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A Study of Cholesterol Concentrations of Camel Meat and Beef

Dr. Siham Abdelwhab Alamin Mohammed
College of Animal Production Science and Technology, Sudan University of Science and Technology, Khartoum - Sudan
Corresponding author email id: sihamlmn666@gmail.com ; Sihamlmn666@sustech.edu

Abstract **– This study was conducted in the College of Animal Production Science and Technology, Sudan University of Science and Technology to evaluate the chemical composition and cholesterol levels of fresh beef and camel meat, (*longissimus muscle* from different carcass of young animals). The chemical composition determined according to Association of Official Analytical Chemists methods (AOAC 2002) and cholesterol content by (HPLC method) the samples were analyzed in three different brands of these raw cuts in duplicate. The results showed that chemical composition of beef and camel meat were significantly different (P<0.05). Camel meat had higher moisture content compared to beef as (79.7, and 74.13%) respectively. Whereas beef had higher protein content as (22.08%) compared to camel meat as (19.25 %). Camel meat had the lowest fat content (1.54%) compared to beef as (2.74 %). However, camel meat had the highest ash content (0.88%) followed by beef (0.57%). The present result showed that the camel meat had lowest cholesterol content (57.56 mg/100gm) compared to beef as (74.5 mg/100gm) respectively. Chemically camel meat had low fat and cholesterol concentration which makes it an ideal healthy meat compared to beef. The differences in cholesterol concentration between studied muscles sample may be due to the variation in the content of intramuscular fat and the muscle fiber types. Also there was a variation between the muscles in the amount of fat and proportion of muscle fiber types.**

Keywords **– Camel Meat, Beef Meat, Chemical Composition, Cholesterol Level.**

I. INTRODUCTION

Sudan (formally the Republic of Sudan) is a country in northeast Africa, bordered to the east by Ethiopia and Eritrea, to the north by Egypt and Libya, to the west by Chad and the Central African Republic and from the south by the State of Southern Sudan. Meat consumption in developing countries has been continuously increasing from annual per capita consumption of 10 kg in 1960s to 26 kg in 2000 and expected to reach 37 kg in 2030 according to FAO projections (FAO, 2007). Meat is defined as the whole of the carcass of cattle, sheep, goat, camel, buffalo, deer, hare, poultry or rabbit (Williams, 2007). The Camel meat has been processed into burgers, patties, sausages and shawarma to add value. Future research efforts need to focus on exploiting the potential of the camel as a source of meat through multi-disciplinary research into efficient production systems, and improved meat technology and marketing. The demand for camel meat appears to be increasing due to health reasons, as it contains less fat as well as less cholesterol and relatively high poly-unsaturated fatty acids than other meat animal's (Zidan *et al*., 2000). On the other hand, goat meat is less preferred for its lower in tenderness and flavor compared to mutton and beef (Webb *et al.* 2005). Camel meat has been processed into burgers, patties, sausages and shawarma to add value. Future research efforts need to focus on exploiting the potential of the camel as a source of meat through multi-disciplinary research into efficient production systems, and improved meat technology and marketing. The dromedary camel meat is described as tough, coarse, watery and sweetish in taste compared to meats from beef. Gheisari *et al.* (2009) found no differences in moisture content between dromedary camel meat and meat from other species at a similar age and sex. Individual muscles from the same camel appear to have similar moisture contents. This may be partly attributed to the fact that camel meat is usually a by-product of primitive traditional systems of production. Recently more attention has been paid to the nutritional value of camel meat, with the aim of creating additional value for various camel meat products (Ulmer *et al*., 2004). Camel lean meat contains about 78% water, 19% protein, 3% fat, and 1.2% ash with a small amount of intramuscular fat, which renders it a healthy food for growing human population. Kadim *et al*. (2006) found that moisture content of the Dromedary meat decreases with the increase in the animal age. The differences between the maximum and minimum moisture contents of camel *Longissimus thoraces* were 3.2%, 6.4% and 12.3% for 1-3, 3-5 and 6-8 years age groups, respectively. Differences in muscle fiber types and intramuscular fat content have been reported to cause differences in cholesterol content of meat collected from different anatomical locations (Dinh *et al.,* 2011). Many researchers reported that ash content were varies with muscles and between muscles (Babiker and Yousif, 1990; Dawood and Alkanhal, 1995; Gheisari *et al*., 2009; Kadim *et al*., 2013). This supported the earlier reports of low cholesterol content of dromedary camel meat compared to beef and lamb (Elgasim and Elhag, 1992). The cholesterol content in dromedary meat increases with increasing animal age. It was 135 mg/100 g fresh weight for 8 months old vs. 150 mg /100 g fresh weight for 26 months old dromedaries). This is particularly important in regions breeding dromedaries where the eating habits and cooking styles are different from other regions and the use of animal fat in cooking is very common. The cholesterol levels in dromedary individual muscles were investigated by Kadim *et al.* (2014). 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 slaughtering dromedary for better meat quality. The Objective of this study was to determine the proximate analysis and cholesterol concentrations of beef and camel meat.

