BRJ BASIC RESEARCH JOURNALS

Basic Research Journal of Agricultural Science and Review ISSN 2315-6880 Vol. 6(3) pp. 15-20 April 2018
Available online http//www.basicresearchjournals.org

Review

Camel meat consumption trends and its medicinal values: A review

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Accepted 13 April, 2018

ABSTRACT

Camels are the only means of people survival in tropics and extra tropics by providing meat, milk as a food where crop production is extremely difficult, and serving as sole source of power in area where motorized transportations is inadequate or unavailable. Currently, camel meat particularly has got especial places in the world due its uniqueness in composition and medicinal values as compared to other livestock meat. The meat of camel has especial characters, such as high protein with most essentials amino acids, vitamins and unsaturated fatty acids, low cholesterol and low saturated fatty acids. Moreover, its' intramuscular fat contents is low with advancement of age which is too special to render health for consumer. Therefore, camel meat is a most important medicine for the cure, prevention many diseases including hypertension and cancers which are currently many people life threatening diseases worldwide. Consequently, the number of camel slaughtered and amount of meat produced is increasing than ever.

Keywords: Camel: composition; meat; medicinal; value

INTRODUCTION

Camel is important livestock specie which plays a major role in pastoral mode of life by fulfilling basic demands of livelihood. They are even-toed ungulates in the genus with average life expectancy of 30 to 50 years (Khan *et al*., 2016). The animal belongs to the camelidae family, order of Artiodactyles and sub-order tylopoda (animals with padded feet) (Faye, 2015) lives in the vast pastoral areas of Africa and Asia (Farah, 1996). Camelus dromedary or one humped camels are found in Africa, Arabia, Iran, Afghanistan and India. Camelus Bactrian or two humped camel found in Central Asia, reaching up to Mongolia and Western parts of China (Patel *et al*., 2016). In many countries both species have been commercially exploited however, this utilization has been based on farmed camels, and has never been associated to the control of a wild population (Zeng and McGregor, 2008).

The total population of camel in the world is believed to be 25.89 million, of which 89% are one-humped dromedary camels (*Camelus dromedarius*) and the remaining 11% are the two-humped (*Camelus bactrianus*). Bactrian camels are generally found in the cold deserts of Asia, whereas more than 60% of the dromedary is concentrated in the arid areas of North East African countries (Faye, 2015). Occurrence in arid, semi-arid and tropical areas of developing countries where deprived nutrition and farming are the main flaws, inaccurate estimates of camel populations due to lack of regular census, underestimation of their contribution to

subsistence and the national economy are some of the reasons for this neglect (Faye, 2015).

The quality of camel meat has received little attention and is wrongly believed to be low in nutritive value and quality than other types of meat (Khadim *et al.,* 2009). These might happen due to shortage of information on camel meat characteristics or composition. Depth review has undertaken about camel milk composition, production and medicinal values by many scholars (Gizachew *et al*., 2014; Asresie and Yusuf, 2014; Kula, 2016; Levy *et al*., 2013). However, information about camel meat is not fully available. Therefore, updating available reality and compiling currently available research result about camel is very crucial.

In the Central African sub-region, camel meat production has been doubling during the past two decades, but only few investigations on the chemical composition and physical properties of this meat and their products have been published (Yam *et al*., 2016). Therefore, the current review was to document existing reality about camel meat composition, its eating values and current trends of camel meat production.

Camel meat production capacity and consumption trends

Meat and meat products are essential components in the diets of humans. The red meat production in Central Africa reached 277,414 tons in 2009 (FAO, 2013). Camels are good potential meat producers especially in arid regions where other meat-producing animals do not thrive. They grow well and yield carcasses of a comparable weight to beef cattle if optimal management conditions are provided. Camel meat is acceptable for human consumption and in some communities it may replace meat from other animals. Camel's produces large quantities of meat compared to other farm animals (Khan *et al*., 2016).

