Assessment of Mineral Concentration in Camel (*Camelus dromedarius*) meat, beef, and Sheep meat (Mutton)

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Abstract

This study was conducted in the College of Animal Production Science and Technology, Sudan University of Science and Technology to evaluate the mineral concentration Calcium of (Ca), phosphorus (P), sodium (Na), magnesium (Mg), Potassium (K), copper (Cu), iron (Fe) and zinc (Zn)) in camel (*Camelus dromedarius*), beef and sheep meat (mutton) (*longissimus muscle*) from the different carcass of young animals. The study showed that mineral contents in camel meat were significantly higher (P< 0.01) in comparison with that in beef and sheep meat. Calcium concentration was apparently high significant (*P*< 0.01) difference among camel meat, beef, and, sheep meat. Camel (*Camelus dromedarius*) meat had a high concentration of Calcium (Ca) (10.5mg/100g) compared to beef (6.0mg/100g) and sheep meat (8.0 mg/100g). Phosphorous (P) content in camel meat and sheep meat were wash in comparison with that of beef (209, 205 ,and 167mg/100g), respectively. Als,o camel meat and sheep meat contained higher cconcentrations magnesium compared to beef (31, 28 and 25mg/100g), respectively. While the concentration of sodium in camel meat increased(117mg/100g) compared to sheep meat (72 mg/100g) (28) and beef (65 mg/100g) 25mg/100g. Potassium (K) content in camel meat hasa high concentration (380 mg/100g) compared to beef (358 mg/100g) and sheep meat (365 mg/100g). Concentrations of copper (Cu) in camel meat, beef and sheep meat were (0.4; 0.2,6 and 0.24 mg/100g), respectively. Ferrous (Fe) level revealed high significant difference (*P*< 0.01) between camel meat, beef and sheep meat. Ferrous content in camel meat showed higher levels (4.58 mg/100g) followed by sheep meat (3.78 mg/100g) and beef (2.8 mg/100g). And zinc (Zn) showed significant (P< 0.05) difference between camel meat, beef and sheep meat. It showed high concentrations level in camel meat (5.3 mg/100g) compared to beef (4.58 mg/100g) and sheep meat (4.0 mg/100g).

Keywords: minerals, camel meat, beef, sheep meat.

Introduction:

The Food Standard Code defines meat as ‘the whole or part of the carcass of any buffalo, camel, cattle, deer, goat, hare, pig, poultry, rabbit or sheep. Lean meat is low in sodium with a potassium/sodium ratio of greater than five (FSAN2003). The copper content in raw lean cuts range from 0.055 to 0.190mg/100g in beef and veal, 0.090 to 0.140mg/100g in lamb and 0.190 to 0.240mg/100g in mutton, all significantly higher than values reported in British meat (Kadim *et al*., 2014). Many variables and alternatives can be exploited to bridge the gap between the world population need and the available source of meat. Camel meat is a popular and cheaper source of red meat in the arid, and semiarid areas that can compensate for beef shortage to a large extent. Minerals or inorganic compounds are necessary for the diet. Most of the essential minerals, except calcium, are found in the lean. Basarir 2013 mentioned that lean meat has low calcium content. (Kadim *et al.* 2008) Mentioned that camel meat contains a higher level of potassium. Abdon et al. (1980) Stated that mineral content in camel meat is higher in comparison with that of beef. (Basarir 2013) Mentioned that magnesium is required for normal skeletal development. Siham (2008) Stated that camel meat has a higher concentration of calcium, phosphorus, potassium, sodium, copper, manganese and magnesium compared to beef. Zink is distributed widely in body tissue, but it is found in the highest concentration in the liver, kidney, muscle, pancreas, eye, prostate gland, skin, bone, hair and wool. Minerals are generally classified as essential elements that are required for growth, and health or toxic elements, which poses a health risks to dromedaries. Deficiency of essential elements as well as exceeding the safe limits of toxic elements can be detrimental to human health. The level of variation in camel meat indicates that physiological factors play a major role in determining the calcium contents in camel meat. Copper contents in dromedary meat ranged between 0.04 to 0.12 mg/100g fresh weight. Dromedary meat contains about 3.1 to 4.8 mg/100g according to the study of (Kadim 2013) (mg/100gram) in muscle of the dromedary camel, Calcium (0.05), Magnesium (1.37), Phosphorus (5.23), Sodium (5.18), Potassium (25.2), Zinc (0.01), Iron (0.03) and Copper (0.001 mg /100gram). Meat quality characteristics from young dromedary camels are comparable to those of beef at a similar age (Leupold 1968 ; Knoess 1977 ; Mukasa 1981; Kadim *et al*.2006). In this respect, Kadim *et al*. (2009) found that dromedaries (2-4 years old) and beef (2-3 years old) had similar mineral contents in longissimus Dorsi muscle. The effect of camel age on meat quality was studied by Kadim *et al*. (2006) and found that 1-3 years of age is the optimum age for the slaughtering of dromedary for better meat quality.