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II. Materials and Methods

The study was conducted at the laboratory 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 and the laboratory of Sudanese central Petroleum Labs in Khartoum State.

Meat Samples:

5 kg of fresh deboned from each types of meat (camel meat and calf meat (beef) were obtained from the Sudanese local market (The muscles samples from male camel at 2-3 years old and calf from 12-13 month old). Each muscle samples (*longismuss dorsi*) were freed from external visible fat and connective tissue. Meat Samples for chemical analysis were stored at 4°C till analysis (24 hrs.).

Determination of Chemical Composition (Proximate Analysis):

Determination of total moisture, ash, total protein and fat (ether extract) were performed according to Association of Official Analytical Chemists methods (AOAC, 2002).

Moisture Determination:

Moisture content was determined as weight loss of 5 gram of each meat sample (5 cm length and one cm thickness). The fresh samples were put in an oven at 100C° for 24 hrs. Consequently the samples were cooled in desiccators and their weights were determined as described by AOAC (2002).

$$\text{Moisture\%} = \frac{\text{Fresh sample weight-dried sample wt.}}{\text{Fresh sample weight}} \times 100$$

Crude Protein Determination:

Kjeldahl method was used to determine the nitrogen content of the meat samples. The crude protein was determined by multiplying the amount of nitrogen times 6.25. The formula used for calculation of Nitrogen content was:

$$\text{Nitrogen content \%} = \frac{\text{Tv x N x 14 X 100}}{\text{Weight of sample}} \times 1000$$

Where:

TV = Actual volume of HCL used for titration.
N = Normality of HCL.
14 = Each ml is equivalent to 14 mg nitrogen.
1000 = To convert from mg to gm.
6.25 = Constant factor.
Protein content % = Nitrogen content%×6.25

As described by AOAC (2002).

Fat Determination:

Fat level in the meat samples was determined by ether extract. Five gram from each Sample was taken to soxhlet apparatus. The samples were subjected to continuous extraction with ether for 5 hrs. The samples were then removed from the extractor and allowed to dry for 2 hrs. at 100C° in drying oven till no traces of ether remained. The calculation was as described as follows:

$$\text{Fat \%} = \frac{\text{Fat weight}}{\text{Sample weight}} \times 100$$

As described by AOAC (2002).

Ash Determination:

Five gram of the meat samples after fat extracting (fat free samples) were placed into dried crucible of known weight. The crucible was placed inside a muffle furnace at 150C°. The temperature was increased gradually till it reached 600C° for 3 hrs. Then the crucible was taken out, cooled into desiccators and weighed. The ash % was calculated by the following formula: as described by AOAC (2002).

$$\text{Ash\%} = \frac{\text{Weight of crucible before ashing-weight of crucible after ashing}}{\text{Sample weight}} \times 100$$

Determination of Cholesterol:

Total cholesterol concentration in the tow different types of meat (Camel meat and beef) were quantified by using high performance liquid chromatography (HPLC). HPLC has been used to separate cholesterol as described by the study of (Fenton 1992). Cholesterol by HPLC technique with a 25-cm Zorbax RX-Sil. Column (particle size of 5 µm). The compounds were detected with an ultraviolet (UV) detector at (202nm) for cholesterol. The column was made of ultra-clean porous silica micro particles. The mobile phase was 99% hexane and 1% iso-propanol. Most HPLC methods use the polar stationary phase column made of highly pure, porous silica micro particles (Ponte, *et. al.*, 2008) and Costa, *et. al*. 2006).

