Assessment of Moisture and Ash Content in Cattle meat, Sheep meat, Camel meat and Goat 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 moisture and ash content in meat of four different types of meat (cattle meat, sheep meat, camel meat and goat meat) which are marketed in Khartoum State. A total of 20 samples were randomly collected from the local market of Khartoum State (from Khartoum city abattoir). The result in this study showed that there were statistically significant differences (P< 0.05) observed in different types of meat. The results revealed that the average moisture content in cattle meat was (74.09%) which is lower than the mean moisture content compared to camel meat as (78.43%). Also the results revealed that the average moisture content in sheep meat (71.52%) and in which is lower than the mean moisture content compared to camel meat, cattle meat and goat meat (75.65%). The ash content in meat of all four types of meat were in a mean of 1.87, 1.04, 1.95 and 1.42% for cattle meat, sheep meat, camel meat and goat meat respectively. Statistically there were highly significant differences (P< 0.001) in average ash content in meat of these four different types of meat. Chemical components of meat varies according to the difference such as, animal species, age, breed, sex, feed and body weight. The percentage of naturally occurring water in meat varies with the type of muscle, the kind of meat, the season of the year, and the pH of the meat. In this study the sheep meat has the lowest moisture content followed by cattle meat, camel meat and goat meat.

Keywords: cattle meat, Sheep meat, camel meat, goat meat, moisture, ash,

I. INTRODUCTION

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 one of the richest Arab and African countries in livestock, where the number of food animals is estimated at 103 million heads (30 million cattle, 37 million sheep, 33 million goats, 3 million camels) In addition to 4 million head of the family, 45 million poultry and fish wealth estimated at 100 thousand tons of fisheries income and 10 thousand tons of marine fisheries, in addition to large numbers of wild animals (Wikipedia, October 2018). AlsoAAS (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).Moisture analysis involves the whole coverage of the food items in the world because foods are comprising a considerable amount of water rather than other ingredients. 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). Moreover, lamb meat presents higher polyunsaturated fatty acid (PUFA) content compared to beef and pork meat, which are important for human health (Wood, 1999). Siham, (2015) reported that the protein in beef was 21.07% and the fat percent was 2.74%. Chemical composition analysis of cattle meat revealed72% water, 4.4% ash, 6% fat, and 66.4%protein (Mahmud et al, 2011). The percent moisture content of beef (78.98±1.8 %) was higher than mutton (60.64±9.4%). The ash content was 1.11±0.3% in mutton and 1.10±0.1 for beef (Farhat, et. al.2014). As reported by Nagwa, et. al.(2018). The mean moisture, and ash content for for beef meat were 68.5 and 1.3 respectively. The sheep meat production have been increasing in the last years (FAO, 2017), and lamb meat is preferred by consumers due to milder flavor and greater softness than sheep meat (Pinheiroet. al., 2009).The meat of the youngest animals showed higher ash content, higher pH, and lower water holding capacity. Schonfeldt, et. al. (1993), reported that the consumption of lamb and mutton is relatively low in America and Europe where consumers prefer beef. Lee et al. (2008) noted that detailed information of these parameters in sheep and goat in the tropics especially from traditional production systems is missing. Jamal, (2012) found that the fat percent in mutton 4.04%, ash was 1.1% in beef but 0.9% in sheep meat.The longissimus dorsi muscle of sheep contains an average of 76.94 % water, 1.34 % fat, 19.45 % protein and 1.10 % ash. Schonfeldt, et. al. (1993), reported that the consumption of lamb and mutton is relatively low in America and Europe where consumers prefer beef. As reported by Nagwa, et. al.(2018) the mean moisture, and ash content for mutton were 73.4 and 1.1 respectively.