The objective of this study was to determine, and compare the mineral content in camel, beef and sheep meat (mutton).

Material and Method

The study was conducted in the lab of Meat Science and Technology, College of Animal Production Science and Technology, Sudan University of Science, and Technology and the Laboratory of Chemistry of Faculty of Science, Khartoum University.

Meat samples

5 Kilograms of fresh meat of every type of the three animal types (camel meat, beef and sheep meat) were purchased from the Sudanese local market, and used in the current study. The meat samples were obtained from male camel at 2-3 years old, male cattle of 12-13-month-old and male sheep of 10 -11-month-old.

Minerals analysis

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 were subjected to complete digestion in a muffle furnace with a maximum temperature of 450cº to constant weight.

Calcium Ca, **Ferrous (Fe)**, **Magnesium** (Mg), **and Copper (Cu) determination in the samples of meat:**

Instruments: A Model AA-6300 atomic absorption spectrometer with flame (Shimadzu, Japan) equipped with deuterium background correction was used for the determination of Fe in samples of meat. An air-acetylene flame was used for all determinations. The spectrometer was operated using wavelengths of 422.7, 248.3, and 285.7 nm, and a spectral band pass of 0.7 nm, for determinations of Ca, Fe and Mg, respectively. The lamp current used for the respective elements was 10, 12 and 8 ma. Due to its superior background correction capacity and to the much higher level of information provided, a high-resolution continuum source atomic absorption spectrometer (HR-CS AAS) Model Contra AA 700 equipped with a transversely heated graphite tube atomizer was used for Cu determination. A xenon short-arc lamp working in optimized hot-spot mode at 300 W for the full measurement range of AAS (185-900 nm) was used as a radiation source. A high-resolution double monochromator, consisting of a prism as pre-monochromator and an echelle grating monochromator, providing a spectral bandwidth per pixel of ca. 2 pm at 200 nm, was used to promote spectral dispersion of the continuum radiation, and a linear charge-coupled device (CCD) array detector with 588 pixels for the detection of the radiation. Argon with a purity of 99.996% was used as the purge gas with a flow rate of 2 L min-1 during all stages, except during the atomization step, when the flow was stopped. An analytical line at 327.396 nm was employed for Cu, using integrated absorbance (peak area) for signal evaluation. The temperature program of the graphite furnace was optimized through pyrolysis and atomization curves. The adopted pyrolysis and atomization temperatures were 1200, and 2300 °C, respectively. The samples were weighed using an Ohaus Adventurer analytical balance (Model AR 2140, Pine Brook, NJ, USA) with a resolution of 0.1 mg, and a tare maximum of 210 g. For the sample acid digestion, a heated digester block was used (MA-4025 from Marconi, Piracicaba, SP, Brazil). In order to facilitate the sample solubilization with formic acid, an ultrasonic bath (Model Q335D, Quimis, SP, Brazil) was used (Damin, et al. 2007).

Working solutions of Cu and Fe were prepared daily by appropriate dilution of the stock solution containing 1000 mg L-1 (Fluka, Buchs, Germany) in ultrapure water. The following reagents were used for sample digestion: formic acid (06450, Fluka Analytical, Germany), tetramethylammonium hydroxide 25% (m/v) (331635, Sigma Aldrich, Germany), 35% (v/v) hydrogen peroxide (95299, Fluka Analytical, Germany), and nitric acid (Synth, Brazil).