HPLC Adjusted to Determination the Cholesterol of Meat Samples:

Column: C18
T: 256
Solvent: CH_3 OH: H_2O (the ratio is 98: 2)
Flow rate: 1.5ml /min.
Cholesterol stock: 0.2 gm cholesterol/ 100ml CH_3OH

Preparation of Cholesterol Standard:

0.5 mg/100 ml methanol
1.0 mg/100 ml methanol
1.5mg/100 ml methanol
2.0 mg/100 ml methanol

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, 2008 version ,17).

III. Results

Table (1) and figure (1) shows the mean values (±SD) of chemical composition of camel meat and beef. The moisture content showed significant difference (P< 0.05) among the meat sample studied. Camel meat had higher moisture content (79.7 ± 0.7%) compared to beef (74.13 ± 0.8%). Protein content was highly significant difference

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(P<0.01) among the meat types. Beef had higher protein content (22.08 ± 0.4%) compared to camel meat (19.74 ± 0.6%). Fat content was not significantly different (P>0.05) among the meat samples used. However, the fat content of beef higher (2.74 ± 0.8%) compared to camel meat (1.54 ± 0.36%). Also Ash content was highly significant difference (P< 0.01) among treatments studied. Camel meat had higher amount of Ash content (0.88 ± 0.56%) compared to beef (0.57 ± 0.13%). The cholesterol content of the two species showed high significant difference (P< 0.01) among the meat sample used. Camel meat had significantly lower cholesterol content (57.56 ± 4.66 mg/100gm) compared to beef (74.50 ± 6.73 mg/100gm).

Table 1. Mean values (±SD) of chemical composition of camel meat and beef.

Meat type / Parameters	Camel meat	Beef	Significant level
Moisture %	79.7 ± 0.70[a]	74.1 3 ± 0.85[c]	*
CP %	19.74 ± 0.67[b]	22.08 ± 0.44[a]	**
Fat %	1.54 ± 0.36	2.74 ± 0.80	NS
Ash %	0.88 ± 0.56[b]	0.57 ± 0.13[a]	**
Cholesterol (mg/100gm)	57.56 ± 4.66[b]	74.50 ± 6.73[a]	**

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 super--scripts differ (P < 0.05).

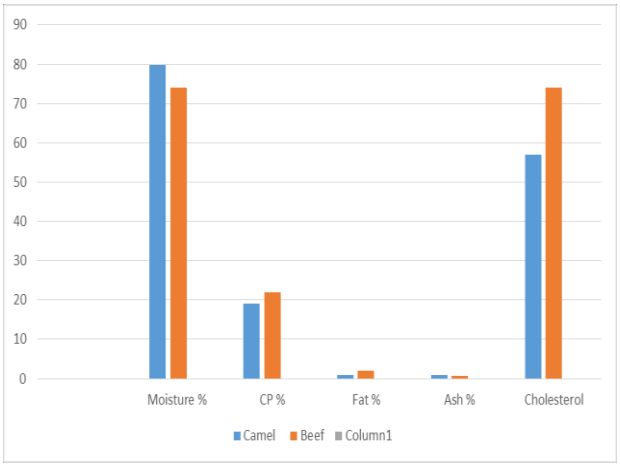

Fig. 1. Mean values (± SD) of chemical composition of camel meat and beef.