FAO, (1999) recorded the moisture content for beef and mutton meat are 74.7 and 76.4 respectively.The sheep 2.33%±0.29 has the highest ash content followed by the goat, the cow and the least was the camel's meat as content 1.17±0.29%. Camel meat contains(70 – 77%) moisture as reported by Al-Owaimer, 2000, Al-Sheddyet al., 1999, Dawood and Alkanhal, 1995; Kadimet al., 2006 and Siham 2008. Similarly (Raiymbek et al 2013) conducted a study in Kazakhstan and found that camel muscles contained 70-77% moisture and 0.9-1.1% ash. Kadim, et al., (2006) reported that the average moisture content in camel meat is about (64.4 % to 77.7%) irrespective of the different muscles or cuts. Babiker and Yosif, (1990) reported that the average moisture % was ranged from (75 - 89%), (75-81 %) and (75- 83%) in longismussdorsi muscles, semitendinosus and triceps brachia respectively. Zamel et al., (1992) stated that camel meat had higher moisture content (5-8%) more than beef. Babiker, (1988) and Siham, (2008)reported that camel meat contained more moisture compared to beef. Babiker and Tibin, (1986) reported that camel meat contains more moisture than beef (79.3%). Mohammed, (1993) reported that the chemical composition of camel meat and beef were not significantly different but the camel meat score was higher in moisture (69-73%). Dawood, (1995) reported that camel meat had highest percentage of moisture content (75-78%) while beef meat had lowest % (73-75%). number of authors reported ash content of camel meat to range between (1.05 and 1.60%) (Abdelbary and Muhammad, 1995; Paleari et al., 2003). Al- Owaimer, (2000) and Kadim et al., (2006) reported that ash content in camel meat ranged between (1.1% and 1.5%). EL-Gasim, and Alkanhal, (1992) stated that camel meat is lower in ash content than beef and had similar content of the element compared to beef. Mohammed, (1993); Suad, (1994); Kadima et al., (2006) and Siham (2008) reported that the average mean percentage of camel meat ash content is (1 - 1.1%). Owaimer, (2000) and Kadimetal., (2006) stated that ash content in camel meat was ranged between 1.1% and 1.5%.The chemical composition of the meat were significantly influenced by the age of animal. Camel meat is considered a healthy food; it contains 64.476.7% moisture and 11.4% ash, with lower level of cholesterol in edible meat tissue than other farm animals (Babiker&Yousif 1990; Kadim et al. 2008). Camel meat is considered a healthy food; it contains 64.476.7% moisture and 11.4% ash, with lower level of cholesterol in edible meat tissue than other farm animals (Babiker&Yousif 1990; Kadim et al. 2008). As reported by Nagwa, et. al. (2018) the mean moisture, and ash content for camel meat were 75.8 and 1.2 % respectively. The fat content of camel meat has a great effect on their moisture, cooking loss, drip loss and water holding capacity as reported by FAO, (1999) and Edris, (2013).Goat meat has less subcutaneous fat but more internal fat than sheep. The demand for sheep and goat meat is affected by seasonal factors.Goatmeat is preferred and comparable with other meats in respect to its moisture, protein and ash contents. Goat meat has been established as lean meat with favorable nutritional quality. The demand for goat meat has encouraged increased slaughter of breeding animals with a consequent erosion of the basepopulation in qualitative and quantitative terms (Devendra, 1988). In many developing countries, goat meat is relished and sought after although sheep and goat meat is perceived as low quality meat. Goat meat is one of the most important protein sources for people living in rural areas and is a high-quality protein source. It is leaner than other red meats and its fat is less saturated than that of other ruminants, there is a high demand for goat meat in the market due to its palatability, lower fat content, tenderness, and good flavor (Banskalieva, et. al., 2000).

The Objective of this study is to evaluate the moisture and ash content of cattle meat, sheep meat, camel 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.

a) Samples for Chemical analysis: Meat samples:

3 kg of fresh deboned from each types of meat cattle meat, camel meat, sheep meat and goat meat) was obtained from the Sudanese local market. The muscles samples from male cattle at 2-2.5year's old and male camel at 2-3 years old and male sheep from 12-14 month old and male goat 10-12 month old. Each muscle samples (longismussdorsi) were freed from external visible fat and connective tissue. Samples for chemical analysis were stored at 4oC till analysis (24 hrs.).

b) 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, 2007).

c) Moisture Determination:

Moisture content was based on weight loss of 5 gm of sample. The fresh muscle samples were put in an oven at 100oC 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

d) 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 150oC. The temperature was increased gradually till it reached 600oC 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 bythe following formula:

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

e) 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 moisture content of cattle meat, sheep meat, camel meat and goat meat. In this study the result found that there were significant differences (P< 0.05) between the four types of meat in moisture percentage. The moisture content in camel meat and goat meat had higher moisture content than cattle meat and sheep meat as 74.09, 71.52, 78.43 and 75.65% respectively. However the cattle meat had higher moisture content (74.83%) than sheep meat (73.25%). In this study the sheep meat has the lowest moisture content followed by cattle meat, camel meat and goat meat.

Table (2) and figure (2) shows the mean values (±SD) of ash content in meat. This study was found that there were highly significant differences (p< 0.001) between the four types of meat in ash percentage. The ash content in meat of all four types of meat were in a range of 1.87, 1.04, 1.95 and 1.42% for cattle meat, sheep meat, camel meat and goat meat respectively. However Camel meat had the highest amount of ash (1.95%) followed by cattle meat(1.87%) goat meat (1.42%)and sheep meat (1.04%) However the cattle meat had higher amount of ash content (1.87%) compared to sheep meat (1.04%).