Digestion with HNO_3 and H_2O_2: Meat samples were treated by acid digestion based on the method described by (Damin, et al 2007). Approximately 500 mg of fresh samples were weighed in triplicates directly into a 50 mL glass digester tube; 5 mL of concentrated HNO_3 was added, and the mixture was heated in a digester block at 90 ºC for 1 h. After cooling, 2 mL of H_2O_2 was added, and the mixture was heated at the same temperature for an additional

1 h. The digestion was considered complete when all fat of the meat had dissolved. After cooling, the volume was completed to 50 mL with ultrapure water for subsequent analysis.

Solubilization with formic acid: Meat samples were treated with formic acid for solubilization based on the method proposed by Scriver et al. 17 The same mass used in the previous procedures was weighed directly in polyethylene flasks and 10 mL of formic acid was added. The mixture was placed in an ultrasonic bath at 70 °C for 4-6 h to complete the solubilization process. After cooling, the flask was filled to 50 mL with the ultrapure water for subsequent analysis.

Methodology: about 1 g of fresh meat samples was dried in an oven at 103 ºC up to a constant weight to eliminate the humidity. All samples were dried in triplicate and kept in desiccators until weighed. The analytical results were obtained by preparation of calibration curves using solutions in the same medium used for treating the samples. The sample solutions were diluted with de-ionized water to be within the linear calibration range. For the determination of Ca and Mg in the Air-C2H2 flame, it was necessary to add buffer solutions of LaCl3 0.1% (m/v) in the samples, and standards for minimizing the possible interferences from oxide formation. For the determination of Cu, the samples were analyzed at least three times by introducing 20 µL of each sample into the graphite tube, and submitted to the temperature program. For sample measurement, there was no need to use a modifier, since a high pyrolysis temperature was allowed.

Phosphorus (P) determination in the three 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. A 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 was added, mixed, and allowed to stand for 3 minutes at room temperature, finally read in a colorimeter at wavelength 680 nm.

Determination of sodium (Na) and potassium (K) concentration in meat samples:

Sodium and potassium concentration in meat was determined by a flame photometer (Corning 400) as described by (Wootton 1974). Low Na and K standard solutions were prepared by dissolving 8.1, and 0.373 g of Na and, K respectively. High Na and K standard solutions 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 the light filter was adjusted to Na or K, then the power was connected, and the Galvanometer light was 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.

Zinc determination in the three samples of meat:

Zinc (Zn) concentration in meat was determined by the method described by (Varley 1967), 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. England.

- Stock zinc solution (1000 ppm): One gram of 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 standards Zn solution were prepared from the stock solution by dilution.

- Analysis procedure of Zn**:** 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 neubulizer 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 high energy state, i.e. excited atoms. The 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 the photomultiplier, an amplifier and finally gives the reading on the scale meter. Absorption of different concentrations 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. Diluted samples under test were aspirated in the machine exactly like standards and meat zinc concentration was then read.

Statistical analysis:

The collected data were subjected to statistical analysis by using a complete randomized design to analyze the results, and subjected to ANOVA followed by the least significant difference test using the (SPSS 2008) version, 17.

Results:

Table (1) and Figure (1) show the mean values (±SD) of calcium (Ca), phosphorus (P), sodium (Na), magnesium (Mg), potassium (K), copper (Cu), ferrous (Fe), and zinc (Zn) concentration in the camel meat, beef and sheep meat.

This study showed that there was significantly ($P< 0.01$) high difference in the mineral content between the three types of meat (camel meat, beef, and sheep meat). The calcium concentration apparently was a significantly high ($P< 0.01$) in the camel meat, beef, and sheep meat. Also, camel meat has a high amount of calcium concentration (10.5 mg/100gm) followed by sheep meat (8 mg/100gm) compared to beef (6 mg/100gm). There was a highly significant difference ($P< 0.01$) between the three types of meat. Also, camel meat has a high amount of phosphorus content as (209 mg/100gm) compared to beef (167 mg/100gm) , and sheep meat (205 mg/100gm).

The study showed that there was a significant ($P< 0.01$) difference in the sodium level between camel meat, beef, and sheep meat. Camel meat and sheep meat contained higher concentrations of sodium than of beef (117, 72, and 65 mg/100g), respectively. Moreover, the magnesium concentration showed more level in the camel meat and sheep meat than in beef (31, 28, and 25mg/100g), respectively. Also, there was significant difference ($P< 0.05$) between the meat samples in magnesium concentration. This study also showed that there was significant ($P< 0.01$) difference in the potassium level between camel meat, beef, and sheep meat. Also Potassium (K) contents were higher in camel meat, (380 mg/100g) compared to beef (358 mg/100g), and sheep meat (365 mg/100g).

