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Study of Chemical Composition of Cattle Meat and Sheep Meat in Khartoum State

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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 investigate the chemical composition of beef and sheep meat (mutton) are marketed in Khartoum State, (longissimus muscle from different carcass of mature animals). The chemical composition determined according to the Association of Official Analytical Chemists methods (AOAC. 2007). The samples were analyzed in three different brands of these raw cuts in duplicate. The results showed that the chemical composition of beef and mutton was no significant difference (P> 0.05) between beef and mutton in the moisture and ash content. Also the study showed no significant difference (P <0.05) between beef and mutton in the protein and fat percentage. In this study beef had higher moisture content (74.83%) compared to mutton (73.25%). Whereas sheep meat (mutton) had higher protein content (18.61%) compared to beef (17.41%). In this study beef had the lower fat content (3.0%) compared to sheep meat (3.87%). However, the beef had the higher ash content (1.88%) compared to sheep meat (1.0%). Chemically beef had low fat concentration compared to sheep meat with favorable nutritional quality. Also in this study there was a decrease in moisture content by a significant increase in fat content.

Keywords: Cattle meat, Sheep meat, Chemical Composition, (protein, moisture, fat, ash).

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. Sudan is mainly an agricultural country with a large livestock population. Western Baggara cattle form the majority of Sudanese cattle representing about 80% and are of Zebu type (*Bosindicus*), Western Baggara cattle are considered as the main producers of the bulk of meat consumed in Sudan (Elkhalifa *et al.,* 1985).

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AAS (2012) estimated the beef production in the Sudan as (1286400.0 tons/year), the sheep and goat meat were estimated as (1286400.0 tons/year) and the camel meat as (511850.0 tons/year). Meat is defined as the whole of the carcass of cattle, sheep, goat, camel, buffalo, deer, hare, poultry or rabbit (Williams, 2007). The quality of sheep meat is defined by tissue composition, physical and chemical properties, chemical composition, nutritive value and sensory characteristics (Lambe *et al.,* 2009; Kaic *et al.,* 2012; Krvavica, 2012). Shorthose and Harris, (1991) stated that the perceptions of meat quality vary from country to country and between ethnic groups within countries. Williamson *et al.,* (2006) reported that lean red meat has a relatively low fat content, moderate in

cholesterol. According to (Peacock, 1985) in the Sudan camels represent an important national resource which is not properly managed for utilization. Quantitatively and qualitatively meat and other animal food are better sources of high quality protein than plant food. Shalash, (1979) stated that the percentage of protein, water, fat and ash contents of meat vary in different parts of the animal's body. Also, the age of the animal reflects on the composition of different meat components.

The chemical composition of meat is influenced by different factors such as species, breed, age, sex, anatomical location of the muscle and nutrition (Lawrie, 1998). Tornberg, (2005) stated that the muscle consists of 75% water, 20% protein, 3.5% fat and 2% soluble non-protein substances. Mills, *et al*., (1992) stated that the chemical composition of beef is 71.5, 22.5, 5.5 and 0.9 for moisture, protein, fat and ash respectively. Nesimi Aktas *et al*., (2003) reported that the proximate composition of beef was 21.26% protein, 76.56% moisture, and 1-3% fat. Meat and meat products are concentrated sources of high quality protein and their supply easily absorbed iron (Snijders, and Collins, 2004). Siham, (2008) reported that the chemical composition of beef has a moisture content of 70.47%.

Moisture in beef was estimated at 72.12% (Siham, 2015). The proportion of protein in beef was 70% (Siham, 2008). Protein content of beef 17.38% (Lee, 2012). Siham, (2015) reported that the protein in beef was 21.07% and the fat percent was 2.74%. Lee *et al*. (2008) noted that detailed information about these parameters in sheep and goat in the tropics, especially from traditional production systems is missing. Lawrie, (1991) reported that proximate chemical composition, of cattle meat contains an average of 75% moisture, 19% protein, 2.5% lipid and 3.5%soluble non-protein substances. Jamal, (2012) found that the fat percent in mutton 4.04%, ash percentage was 1.1% in beef but0.9% in sheep meat.