Table (1): Average Moisture Percentage and Range in meat of cattle, sheep meat, camel meat and goat meat:

Parameter / Meat type	Minimum	Maximum	Mean	SE ±
Cattle meat	70.54	77.64	74.09,	±0.85^{c}
Sheep meat	68.5	73.63	71.52	±1.23^{b}
Camel meat	76.78	79.67	78.43	±0.62^{a}
Goat meat	73.54	77.75	75.65	±0.71 ^{b}
Significant level	*	*	*	

* = significant difference between the two means. (P< 0.05)

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

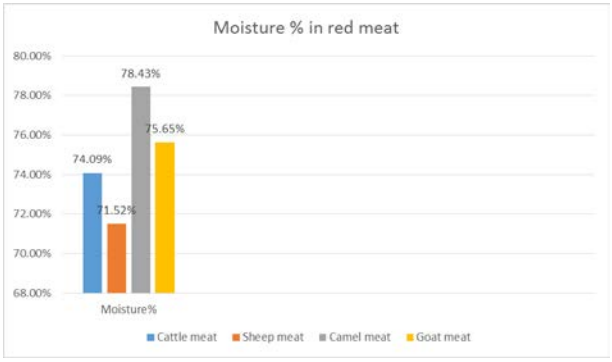

Figure (1): Average Moisture Percentage in meat of cattle, sheep meat, camel meat and goat meat

Table (2): The Average of Ash percentage and Range in meat of cattle, sheep meat, camel meat and goat meat:

Parameter / Meat type	Minimum	Maximum	Mean	SE ±
Beef	1.99	1.76	1.87	±0.13
Sheep meat	0.99	1.02	1.04	±0.39
Camel meat	2.02	1.87	1.95	±0.57
Goat meat	0.97	1.87	1.42	±0.32
Significant level	**	**	**	

** = There is a highly significant difference (P< 0.01)

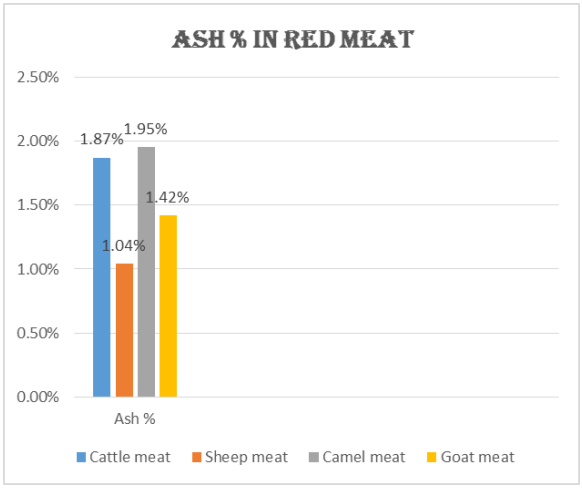

Figure (2): The Average of Ash percentage in meat of cattle, sheep meat, camel meat and goat meat:

IV. DISCUSSION

The present results showed that the moisture content was significantly (P< 0.05) different among different four types of meat. The moisture content in camel meat and goat meat had higher moisture content than cattle meat and sheep

meat as 78.43, 75.65,74.09 and 71.52% respectively. However the cattle meat had higher moisture content (74.83%) than sheep meat (73.25%). The moisture content of cattle meat in this study was (74.09 %). This finding was in line with the value reported by Arganosa and Bandian, (1978) who reported the moisture content of beef as (74.24%). However, the present result was lower than the result found by (IJFSN, 2010) as (75.7%) and Lee, (2012) as (78.07%). The present result was higher than the result reported by Sadler, et. al., (1993) ; Sinclair et. al., (1999) and Williams, et. al., (2007) as (73.1%). The present result was higher than the value of Siham, (2008) who reported the moisture content of beef as (70.47%). The result in this study agreed with the results reported by (Jiang, l998) who reported that the moisture content in muscle for cattle meat up to 76%, also the result in this study agreed with the results reported by (Abdel-Aal, et. al., 2008) Who reported that the moisture content in cattle meat is within the limits (57-77.1%).The present result was higher than the result reported by Nagwa, et. al. (2018) who reported that the moisture, and ash content for beef meat were 68.5% and 1.3% respectively.

