

A Study of the Protein Fractionation and Cholesterol Concentration of Camel Meat, Sheep Meat and Goat Meat

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Abstract - The present study aimed to evaluate the Protein Fractionation and Cholesterol concentration of meat taken from fresh Camel meat, Sheep meat and Goat meat. This study was conducted in the College of Animal Production Science and Technology, Sudan University of Science and Technology. In this study longissimus dorsi muscle from different carcass of young male animals was used to analysis. The protein fractionation determined according to Ornstein & Davis (1964). The cholesterol concentration determined by (HPLC method has been used to separate cholesterol as recorded by Costa, et. al. (2006) and Fenton (1992). The samples were analyzed in three different brands of these raw cuts in duplicate. The result in this study showed that there were highly significant differences ($p < 0.001$) in cholesterol levels between camel meat, sheep meat and goat meat. However the Camel meat had significantly lower cholesterol concentration as (57.67 mg/100g) compared to sheep meat (75.53 mg/100g) and goat meat (70.44 mg/100g). Also sheep meat revealed the highest level of cholesterol compared to camel meat and goat meat. The study showed that the Myofibrillar proteins, Sarcoplasmic proteins and non-protein-nitrogen were not significantly ($P > 0.05$) different among the three types of meat, The study showed that the Myofibrillar proteins of the meat samples were slightly similar between the three meat samples As 5.62%, 5.5% and 5.23% in camel meat, sheep meat and goat meat respectively. However sarcoplasmic proteins were higher in camel meat (11.69%) compared to sheep meat (11.50%) and goat meat (11.32%). Also the study showed that the non-protein-nitrogen was higher in camel meat (2.45%) and sheep meat (2.33%) compared to that in goat meat (1.75%). However the goat meat appears the lowest value of non-protein-nitrogen compared to that in camel meat and sheep meat. Chemically camel meat had low cholesterol concentration which makes it an ideal healthy meat. Goat meat has been evaluated as a lean meat with favorable nutritional quality.

Keywords: cholesterol, myofibrillar protein, sarcoplasmic proteins, non-protein-nitrogen.

I. INTRODUCTION

Meat is composed of higher concentration of proteins which includes the “structural proteins such as myofibrillar protein, sarcoplasmic proteins and proteins that are present in connective tissue such as collagen and elastin (Pighin *et al.*, 2016). Several factors affected in the chemical and physical properties of the meats as the type, size, sex and physiological status as well as sexual maturity and nutrition.

Meat consumption in developing countries has been continuously increasing from a modest average annual per capita consumption of 10 kg in the 1960s to 26 kg in 2000 and will reach 37 kg around the year 2030 according to FAO STAT (2012) projections. Meat is defined as the whole of the carcass of cattle, sheep, goat, camel, buffalo, deer, hare, poultry or rabbit (Williams, 2007). Quantatively and qualitatively meat and other animal food are better sources for high quality protein than plant food, for its richness in essential amino acids and organic acids that cannot be synthesized in human are available in well balanced proportions and concentration. The dromedary is an important domestic animal in various countries for producing valuable milk and meat and for its adaptation to extremely harsh environment the dromedary camel meat is described as tough, coarse, watery and sweetish in taste compared to meats from beef. This may be partly attributed to the fact that camel meat is usually a by-product of primitive traditional systems of production where it is mainly obtained from old camels that have become less effective in their primary roles of providing milk, racing, or as breeding female (Kadimet *et al.*, 2008). It can survive on sandy terrain with poor vegetation and may chiefly consume feeds unutilized by other domestic species (Tandonet *et al.*, 1988). 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 (Zidanet *et al.*, 2000). 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). 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). Goat