Camel can provide a considerable amount of high quality meat (Muhmud *et al*., 2011) In 2011, Africa produced 62.2% of the world camel meat followed by Asia (35.8%) while South America contributed 5.3% (Kadim *et al*., 2014). The average birth weight of camels is about 35kg, but it varies widely between regions, breeds and within the same breed. Male camels are slaughtered when they are 1-3 or even 4-5 years old, which is considered their best age for meat production. When the weight of a camel is between 350-700kg, they are good potential meat producers especially in arid regions, where other meat-producing animals do not thrive. Camels weighing live weights of about 650kg at 7–8 years of age can produce carcass weights ranging from 125 to 400kg with dressing percentage of 55% to 70% (Khan *et al*., 2016). At the age of 7 years a fattened camel can produce a carcass of about 260kg with meat: bone ratio of 3:1. Hence the camel as a meat source seems to present a viable alternative to cattle (Kadim *et al*., 2008).

The percentage of slaughtered camels has regularly increased since the year 1960 ranging from 5 to 7%. From 1961 to 2009, the camel meat production increased at a rate of 2.8% from 123,000 to 356,000 tons. Camel meat producers are more in Sudan, Egypt, Saudi Arabia or KSA (Kingdom of Saudi Arabia) and Somalia, But some of these countries products are mainly for export (Sudan, Somalia) though, KSA and Egypt are importers. In spite of the low contribution of camel to the world meat production, it is noticeable that the growth is higher than that of cattle, sheep and horse meat. Using the index of 100 in 1961, the index of meat production in 2011 was 448 for goat, 309 for buffalo, 285 for camel, 223 for cattle, 165 for sheep and 136 only for horse. The contribution of camel meat to the world meat production has less contribution among the herbivorous. Compared to all meat producing types (except fish), the camel meat represents 0.13% of the total meat produced in the world and 0.45% of red meat from herbivorous (Faye, 2015).

The demand for camel meat appears to be increasing due to health reasons (Muhmud *et al*., 2011). In recent years, camel meat has become increasingly available in many countries. As a result slaughter rate and consumption of camel meat has increased three times faster than that of cattle in some locality (Koussou and Amine, 2012). In the Central African sub-region, camel meat production has been doubling during the past two decades (Yam *et al*., 2016).

Camel meat composition

The quality of camel meat has received little attention and is wrongly believed to be of lower nutritive value and quality than other types of meat (Khadim *et al.,* 2009). However, the existing reality is opposite of what wrongly interpreted, opposite of what perceived by many society for long period. The nutritive contents of camel meat is of great medicinal value for human health, whatever the nutrient contents may be either high and low for given nutrients as compared to beef. As a fact, recently the peoples of world are turning its face toward camel meat consumption than ever before. As an example Koussou and Amine, (2012) reported three times increment of camel meat trade than that of the cattle in Chad.

Camel is a good source of meat in areas where climate adversely affects the production efficiency of other animals. Camel can provide a considerable amount of high quality meat (*Tariq et al.,* 2011). The nutritive content of the meat depends upon age, sex, carcass weight, the degree of fatness of the animals, the type of cut, the extent of cutting and trimming, and the methods

Table 1. Some nutritional contents of camel meat, beef and goat meat

Species	Parameter	Sources (Siham *et al.,*2015)
Camel	Moisture	77.92 ± 0.60
	Protein	19.78 ± 0.77
	Fat %	1.17 ± 0.26
	Ash	0.78 ± 0.47
	Cholesterol mg/100g	59.2±4.66
Beef meat	Moisture	72.12 ± 0.95
	Protein	12.07 ± 0.77
	Fat %	2.74 ± 0.80
	Ash	0.47 ± 0.03
	Cholesterol mg/100g	73.6±6.73
Goat	Moisture	75.55 ± 0.70
	Protein	20.32± 0.71
	Fat %	1.66± 0.17
	Ash	0.43 ± 0.02
	Cholesterol mg/100g	71.20±5.81

of packaging and storage (Kadim *et al.* 2013; Muhmud *et al.,* 2011).