In this study, the percentage of moisture in sheep meat is 71.52%, 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%. In this study the moisture content of goat meat was (75.65%). This result was higher than the findings of Schonfeldt, (1989) as (64.6- 65.4 %). Also the present result was higher than the result of Shijaet. al., (2013) who reported that moisture in goat meat as (70.65%) and higher than the result of Dhanda, (2001) who reported the moisture content of goat meat as (72.3%). On the contrary, the present result was lower than the findings of Arguelloet.al., (2004) who reported the moisture content in goat meat was (76.63%) andWattanachant, et al, (2008) who reported a value of (76.61%) in goat meat. Also lower than the value reported by Songklanakarin J. Sci., (2008) as (76.61 -78.6%).The result in the present study in line with the result reported by Mohammad, et al., (2010) who found the moisture content in goat meat ranging between (72.20 and 80.02). also the present result agreed with the result reporting by USDA, (2007) as (75.84%) and agreed with the result of Agranosa and Bandian, (1978) who reported that the moisture content in goat meat as (75.34%). The percentage of moisture in sheep meat in this study is (71.52%) which is lower than the result reported by (Al-Awimmer, et. al., 2003) who reported that the moisture content in sheep meat was 75.80% and agreed with the result reported by (Owen, et. al., 1986) who noted that the percentage of moisture in lamb meat was 72.90%. Also agreed with the result reported by (Al-Ani, 1999) who indicated that the percentage of moisture in the sheep was 72%. The result in this study less than that reported by Mahmud, et. al., 2011) showed that cattle meat contain 72% water and 4.4% ash. The present result agreed with the result reporting by Nagwa, et. al. (2018) who reported that the mean moisture, and ash content for mutton were 73.4% and 1.1% respectively.

In the present study the moisture content in camel meat was (78.43%), this result agreed with the results of Dawood and Alkanhal, (1995), Al-Sheddyet. al., (1999), Al-Owaimer, (2000); Kadimet. al., (2006), and Siham (2008) who reported a value ranging between (70 and 77%). The moisture content in this study was higher than that reported by Mohammed, (1993) who reported moisture content of (69 - 73%). Also the result of the present study showed similer value to that reported by Adimet. al. (2008) who reported the moisture content in camel meat as (78%). The present result was higher than the value reported by Gulzhan,et. al., (2013) who reported the moisture% in camel meat as (72.1%) and higher than the findings of Shehata (2005) who reported that Longissimus thoraces of camel meat had moisture content of (69.2%) and also more than the result of Tariq Mahmud,et. al., (2011) who reported that moisture in camel meat as (72.03%). Also the present result was higher than the result of El-Faer,et. al. (1991);Elgasim and Alkanhal, (1992) who reported the mean moisture content of camel meat as (76.82%). Also the result of this study agreed with the result of Mohammad and Abubakar, (2011) who mentioned moisture content in camel meat as (77.45%). The results of this study were slightly higher than that reported by IJFSN, (2010) who reported that moisture in camel meat as (76.7%) and higher than the result stated by Lawrie, (1979) as (75%). Similarly the result of this study was higher than the result of Hamman et al., (1962) as (76.2%) and higher than the result of Fakolade,et. al., (2006) who reported a moisture content value as (74.55%) for camel meat. The present result agreed with the findings of Nasr et al. (1965) who recorded the moisture in camel meat as ranging between (76.2-78.3%). The moisture content in this study was higher than the result recorded by Abdelbary and Muhammed, (1995) as (68.8 - 76.0%) for camel meat. The moisture content of camel meat in this study was higher compared to beef and goat meat; these results were in conformity with the findings of Gheisari, et. al., (2009). The results of this study were in line with corresponding value reported by Dawood, (1995) who reported that the camel meat had highest moisture content as (75-78%) where beef had lowest value as (73-75%). This may be due to the lower intramuscular fat of camel meat compared to beef and goat meat. This was similar to the statement of Stankovet. al. (2002) who reported that the decrease in moisture content in meat has been due to increase in fat content. The higher moisture content of camel meat compared to beef and goat