meat has been established as a lean meat with favorable nutritional quality and it is considered an ideal choice of the health-conscious consumer (Correa, 2010). Furthermore goat meat is preferred in most African and Asian countries for its taste, higher lean ground, due to the high price of beef and mutton, coupled with low incomes. Kurtu, (2004) stated that camel meat regarded as a high quality food with medicinal value, economically and environmentally adaptable alternative source of meat. Morton, (1984); Fallahet *al.*, (2008) and Kadimet *al.*, (2009) reported that camel meat is in fact leaner than other red meat, has fewer calories and is low in cholesterol. Beserraet. *al.*, (2004) reported that cholesterol concentration of goat meat was affected by goat genotypes. Park *et. al.*, (1991) reported that fat and cholesterol concentration in goat meat were influenced by dietary calcium, breed and type of tissue. Pratiwiet. *al.* (2007) reported that the cholesterol content of goat meat is associated with its fat content, which means that fattier meat contains more cholesterol than leaner meat. Park *et. al.* (1991) stated that cholesterol content of goat meat ranging from (58 to 70 mg/100gm). Meat and meat products are important sources of dietary cholesterol and saturated fat. The consumption of meat products naturally increases serum total and LDL (low-density lipoproteins) cholesterol levels (Park, *et. al.*, 1991; Chizzolini, *et. al.*, 1999 Wahrburg, *et. al.*, 2002). However, it should also be noted that some studies conflict with the direct correlation between the consumption of red or processed meat and cardiovascular disease (Wagemakers, *et. al.*, 2009; McAfee, *et. al.*, 2010; O'Connor, *et. al.*, 2017). It is difficult to establish if cholesterol content of fresh meat has significantly changed in recent years due to the decrease in intramuscular fat content. If a hypothesis can be put forward, it is that cholesterol content might have decreased a little in low-fat animals since genetic selection and some metabolic modifiers have changed the balance between red and white muscles. Indeed, the search for fast growth has produced animals with hypertrophied muscles, especially those of the loin, the hind limb and the breast which are rich in white fibers (Monin, *et. al.*, 1991 and Sainz, *et. al.*, 1997). Average cholesterol contents of the main meat species as reported by Chizzolini *et al.* 1999 Cholesterol in Veal (muscles) 70.00 and in Mutton 70 and in lamb 75mg/100gm. The result is protein denaturation that affects the technological properties of meat. Changes in myofibrillar proteins have a great influence on the texture and other properties of meat and meat products (Matarneh, *et. al.* 2017). Several techniques are used to analyse myofibrillar and sarcoplasmic proteins in meat. Polyacrylamide gel electrophoresis (PAGE) is often used for protein separation (Sørensen, *et. al.* 1999). New technical solutions, transferred from high-performance liquid chromatography (HPLC) instruments, enabled the development of high-performance instruments, such as high-

performance capillary electrophoresis (HPCE). HPCE is a modern analytical technique based on the principles of classical electrophoresis and chromatographic performance (Weinberger, (2000). Cholesterol values in goat meat ranged from 61.5 to 76.1 mg/100 g (Table 1). These values were similar to those reported by Feeley *et al.* (1972) and Kühne (1977), in tables of food composition and by Reiser (1975) and Park *et al.* (1991) for Alpine and Nubian goat kids. The cholesterol levels in dromedary individual muscles, they stated that differences in cholesterol contents between dromedary individual muscles might be due to variation in the amount of intramuscular fat and/or muscle fiber types. There was a variation between the muscles in the amount of fat and proportion of muscle fiber types these results were investigated by Kadim *et al.* (2014). Myofibrillar fragmentation index of camels above 6 years was lower than 1-3 years of age (Kadim *et al.*, 2008, 2009a). Sheep and goats make an indispensable contribution to food, agriculture, and rural development in many parts of the world particularly in Sub-Saharan Africa (Green, 1986 and Kitalyi, *et. al.* 2015). Sheep meat is one of the major red meats consumed globally, both as a key component in the diet of some countries, and as a niche meat product in others. Sheep meat is widely consumed around the world even though it is currently considered by some as a niche product in developed countries. The protein in muscle can be broadly divided into those which are soluble in water or dilute salt solutions (the sarcoplasmic proteins), those which are soluble in concentrated salt solutions (the myofibrillar proteins) and those which are insoluble in the water or salt (Shimada, *et al.* 2004). Babiker, (1988); Siham (2008) reported that camel meat had lower sarcoplasmic protein content. In broad sense the composition of meat can be approximate to 3.5% soluble non-protein substance (Lawrie, 1991). Siham, (2008) stated that myofibrillar protein solubility was highly correlated with tenderness as determined by shear and panel measurements. Zaglul and Cassen, (1987) reported that two structural components have been shown to determine the tenderness of meat, namely the collagen of connective tissue and the contractile apparatus of myofibrillar protein. According to Van Laack, (1999) the iso-electric point of myofibrillar proteins is around pH (5.0 to 5.1), readings above and below this pH value was result in myo-filament repulsion due to negative or positive net charges of ions. The rate of pH decline affects the rate of sarcoplasmic protein degradation. The sarcoplasmic proteins were precipitate into the myofibrillar protein fraction and cause a decrease in the myofibrillar protein's ability to bind to water. Myofibrillar proteins are the meat proteins responsible for functional characteristics. The role of myofibrillar proteins in texture, water retention, gelling and tenderness of processed muscle food has been reviewed recently by Xiong (1994). Sarcoplasmic proteins are to some

