (165mg/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 more than the findings of Wan Zahari and Wahid, (1985), who stated that the 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).

In the present study result showed that the magnesium concentration was higher in camel meat as (28mg/100gm) compared to that of beef as (24mg/100gm). The result in this study more than the findings of Wan Zahari and Wahid, (1985), who stated that the magnesium concentration in camel meat, was (19.7 mg/100g) and similar to 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). 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 (24mg/100gm), this result slightly similar to the findings of Sadler, *et al*., (1993); Sinclair *et al*., (1999) and Williams, *et al*., (2007) as (25 mg/100gm). In the present study result showed that the ferrous concentration was higher in camel meat as (5.6mg/100gm) compared to beef as (2.8 mg/100gm). The result in this study in line with the findings of Wan Zahari and Wahid, (1985), who stated that the ferrous concentration in camel meat, was (4.37 mg/100gm). Also, this result agreed with the findings of USDA, (2001) who mentioned that iron concentration in beef (2.9 mg/100gm). This result in line with the findings of Gulzhan et al., (2013) who reported that the iron concentration in longissmus dorsi of camel meat was (5 mg/100gm). The present result disagrees with the result reported by Tariq, et al., (2011) who stated that the iron concentration of camel meat was (16 mg/100gm). The result in this study more than the result 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). 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 iron concentration of camel meat and reported a value of (3.24 mg/100gm). The present result showed that the iron concentration of beef was (2.96mg/100gm), this result in line with the result of USDA (1986) as (2.72 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 contains more iron than beef, this result agrees 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.

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, Fe, Mn, Zn and Cu were higher in camel meat compared to beef.

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