IV. Discussion

In this study the moisture concentration was significantly different (P< 0.05) among the two different types of meat. Camel meat had higher moisture content compared to that of beef meat. The moisture content of camel meat was (79.7 %) and this agrees with the results reported by Dawood and Alkanhal, (1995), Al-Sheddy *et al*., (1999), Al-Owaimer, (2000); Kadim *et al.*, (2006), and Siham (2008) who reported a value ranging between (70 and 77%). The moisture content of beef in this study was (74.3%). This finding was lower than the value reported by Agranosa and Bandian, (1978) who reported moisture content of beef as (74.2%). The result in this study agrees with the findings of Mohammed, (1993) who reported that the chemical composition of camel meat and beef were not significantly different but the camel meat score was higher in moisture content compared to beef. Kadim *et al*. (2006) found that moisture content of the Dromedary meat decreases with the increase in the animal age.

The protein concentration showed high significant difference (P< 0.01) among the two types of meat. Beef had higher protein content as (22.08%) compared to that of camel meat as (19.74%). The protein content in camel meat was (19.74%), the result in this study was almost in line with the findings of Mohammad and Abu-Bakr, (2011) as (19.25%) and in line with the result of Adim *et al*., (2008) as (19%). The protein content in beef was (22.08%), this result was less than that stated by (USDA, 2001) as (25%) and higher than the findings of Lee, (2012) as (17.4%).

The fat content in this study showed no significant difference (P>0.05) between camel meat and beef meat. Fat content was (1.54%) in camel meat which was in line with the findings of Zamil El-Faer *et al*., (1991) as (1.2 - 1.8%), and Kadim *et al*., (2006) as (1.1 - 10.5%). The fat concentration in beef was (2.74%). This result agreed with the result reported by (Sadler *et al.,* 1993 and Williams, *et al.,* 2007) as (2.8%).

The ash concentration in this study was highly significant difference (P<0.01) among the two types of meat. In this study Camel meat had the highest ash content as (0.88%) compared to beef (0.57%). The ash content of fresh camel meat was (0.88%) which was in line with the result found by Gulzhan *et al.,* (2013) as (0.9%) and Nasr *et al*., (1965) who reported that the ash content in fresh camel meat as (0.76 - 0.86%). Also in this study the ash content of beef was (0.57%), this result agreed with the findings of IJFSN, (2010) who reported that the ash content in fresh beef meat as (0.9%). Tornberg, (2005) stated that the muscle consists of 75% water, 20% protein, 3.5% fat and 2% soluble non-protein Substances. Many researchers reported that ash content were varies with muscles and between muscles (Babiker and Yousif, 1990; Dawood and Alkanhal, 1995; Gheisari*et al*., 2009; Kadim *et al*., 2013).

The cholesterol concentration in this study was highly significant difference (P<0.01) among the two types of meat. In this study camel meat had lower cholesterol content as (57.56 mg/ 100 gm) compared to beef as (74.50 mg /100 gm). The result in this study agrees with the findings of Siham (2015) who reported that the cholesterol concentration in the camel meat, beef and goat meat was highly significant (P< 0.01) different, and the camel meat had lower cholesterol concentration (59.2 mg/100gm) compared to that of beef and goat meat as (73.6 and 71.2 mg/100gm) respectively. These results were similar to that reported by Elgasim and Elhag, (1982). Also the result in this study in line with the result reported by Fallah *et al*., (2008) and Kadim *et al*., (2009) who found that the camel meat was leaner than beef. The chemical composition of meat is influenced by different factors such as species,

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breed, age, and lower fat content compared to mutton and beef. The result in this study agrees with that reported by Elgasim and Elhag (1982) who stated that the cholesterol concentration in camel meat was noted to be lower than that of beef. This supported the earlier reports of low cholesterol content of dromedary camel meat compared to beef and lamb as reported by (Elgasim and Elhag, 1992). The cholesterol content in dromedary camel meat increases with increasing animal age. It was 135 mg/100 g fresh weight for 8 months old vs. 150 mg /100 g fresh weight for 26 months old dromedaries). This is particularly important in regions breeding dromedaries where the eating habits and cooking styles are different from other regions and the use of animal fat in cooking is very common. The cholesterol levels in dromedary individual muscles were investigated by Kadim *et al.* (2014). 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 slaughtering dromedary for better meat quality.

V. Conclusion

Chemically camel meat had low fat and cholesterol content compared to beef meat which makes it an ideal healthy meat.

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