meat were in conformity with hose reported by Dawood and Alkanhal, (1995); El-Faer,et. al., (1991); Elgasim and Alkanhal, (1992); Kadim,et. al., (2006) and Siham, (2008) and Nagwa, et. al. (2018) who reported that the moisture, and ash content for camel meat were 75.8% and 1.2% respectively. The present result agreed with the findings of (Nnadozie, 2014) who reported that the sheep meat has the lowest moisture content followed by the cow, the camel and goat meat. FAO, (1999) recorded the moisture content for beef and mutton meat are 74.7 and 76.4 respectively. The obtained results are nearly similar to those obtained by Williams, 2007; Tariq et. al. 2013; Madruga, et. al. 2006 and Lijalem 2015. The fat content of camel meat has a great effect on their moisture, cooking loss, drip loss and water holding capacity as reported by FAO, (1999) and Edris, (2013).This study was found that there were highly significant differences ($p < 0.001$) between the four types of meat in ash percentage. The ash content in meat were in a range of 1.87, 1.04, 1.95 and 1.42% for cattle meat, sheep meat, camel meat and goat meat respectively. However Camel meat had the highest amount of ash (1.95%) followed by cattle meat (1.87%) goat meat (1.42%) and sheep meat (1.04%) However the cattle meat had higher amount of ash content (1.87%) compared to sheep meat (1.04%). In this study results showed the ash content of beef was (1.87 %), this result was higher than the findings of IJFSN, (2010) as (0.9%). Also the present result was in line with the findings of Ezekwe et al., (1997) who reported that the ash content in beef ranged between (0.98 and 1.6%). The present result showed that camel meat had higher ash content compared to beef. The result in this study was less than the result reported by Nora, (2009), which obtained a percentage of ash in beef as 2.1%. The result of this study is higher than the result of Siham (2008), which obtained the percentage of ash in beef as 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 agrees with that reported by Zeljka, et. al. (2015) who obtained the percentage of ash in mutton as 1.1%. And agreed with Muhammad, (2004), which obtained the percentage of ash in mutton (1%) and higher than the result reported by Yusuf, (2010), who obtained the percentage of ash in mutton as (0.9%).In this study the ash percent in camel meat is (1.95%) which was higher than the result found by Gulzhan,et al., (2013) who reported the ash% in camel meat as (0.9%) and higher to the findings of Nasr,et al., (1965) as (0.76 - 0.86%). The ash content in the present study slightly agreed to that reported by Babiker and Yousif, (1990) as (1.05%) and Abdelbaki, (1957) and Hamman et al. (1962); Owaimer, (2000); Kadim, et. al., (2006) and Siham, (2008) who reported value ranged between (1.0% and 1.4%). The present result was similar to the result reported by Adim et al., (2008) as (1.2%); Suaad, (1994) as (1.17%) and Abdelbary and Muhammad, (1995) and Palealiet al., (2003) as (1.05-1.60%). The present result was also agreed to that reported by IlJFSN, (2010) as (1.1%) and the value reported by Tariq et al., (2011) as (4.45%) and Abdelbary and Mohammad, (1995) and Palealiet al., (2003) as (1.05- 1.6%). The ash content in camel meat in this study was lower than that reported by Mohammad, and Abu-bakr, (2011) as (2.99%). The ash content in goat meat in this study was (1.42%), which is more than the result of Wattanachant, et al., (2008) as (0.45%) and Songklanakarin, (2008) as (0.45%). The ash content in goat meat was in line with the findings of Schonfeldt, 1989 and Henryk, et. al., (2008) as (1.06 - 1.08%) and USDA, (2007) as (1.11%). Also the result in the present study was in line with the findings of Dana, (2001) as (1.17%) and higher than the findings of Mohammad, et al., (2010) as (0.06%) and lower than the result reported by Shijaet. al., (2013) who found that the ash content in goat meat is (4.40 %).The result in this study agreed with the result reported bySiham, (2008) who showed that camel meat had higher ash content compared to beef and goat meat.The result in the present study was in line with the findings of Raiymbek, et. al. 2013) conducted a study in Kazakhstan and found that camel muscles contained 70 - 77% moisture and 0.9 - 1.1% ash. In this study the percent moisture content of cattle meat was higher than that of sheep meat (mutton) this result agreed with that reported by (Farhat, et. al.2014).The results of the current study agreed with the results reported by (Al- Hadithy, 2001) and (Suchy, et. al. 2002) who have suggested the amount of ash in the cattle meat of different species of animals was between (1- 0.8) %, but (Catalon , 1977) was reported that the percentage of ash in beef ranged (3.5-5)%. This ash ratio was in line with the result found by (Lyon, 1984) as showed that the percentage of ash in beef was 1.28%, but higher than the ratio found by (Lamkey, 1986), who stated that the percentage of ash in beef was 0.9%. The percentage of ash in sheep meat was (1.01 and 1.13) found that the ash content in fresh and frozen goat meat which studied by (Xiong, 1997).

V. CONCLUSION:

In this study the result found that the sheep meat has the lowest moisture content followed by cattle meat, goat meat and camel meat. Camel meat had the highest amount of ash (1.95%) followed by cattle meat (1.87%) goat meat (1.42%) and sheep meat (1.04%)

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