The *longissimus dorsi* muscle of sheep meat contains an average of 76.94 % water, 1.34 % fat, 19.45 % protein and 1.10 % ash. As reported by (Díaz *et al.,* 2020), the chemical composition, pH, water holding capacity, drip loss, color and texture of the meat were significantly influenced by the age of the capons. The meat of the youngest animals showed higher ash content, higher pH, and lower water holding capacity, higher drip loss, higher lightness and lower shear test values, than that of the older ones.Smith *et al.* (1970) reported that an increasing percentage of intramuscular fat was correlated with higher ratings for juiciness, tenderness and overall satisfaction in ovine primal cuts. Elshafie and Osman (1971) found that the fat percentage in the carcass of Western Baggara bulls ranged from 5.2 to 10.9. Prior *et al*. (1977) and Gregory *et al*. (1994) found that the decrease in moisture content was induced by a significant increase in fat content. The Objective of this study is to determine the chemical composition of cattle meat and sheep meat.

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.

Samples for Chemical analysis

Meat samples: 5 kg of fresh deboned from each type of meat (beef and sheep meat) were obtained from the Sudanese local market from Khartoum North. The muscle samples from male cattle at 2-3 years old and male sheep from 1-2years old. Each muscle sample (*longissimus dorsi*) was freed from external visible fat and connective tissue. Samples for chemical analysis were stored at 4^{o}C till analysis (24 hrs.).

Chemical composition (Proximate Analysis)

Determination of total moisture, ash, total protein and fat (ether extract) were performed according to the Association of Official Analytical Chemists methods (AOAC, 2007).

Moisture Determination

The moisture content was based on weight loss of 5 gm of the sample. The fresh muscle samples were put in an oven at 100^{o}C for 24 hrs. Consequently the samples were cooled in desiccators and their weights were determined. The moisture content was calculated according to the following equation:

Moisture %=	Fresh sample weight – dried sample weight / Fresh sample weight	X 100

Crude protein

Kjeldahl method was used to determine nitrogen; crude protein was determined by multiplying the amount of nitrogen times 6.25. The fresh meat sample was minced and 1gm was digested in Kjeldahl flask by adding mercury tablets as catalysts and 25 ml of concentrated H_2SO_4. The mixture was heated for 3 hrs. The digested samples were cooled and transferred to volumetric flasks. Nitrogen was distilled from the flask in the percentage of 40% NaOH solution and received in 4% boric acid. The mixture was titrated against 0.1 N HCl solutions. The formula used for calculation of crude protein was as follows:

Crude protein %=	Tv x 0.1 x 14 x 100 x 6.25
	Weight of sample x 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

Fat Determination

Fat was determined by the ether extract. Two gms from the sample were taken to Soxhlet apparatus. The sample was subjected to continuous extraction with ether for 5 hrs. The ample was then removed from the extractor and allowed to dry for 2 hrs. At 100^{o}C in drying oven till no traces of ether remained. The sample was then cooled and weighed for ether extraction percentage; the calculation was done using the following equation:

Fat%=	Fat weight	X 100
	Sample weight	

Ash Determination

Two grams of fat free sample were placed into dried crucible of known weight. The crucible was placed inside a muffle furnace at 150^{o}C. The temperature was increased gradually till it reached 600^{o}C and the sample was heated at that temperature for 3 hrs. Then the crucible was taken out, cooled into desiccators and weighed. The ash percentage was calculated by the following formula:

Ash %=	Weight of crucible before aching – weight of crucible after drying	X100
	Sample weight	

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).

RESULTS

Table (1) and figure (1) shows the mean values (±SD) of chemical composition of beef and sheep meat, the moisture content showed significant (P<0.05) difference between the meats samples used. This study was found that there were no significant differences (P> 0.05) between the two types of meat in moisture percentage. However beef had higher moisture content (74.83%) than sheep meat (73.25%). The study showed a significant difference (P <0.05) between beef and mutton in protein content. However sheep meat had higher protein content (18.61%) compared to beef (17.41%).

The study showed a significant difference (P <0.05) between beef and mutton in fat percentage. However, the fat content of sheep meat was higher (3.87%) compared to beef meat (3.0%). This study was found that there were no significant differences (P> 0.05) between the two types of meat in ash percentage. However the beef meat had higher amount of ash content (1.88%) compared to sheep meat (1.0%). In this study there was a decrease in moisture content by a significant increase in fat content.

DISCUSSION

This study showed no significant differences (P> 0.05) between beef and lamb in the moisture content. The result in this study found that the moisture content in beef was 74.83%. The result in this study is higher than the result of Siham, (2008) who found a moisture as 70.47% and higher than the result reported by Mills *et al*., (1992) as71.5%. The result in this study is less than the result of Lee (2012), which found that the moisture content in beef75%. As well as less than the result of IJFSN (2010), which reported that the moisture content of beef was 78.07%? In this study, the percentage of moisture in sheep meat is 73.25%, this result is higher than the result of Jamal, (2012), which reported that the moisture in sheep meat 65.5%. The result obtained in this study lower than the result of Zeljka, *et al.,* (2015) as 76.94%.