extent capable of positively influencing these properties of myofibrillar proteins (Grabowska and Sikorski 1976, MacFarlane *et al.* 1977, Kijowski and Niewiarowicz 1978a, b).

The Objectives of this study are to evaluate the Protein Fractionation and Cholesterol concentration of meat taken from fresh Camel meat, Sheep meat and Goat meat.

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.

Meat samples:

3 kg of fresh deboned from each types of meat (camel meat, sheep meat and goat meat) was obtained from the Sudanese local Abattoir (slaughter house). The muscles samples from male camel at 2 - 2.5 years old and male sheep at 1-1.5 years old and male goat from 10 -11 month old).

Each muscle samples (*longissimusdorsi*) were freed from external visible fat and connective tissue. Samples for protein fractionation and cholesterol analysis were stored at 4°C till analysis (24 hrs.).

Cholesterol Determination:

The Total cholesterol concentration in the three different types of meat (Camel, beef and goat meat) were quantified using high performance liquid chromatography (HPLC). HPLC has been used to separate cholesterol 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% isopropanol. Most HPLC methods use the polar stationary phase column made of highly pure, porous silica micro particles

Ponte, *et al.* (2004, 2008) and Costa, *et al.* (2006).

HPLC adjusted to determination the Cholesterol:

Column	:	C18
T	:	256
Solvent	:	CH ₃ OH: H ₂ O (the ratio is 98: 2)
Flow rate	:	1.5ml /min.
Cholesterol stoc	:	0.2 mg cholesterol/ 100ml CH ₃ OH

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

Protein Fractionation:

Samples for protein fraction were trimmed of excessive subcutaneous connective tissue before mincing. All fractionation procedure was carried at 4°C. A 5 gram sample was weighed, put into a micro-bender jar maintained in an ice-bath and 50 ml of cold 0.03 M potassium phosphate buffer (pH 7.4) was added. The contents of the micro jar were blended at low speed for 5 minutes. After homogenization, the homogenate was transferred to 100 ml centrifuge tubes and centrifuged for 20 min. (35000 rpm). The supernatant was kept and the residue was re-suspended in another 50 ml of the same potassium phosphate buffer, homogenized and centrifuged as before. The supernatant was decanted and the two solutions obtained were combined and filtered through filter paper (Whatman No. 4) to remove fat and other particulate materials. This combined filtrate contained both sarcoplasmic proteins and non-protein nitrogen fractions. Sarcoplasmic proteins were determined on 1 ml sample of this filtrate using Biuret method (Gornal; Bardwell and David, 1949). About 30 ml sample was mixed with 10 ml of Trichloroacetic acid 20% (w/v) for 15 minutes and filtered through filter-paper (Whatman No. 1) to obtain non-protein nitrogen in the filtrate. Kjeldahl semi-micro method was used to determine the nitrogen content of this fraction which was then expressed as a percentage of fresh sample weight. The residue remaining from the extraction with phosphate buffer was extracted once with 50 ml of cold 1.1 M KI in 0.1 M potassium phosphate buffer (pH 7.4) using the same method of sarcoplasmic proteins extraction. After centrifugation at 35000 rpm for 20 min. the supernatant was filtered through glass wool and the filtrate was used for myofibrillar protein determination by Biuret method (Gornalet *et al.*, 1949). Bovine serum albumin was used as standard for making the calibration curve. The results were expressed as percentage of fresh met weight. For non-protein-nitrogen, 30 ml of sample from sarcoplasmic proteins were mixed with 10 ml trichloroacetic acid 20% (w/v) for 15 minute and filtered through filter paper (Whatman No. 1) to obtain non-protein-nitrogen in the filtrate. Kjeldahl semi micro method was used to determine the nitrogen content of this fraction, which was then expressed as a percentage of fresh sample weight. Sarcoplasmic proteins were extracted according to Paul *et al.* (1966) using pH 7.5 borate buffer and electrophoresed in polyacrylamide gel columns as described by Ornstein & Davis (1964).