Regarding the ferrous contents, there was a significant (P< 0.01) difference between camel meat, beef, and sheep meat. Ferrous (Fe) content in camel meat showed higher levels (4.58 mg/100g) followed by sheep meat (3.78 mg/100g), and beef (2.8 mg/100g). Copper concentration showed significant (P< 0.01) difference between camel meat, beef, and sheep meat. Concentrations of copper (Cu) in camel meat, beef, and sheep meat were (0.4; 0.26 and 0.24 mg/100g) respectively. Zinc concentration showed a significant (P< 0.05) difference between camel meat, beef, and sheep meat. Also, zinc (Zn) showed high concentrations level in camel meat (5.3 mg/100g) compared to beef (4.58 mg/100g), and sheep meat (4.0 mg/100g).

Table (1): Mean values (+SD) of some mineral's concentration of camel, beef, and sheep meat mg/100gm.

Parameters	Camel meat	Beef	Sheep meat	Standard Error (S E)	Level of significant
1. Calcium Ca	10.5^{a}	6^{c}	8^{b}	0.545	P< 0.01
2. Phosphorus P	209^{a}	167^{c}	205^{b}	0.355	P< 0.01
3. Sodium Na	117^{a}	65^{c}	72^{b}	4.243	P< 0.01
4. Magnesium Mg	31^{a}	25^{c}	28^{b}	1.261	P< 0.05
5. Potassium K	380^{a}	358^{b}	365^{b}	0.168	P< 0.01
6. Copper Cu	0.4^{a}	0.26^{b}	0.24^{b}	0.243	P< 0.01
7. Ferrous Fe	4.58^{a}	2.8^{c}	3.78^{b}	2.76	P< 0.01
8. Zinc Zn	**5.3^{a}**	**4.58^{a}**	**4.0^{b}**	**0.726**	**P< 0.05**

a, b and c = Means within the same row with different superscripts differ (P < 0.05) or (P< 0.01)