The study showed significant differences (P <0.05) between beef and mutton in protein content. In this study, we obtained a protein ratio of 17.41%.This result is agrees with the result of (Lee, 2012) which obtained a protein ratio in beef 17.38%. The result in this study less than the result of (Siham, 2008) which found the protein in beef as 20.5%, also less than the result of (Siham, 2015) as 21.07%. In this study, the protein content in mutton was (18.61%) this result agree with the result of (Shafiq, 1958), who found the protein in mutton as 18%. The result in this study was less than the result of Zeljka, *et al*., (2015) who found that the protein in mutton as 19.45%.

This study showed there was significant differences (P <0.05) between beef and sheep meat in fat content. In this study the percentage of fat in beef meat is 3.0% and this result is agreed with the result of (Lee, 2012), who reported that the fat percent of beef was 3.2%. It is also agree with the result of (Tornberg, 2005), who obtained a fat % in beef as 3.5%. The result in this study is higher than the result of (Hautzinger, 2007), who found fat in beef as 1.8%.

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

Parameters / Type of meat	Moisture	Protein	Fat	Ash
Beef	74.83±1.25	17.41± 0.44	3.00±0.11	1.88±0.24
Sheep meat (mutton)	73.25±1.33	18.61±0.59	3.87±0.19	1.00 ±0.29
Level of Significant	NS	*	*	Ns

NS = No significant differences
* = There is a significant difference

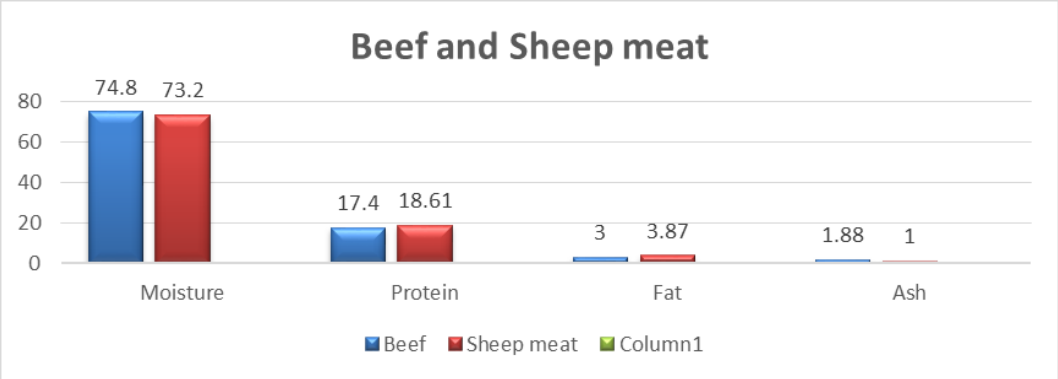

Figure 1. Proximate analysis of beef and sheep meat

The result is less than the result of (Siham, 2008), which obtained a fat ratio in beef 4.88%. In this study the proportion of fat in mutton is 3.87%, this result more than the result (Zeljka, *et al.,* 2015) who obtained a fat percentage in mutton as 1.34%, the result in this study disagree with the result reported by Elshafie and Osman (1971) who found that the fat percentage in the carcass of Western Baggara bulls ranged from 5.2 to 10.9. The result in this study showed no significant differences in the percentage of ash in beef and sheep meat. In this study, the percentage of ash in beef is estimated at 1.88%.

The result in this study was less than the result (Nora, 2009), which obtained a percentage of ash in beef 2.1%. The result of this study is higher than the result of Siham (2008), which obtained the percentage of ash in beef 0.92%and higher than Siham (2015), which obtained the percentage of ash in beef 0.47%. In this study, the percentage of ash in mutton was 1.00% and this result agrees with that reported by Zeljka, *et al.,* (2015) who obtained the percentage of ash in mutton as1.1%, and agreed with Muhammad, (2004), which obtained the percentage of ash in mutton (1%) and higher than its result (Yusuf, 2010), which obtained the percentage of ash in mutton (0.9%).

In this study there was a decrease in moisture content by a significant increase in fat content, these results agreed with Prior *et al*. (1977) and Gregory *et al*. (1994) who found that the decrease in moisture content was induced by a significant increase in fat content.

CONCLUSION

Chemically beef meat had low fat content which makes it an ideal healthy meat compared to sheep meat and evaluated as a lean meat with favourable nutritional quality.

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