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, and 2) shows the mean values (\pm SD) of cholesterol concentration of camel meat, sheep meat and goat meat. The result in this study showed that there were highly significant differences ($p < 0.001$) in cholesterol levels between camel meat, sheep meat and goat meat. However the Camel meat had significantly lower cholesterol concentration as (57.67 mg/100g) compared to sheep meat (75.53 mg/100g) and goat meat (70.44 mg/100g). Also sheep meat revealed the highest level of cholesterol compared to camel meat and goat meat. The study showed that the Myofibrillar proteins, Sarcoplasmic proteins and non-protein-nitrogen were not significantly ($P > 0.05$) different among the three types of meat, The study showed that the Myofibrillar proteins of the meat samples were slightly similar between the three meat samples As 5.62%, 5.5% and 5.23% in camel meat, sheep meat and goat meat respectively. However sarcoplasmic proteins were higher in camel meat (11.69%) compared to sheep meat (11.50%) and goat meat (11.32%). Also the study showed that the non-protein-nitrogen was higher in camel meat (2.45%) and sheep meat (2.33%) compared to that in goat meat (1.75%). However the goat meat appear the lowest value of non-protein-nitrogen compared to that in camel meat and sheep meat.

TABLE 1

Mean values (\pm SD) of some physiochemical composition of camel meat, sheep meat and goat meat

Parameters	Camel meat	Sheep meat	Goat meat	Significant level
Cholesterol (mg/100gm)	57.67 \pm 0.66 ^b	75.53 \pm 0.43 ^c	70.44 \pm 0.81 ^a	**
Myofibrillar protein%	5.62 \pm 0.27	5.5 \pm 0.23	5.23 \pm 0.55	NS
Sarcoplasmic protein%	11.69 \pm 0.35	11.5 \pm 0.21	11.32 \pm 0.54	NS
Non Protein Nitrogen %	2.45 \pm 0.26	2.33 \pm 0.32	1.75 \pm 0.21	NS

NS= no significant difference between means.**= highly significant difference between means ($p < 0.001$)

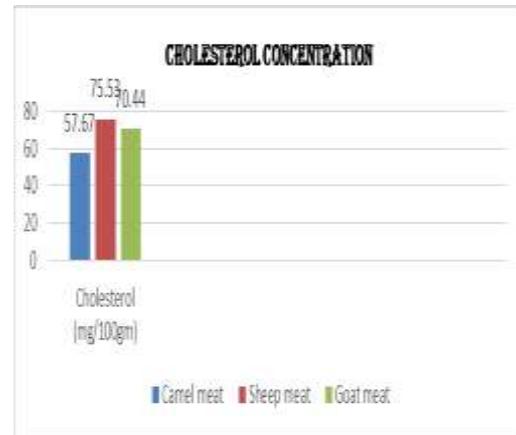


Figure 1: Mean values (\pm SD) of cholesterol levels in camel meat, sheep meat and goat meat

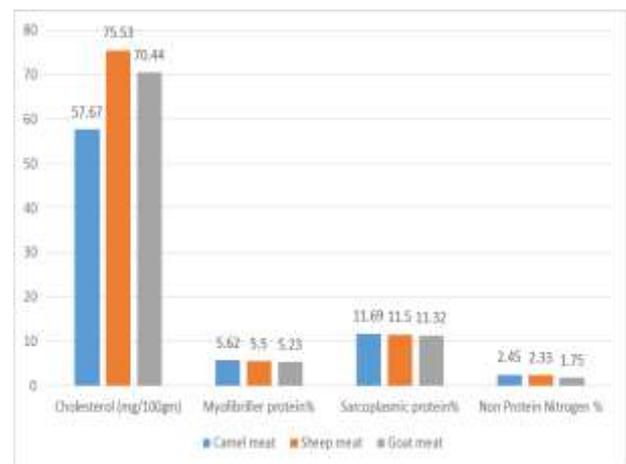


Figure 2: Mean values (\pm SD) of some physiochemical composition in camel meat, sheep meat and goat meat