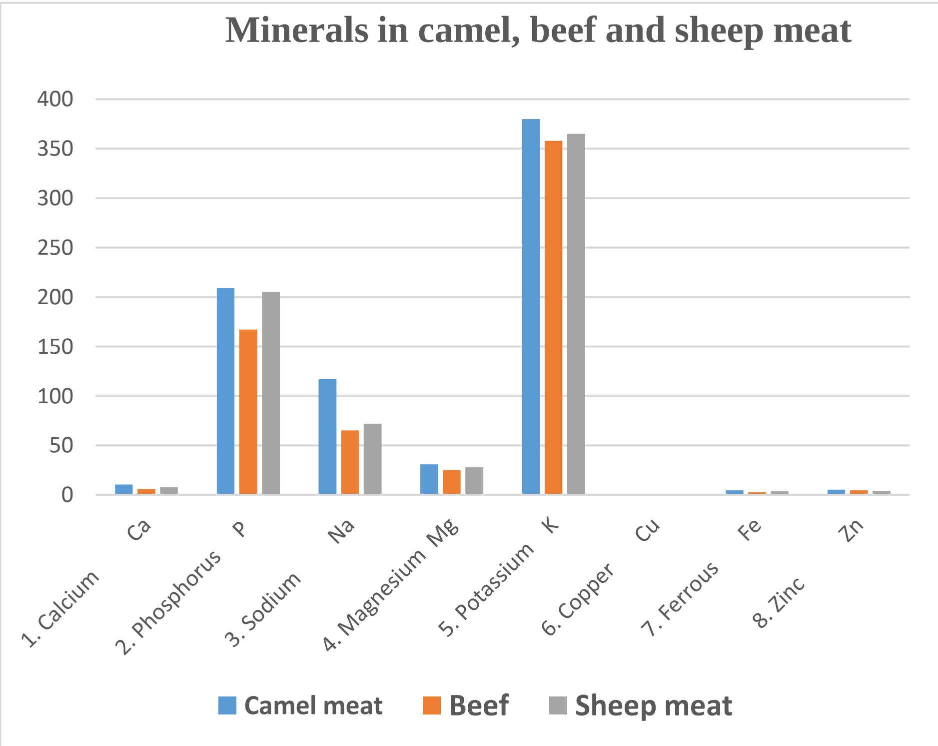

Figure (1): Mineral concentrations in camel, beef, and sheep meat

Discussion

The high minerals contents in camel meat compared to that in beef and sheep meat recorded in the present study disagree with the findings of (Gheisari et al. 2009) who mentioned that camel meat has similar minerals concentration as in beef. The results in this study showed that camel meat has a higher concentration of calcium (10.5 mg/100gm) than beef and sheep meat 6 and 8 mg/100gm respectively. The results in this study are more than the results of (Mohammad and Abubakar2011) who mentioned that calcium concentrations of camel meat to be ranging between 5.59 and 8.27 mg/100gm. Also the current results agree with those of (Kadim *et al*.2006) who reported that calcium concentrations in camel meat are 9.2 - 46.6 mg/100gm. However, the findings of this study were found to be higher than the results of (Gulzhan *et al.* 2013) who reported that the calcium concentration in camel meat was 5 mg/100gm. The finding of the present study was less than those reported by (Tariq *et al.* 2011) who stated that camel meat has a calcium concentration of 27mg/100gm whereas (Siham 2015) recorded a concentration of 12.56 mg/100gm. This study showed that the calcium concentration in beef was (6 mg/100gm) higher than that of Sadler et al. (1993); Sinclair et al. (1999); Nafiseh, et al. (2010) who stated that the calcium concentration in beef was 4.5mg/100gm. The results of the present study were found less than those stated by (Siham 2015) (11.36 mg/100gm) in beef. In this study, the concentration of calcium in sheep meat (8 mg/100 gm) was higher when compared to the values stated by (Sadler et al. 1993) who reported calcium concentration in sheep meat at 6.6, mg /100g.

In this study, the camel meat phosphorus content recorded (209 mg/100gm) was significantly higher ($P< 0. 01$) than that recorded by (Wan Zahari and Wahid 1985) as (155.5 mg/100gm) also more than that recorded by Siham (2015) (176.0mg/100gm). The results of this study were also less than the findings of (Kadim et al.2006) who stated that the phosphorous concentrations in camel meat ranged between 249.9 to 584 mg/100gm, (Gulzhan *et al.* 2013) who reported concentration of 229.0 mg/100gm and Tariq *et al.* (2011) who recorded 549 mg/ 100gm as concentration of phosphorus level in camel meat. The result recorded in this study found the phosphorus level in beef (167 mg/100gm) to be less than the values reported by Williams *et al*. (2007); Sadler et al. (1993), and Sinclair et al. (1999) who stated that the Phosphorus concentrations in beef was 215mg/100gm, also more than the results reported by Siham (2015) as (155.0 mg/100gm in beef). In the present study, the result revealed that the phosphorus concentration in sheep meat (205 mg/100gm) was less than the values stated by Williams et al. (2007), and Sinclair et al. (1999) who stated that phosphorus concentrations in sheep meat is 290 mg /100g.

The present study revealed that the camel and sheep meat contained higher concentration, of sodium than of beef (117, 72, and 65 mg/100g), respectively. These results were in line with the findings of Wootton (1974) who stated that the concentration of sodium in camel meat ranged from (104.7 to 257 mg/100gm), and Siham (2015) (114.4 mg/100gm). However, the result in this study was higher than the findings of Wan Zahari and Wahid (1985) who found the sodium concentration in camel meat to be 64 mg/100gm and less than the findings of Tariq *et al.* (2011) who stated that the sodium concentration in camel meat was 252mg/100gm. Sodium level in beef recorded in this study (65 mg/100g), was higher than the values reported by Sinclair et al. (1999), and Sadler et al. (1993) who stated that the sodium concentration in beef is 51 mg/100gm whereas it is less than the result reported by

Sadler et al. (1993) as (89.08 mg/100gm) regarding sodium concentration in beef. The results reported in this study regarding the sodium level in sheep meat (72 mg/100g), agree with the values reported by Williams *et al*. (2007), and Sinclair et al. (1999) who stated that sodium concentration in sheep meat is 71 mg /100g.