Protein and amino acid

Proteins from meat have a high biological value, rich in lysine and are essential for the development of the organism. Meat is rich in fat and sugars (Tidjani *et al*., 2013). Meat is high in protein quality and low in cholesterol (Yam *et al.,* 2016). According to current finding the protein content of camel meat is in the range of 19.78±0.77% to 24.72 protein while its cholesterol (59.2±4.66) and fat (1.17 ± 0.26) is less than that of beef cholesterol (l73.6±6.73) and fat (2.74%) respectively (table 1). Low cholesterol is a especial property of camel meat for health of humans due to decreases in fat contents of meat with advancement of age. Camel meat is similar in taste and texture to beef. The amino acid and mineral contents of camel meat are often higher than beef, probably due to lower intramuscular fat levels (Kimassoum *et al*., 2016).

Camel meat has a comparable essential amino acid contents to beef, lamb and goat meat. The amount of camel meat required to supply the daily requirements of essential amino acids for adult consumer is similar to that from lamb (based on methionine which has the lowest content in meat) but is less than the amount required from beef (Kadim *et al.,* 2013). Essential amino acids contents of camel meat could vary among animal due to age, sex, and feeding management differences. As a result of different amino acid contents for the same muscle has been reported differently by different authors. For example, (Kadim *et al*., 2011) reported 2.9mg of methionine per100g for l*ongissimus thoracis muscle* whereas; (Dawood and Alkanhal, 1995) reported 2.2mg/100g. The amino acid and inorganic mineral contents of camel meat are high compared to beef due to the lower levels of fat content in the meat of the dromedary (Mulvihill, 2001; Kadim *et al.,* 2006). The most abundant essential amino acid in camel muscles was lysine, followed by leucine, phenylalanine, Isoleucine, threonine and methionine. Muscles from 6- to 7-year old camels had slightly higher insoluble collagen than those from 3- to 4-year-old camels according to the finding of (Ibrahim *et al*., 2017) shown in table 2.

Fatty acids

The fatty acid composition of meat is of great concern to consumers due to its important effects on human health. Reduction of saturated fatty acid intake is very important to prevent obesity, hypercholesterolemia and to decrease the risk of cancer (Chizzolini *et al*., 1999). The fatty acid profiles of camel meat show that oil has high content of palmitic acid and oleic acid and very low in arachidic acid**.** These two fatty acids are essential in humans. The camel meat contains low level of intramuscular fat and relatively high proportion of poly-unsaturated fatty acids (Kurtu, 2004). The proportion of polyunsaturated to saturated fatty acids which ranged from 1 .0 to 1.07 which was above the minimum ratio of 4.0 observed in camel meat recommended to reduce the risk of coronary diseases in humans**.**

Mineral composition

Minerals are generally classified as essential elements that are required for growth and health of human beings. Both deficiency and excessive intake of minerals which exceeds the safe limits can be detrimental to human health. Camel meat is comparable in mineral composition to beef except for potassium content. Camel and beef meat like other red meats contained higher levels of

Table 2. Amino acid and collagen content of different muscle of Sudanese dromedary camel at different age (Ibrahim *et al*., 2017).

	Muscles								
	LT		**ST**		**SM**		**BF**		**SEM**
	Age(year)								
	3-4	6-7	3-4	6-7	3-4	6-7	3-4	6-7	
Amino acids (mg/100 g)									
Lysine	8.31	8.59	8.94	9.01	7.91	7.84	8.66	8.98	0.811
Phenylalanine	6.88	6.76	4.88	4.73	5.01	4.99	4.98	4.99	0.679
Leucine	8.11	7.99	6.86	6.59	6.99	6.91	6.92	7.01	0.653
Histidine	4.00	4.13	3.77	3.81	4.14	4.21	3.77	3.87	0.453
Methionine	3.62	3.28	3.74	3.88	3.56	3.58	3.74	3.03	0.231
Isoleucine	5.79	5.76	5.13	5.33	5.67	5.97	5.13	5.01	0.278
Threonin	4.95	4.75	4.76	4.77	4.85	4.88	4.99	5.01	0.423
Tryptophan	0.77	0.79	0.75	0.73	0.71	0.67	0.71	0.088	
Valine	5.33	5.46	4.58	4.65	5.11	5.14	4.86	0.632	
Collagen(µg/g fresh tissue)									
Soluble	0.70	0.675	0.799	0.872	0.750	0.841	0.816	0.791	0.005
Insoluble	3.452	3.085	2.994	1.087	4.331	4.162	3.963	3.88	0.149