V. DISCUSSION

The result in this study showed that there were highly significant differences ($p < 0.001$) in cholesterol levels between camel meat, sheep meat and goat meat. However the Camel meat had significantly lower cholesterol concentration as (57.67 mg/100g) compared to sheep meat (75.53 mg/100g) and goat meat (70.44 mg/100g). These results were similar to that reported by Elgasim and Elhag, (1982); Fallah et al., (2008); Kadim et al., (2009) who found that the camel meat was leaner than goat meat. The present result in line with that finding of Park *et al.*, (1991) who reported that goat meat cholesterol level range as (57.8 to 70mg/100gm). Also the result in this study was in line with Siham, (2015) who stated that the cholesterol concentration in camel meat was lower than that of goat meat. Also in this study sheep meat revealed the highest level of cholesterol compared to

camel meat and goat meat. Beserra *et al.*, (2004) reported that cholesterol concentration of goat meat was affected by goat genotypes. Kurtu, (2004) stated that camel meat regarded as a high quality food with medicinal value, economically and environmentally adaptable alternative source of meat. The result in this disagree with the result reported by Pond and Maner, (1984) and Potchoiba *et al.*, (1990) reported that goat meat cholesterol indicates levels of (76mg/100gm) compared to (70 mg/100gm) for lamb meat. The result in this study agreed with the finding of (Chizzolini, *et al.* 1999) who reported that the cholesterol content of raw meat and cooked meat and poultry products ranges from 40 to 90 mg/100g average cholesterol concentration of the main meat species. The result in this study in line with the result reported by Feeley *et al.* (1972) and Kühne (1977) who stated that the cholesterol levels in Veal muscles is 70.00mg/100g and in lamb is 75mg/100gm. Also the values in this study were similar to those reported by Kühne (1977) who found that the cholesterol values in goat meat ranged from 61.5 to 76.1 mg/100 g. This study showed that the Myofibrillar proteins, Sarcoplasmic proteins and non-protein-nitrogen were not significantly ($P > 0.05$) different among the three types of meat, The study showed that the Myofibrillar proteins of the meat samples were slightly similar between the three meat samples As 5.62%, 5.5% and 5.23% in camel meat, sheep meat and goat meat respectively. However sarcoplasmic proteins were higher in camel meat (11.69%) compared to sheep meat (11.50%) and goat meat (11.32%). Also the study showed that the non-protein-nitrogen was higher in camel meat (2.45%) and sheep meat (2.33%) compared to that in goat meat (1.75%). However the goat meat appear the lowest value of non-protein-nitrogen compared to that in camel meat and sheep meat. The result in this study was in line with the findings of Siham (2015) who reported that there was no significant difference between myofibrillar proteins in Camel meat and goat meat. The concentration of sarcoplasmic proteins found in this study agreed with a value reported by Babiker and Yousif (1989). The result in this study was in line with the findings of Siham (2015) who reported that there was no significant difference between myofibrillar proteins in camel meat and goat meat. Meat production from goat in Sudan is gaining new sex, anatomical location of muscle and nutrition (Lawrie, 1998). This result was a reflection of species differences in chemical composition of the muscles, as reported by Lawri (1979). Camel meat had more moisture and significantly ($P < 0.001$) less fat content than that of beef (Babiker and Tibin, 1985). However, there is no significant different in the concentration of myofibrillar proteins among the two muscles, the concentration reported in this study was in line with corresponding values reported by Babiker and Tibin (1985) for camel *L. dorsi* muscles.

VI. CONCLUSION

The present study demonstrates that there are differences in cholesterol levels in camel meat, sheep meat and goat meat. However camel meat and goat meat has a lower cholesterol levels compared to sheep meat. Also camel meat had low cholesterol level which makes it an ideal healthy meat.

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