In the present study magnesium concentration showed more levels in camel, meat and sheep meat compared to that in beef (31, 28 and 25mg/100g), respectively. The result recorded in this study was higher than the findings of Wan Zahari and Wahid (1985) who stated that the magnesium concentration in camel meat was 19.7 mg/100g, and agrees with the result reported by (Kadim *et al*.2006) who stated that the magnesium content in camel meat ranged from 24.7 to 57.3 mg/100gm. Also this study revealed results less than those of Siham (2015) regarding the magnesium level in camel meat (90.16 mg/100gm). The present study showed higher contents of Mg compared with the results obtained by (Knoess 1977) (1.37 mg/100gram), and disagree with the results reported by (Gulzhan *et al*. 2013) who stated that the magnesium concentrations in camel meat were 251.0 mg/100gm. The results obtained in this study showed a lower concentration of Mg than that stated by Mohammad and Abubakar (2011) as (79.4 - 80.6 mg/100gm). Moreover, the magnesium concentration in this study revealed showed that beef had the same level as that reported by Sadler et al. (1993), and Sinclair et al. (1999) as (25 mg/100gm) in beef and less than the results of Siham (2015) (37.6 mg/100gm). In this study magnesium concentration in sheep meat (28 mg/100gm) agreed with the values reported by Sinclair (1999) who stated that Magnesium concentration in sheep meat was (28 mg /100g).

In this study potassium level showed highly significant difference (P< 0.01) between camel meat, beef, and sheep meat. The higher potassium (K) content in camel meat (380 mg/100g) compared to beef (358 mg/100g) and sheep meat (365 mg/100g) disagree with the results reported in the study of (Knoess 1977) who reported a potassium level in camel meat of 25.2 mg /100gram. The result obtained in this study was less than the result reported by Siham (2015) as (411.0 mg/100gm). The finding of potassium level in beef (358 mg/100g) was less compared to that reported by Williams *et al*. (2007); Sadler et al. (1993), and Sinclair et al. (1999) who stated that the Potassium concentration in beef is 363 mg/100gm. However, the result obtained here regarding the potassium level in beef showed higher concentration than the result stated by Siham (2015) (323.2 mg/100gm). The present result revealed fewer values of potassium levels compared to that reported by Williams *et al*. (2007).; Sadler et al. (1993), and Sinclair et al. (1999) who stated that Potassium concentration in sheep meat is (365 mg /100g).

Regarding the ferrous (Fe), the present study showed that there was significant difference (P<0.01) in the ferrous content between camel meat, beef and sheep meat. Ferrous content in camel meat showed higher levels (4.58 mg/100g) followed by sheep meat (3.78 mg/100g) and then beef (2.8 mg/100g). The present result showed that the camel meat contains more iron than beef which agrees with the result of Nafiseh, et al. (2010) who stated that the amount of iron was significantly higher in camel meat. Therefore, camel meat is considered as a better source of iron compared to beef. The result in this study is in line with the findings Wan Zahari and Wahid (1985) who stated that the ferrous concentration in camel meat was 4.3 mg/100gm; and more than the result of (El-Faer, et al. 1991) as (1.16 to 3.39 mg/100gm), and also more than that reported by (Knoess 1977) (0.03 mg /100gram).

However, the findings of this study were less than those of (Mohammad, and Abubakar 2011) who stated that iron concentration in camel meat is 5 mg/100gm and less than that of Siham (2015) (5.0 mg/100gm). The present result disagrees with the result reported by Tariq *et al.* (2011) who stated that ferrous concentration of the camel meat is around 16 mg/100gm. The present results disagree with the findings of Mohammad and Abubakar (2011) who stated that camel meat ferrous concentrations ranged between 78 - 156 mg/100gm. In this study it is shown that the iron concentration of beef (2.8mg/100gm), is in line with the result of (U.S.D.A 1986) as (2.72 mg/100gm). However, in this study it was higher than the result reported by Sadler et al. (1993); Sinclair et al. (1999), and (Williams *et al*. 2007) who reported the iron concentration in beef as 1.8 mg/100gm). Also, these study findings agree with Siham (2015) who reported Fe content in beef as (2.96 mg/100gm). The present result showed that the Fe concentration in sheep meat is 3.78 mg/100g, which is in line with the values reported by Williams *et al*. (2007); Sadler et al. (1993) and Sinclair et al. (1999) who found that ferrous concentration in sheep meat is (3.3 mg /100g).

In the present study, the results regarding the concentrations of copper (Cu) in camel meat, beef and sheep meat (0.4; 0.26 and 0.24 mg/100g), respectively, the results in this study agree with the results of the study of (Knoess 1977) who recorded content of camel longissimus muscle of copper to be 0.001 mg /100gram. In this study, Cu concentration in beef was 0.26 mg/100gm, which is in line with the values stated by Sadler et al. (1993), and Sinclair et al. (1999) who stated that the copper concentration in beef is 0.12 mg/100gm. In this study, the Cu concentration in sheep meat (0.24 mg/100g), agree with the values stated by (Sinclair et al. 1999) who stated that copper concentration in sheep meat is (0.22 mg/100g).

Zinc (Zn) concentration showed significant difference (P< 0.05) between camel meat, beef, and sheep meat. The high Zn concentrations level in camel meat (5.3 mg/100g) compared to beef (4.58 mg/100g)**,** and sheep meat (4.0 mg/100g) shown in this study disagree with the results stated by (Knoess 1977) who reported that zinc concentration in camel longissimus muscle was found to be 0.01 mg /100gram. In this study zinc concentration in beef (4.58 mg/100gm) was in line with the values stated by Sadler et al. (1993) as (4.6 mg/100gm). In this study zinc concentration in sheep meat (4.0 mg/100g) agrees with the values stated by Sadler et al. (1993)**,** and Sinclair et al. (1999) who stated that Zinc concentration in sheep meat is 3.9 mg/100gm.

Conclusion

The study showed that the mineral contents in camel meat were significantly higher (P< 0.01) in comparison with that in beef and sheep meat. Minerals (Ca, P, Na, Mg, K, Cu, Zn**,** and Fe) concentrations in camel *(Camelus dromedarius)* meat were significantly higher (P< 0.01) than those in beef, and sheep meat.

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تقييم تركيز المعادن في لحوم الإبل (*Camelus dromedarius*) ولحم البقر والأغنام (الضأن)

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الملخص

أجريت هذه الدراسة في جامعة السودان للعلوم والتكنولوجيا في كلية علوم وتكنولوجيا الإنتاج الحيواني ، بقسم علوم وتكنولوجيا اللحوم بغرض تقييم تركيز المعادن في لحم الإبل و البقر والأغنام من ذبائح مختلفة من الحيوانات الصغيرة. أوضحت الدراسة أن محتوى المعادن في لحم الإبل أعلى معنويا (P <0.01) مقارنة مع لحوم الأبقار والأغنام. يحتوي لحم الجمل على نسبة عالية من الكالسيوم (10.5مجم / 100 جم) مقارنة بلحم البقر (6.0 مجم / 100 جم) والضأن (8.0 مجم / 100 جم). الفسفور (P) في لحم الإبل ولحوم الضأن مرتفعًا مقارنةً بلحم البقر (209 ، 205 ، 167 ملجم / 100 جم) على التوالي. كما احتوت لحوم الإبل والأغنام على تركيز أعلى من المغنيسيوم مقارنة بلحم البقر (31 ، 28 ، 25 ملجم / 100 جم) على التوالي. فيما ارتفع تركيز الصوديوم في لحم البل (117 مجم / 100 جرام) مقارنة بلحم الأغنام (72 مجم / 100 جرام) واللحم البقري 25(65 مجم / 100 جرام). يحتوي البوتاسيوم (K) في لحم الإبل على تركيز عالٍ (380 مجم / 100 جرام) مقارنة باللحم البقري (358 مجم / 100 جرام) ولحوم الأغنام (365 مجم / 100 جرام). النحاس (Cu) في لحم الإبل ولحم البقر والأغنام (0.4 ؛ 0.26 و 0.24 مجم / 100 جم) على التوالي. أظهر مستوى الحديد وجود فروق معنوية عالية (P <0.01) بين لحم الإبل ولحم البقر ولحم الضأن. محتوى الحديد في لحم الإبل أعلى (4.58 مجم / 100 جرام) تليها لحم الضأن (3.78 مجم / 100 جرام) ولحم البقر (2.8 مجم / 100 جرام). واظهر الزنك فرق معنوي (P <0.05) بين لحم الإبل ولحم البقر ولحم الضأن. تركيز الزنك عالي في لحم الإبل (5.3 ملجم / 100 جم) مقارنة بلحم البقر (4.58 ملجم / 100 جم) ولحم الضأن (4.0 ملجم / 100 جم)

الكلمات المفتاحية: المعادن ، لحم الإبل ، لحم البقر ، لحم الضأن