SEM: Standard error for the mean. Means in the same row with different superscripts are significantly different (P < 05); BF= biceps femoris; LT= longissimus thoraces; SM=semimembranosus muscles ST= semitendinosus

Table 3. Mineral content of different muscle of Sudanese dromedary camel at different age (Ibrahim *et al*., 2017).

	Muscles								
	LT		**ST**		**SM**		**BF**		**SEM**
	Age (year)								
	3-4	6-7	3-4	6-7	3-4	6-7	3-4	6-7	
Mineral (mg/100 g)									
Phosphorus	352	412	355	415	389	422	393	425	955
Calcium	13.3[a]	23.4[b]	14.1[a]	24.0[b]	14.4[a]	24.2[b]	13.6[a]	23.8[b]	12.87
Magnesium	37.1	41.5	34.9	44.4	35.6	43.8	35.9	40.2	4.25
Sodium	149	159	139	157	141	155	141	158	19.2
Potassium	797	833	751	845	778	859	759	849	32.1

SEM: Standard error for the mean. Means in the same row with different superscripts are significantly different (P < 05); BF= biceps femoris; LT= longissimus thoraces; SM=semimembranosus muscles ST= semitendinosus

Table 4. Mineral compositions of camel meat

Minerals (mg/100g)		**Sources**
	(Khan *et al*., 2016)	*(Muhmud *et al*., 2011)
Calcium	0.62	27
Magnesium	23.65	56.7
Phosphorus	0.56	549
Potassium	293	1008
Sodium	-	252

*=Mineral content of camel meat (dry weight, fat free basis).

potassium than the other minerals (Alkanhal, 1992). The current finding of (Kadim and Mahgoub, 2008) showed that camel meat is significantly lower in potassium content than beef meat whereas none significant between others minerals contents. But figuratively camel milk is higher in sodium and calcium and lower in magnesium, and phosphorus while all micro mineral composition of camel and beef meat are almost similar. A number of scholars reports showed that the variation in mineral content of camel meat. The variation in amount for a given composition might be due to variation in feed of animal consumed, age, sex, parts of meat studied and

breed differences. As an example Kadim *et al*. (2013) showed that variation in mineral composition between *Infraspinatus* (IS), *Triceps brachii* (TB), *Longissimus thoraces* (LT), *Semitendinosus* (ST), *Semimembranosus* (SM), and *Biceps femoris* (BF) muscles of the dromedary camel; whereas (Ibrahim *et al*., 2017) found increasing trend in minerals with age, particularly calcium concentrations indicated significant increases with increased age and none significant for others (table 3).

On other hands (Khan *et al*., 2016) study showed that high amount of potassium followed by sodium and magnesium which is similar with the finding of (Ibrahim *et al*., 2017) who studied camel muscle meat composition part by part (table 4).

Medicinal aspects of camel meat

Meat is a valuable source of food rich in many essential amino acids, minerals, vitamins and bioactive compounds such as carnosine, anserine, glutathione and essential fatty acids such as Omega 3 fatty acids (Schönfeldt and Gibson, 2008). Apart from the nutritional value of meat, it provides several eating attributes that normally are not achieved by other protein sources. Beef, lamb, pork, poultry and fish are considered the major sources of animal protein worldwide (Kadim *et al., 2013).*

Low levels of saturated fat in camel meat are important for avoiding atherosclerosis, for the control of obesity and hyper cholesterolaemia and decrease the risk of cancer because of their effect on plasma cholesterol levels (Chizzolini *et al*., 1999). Health organizations recommended reductions in total fat intake, particularly saturated fatty acids and at the same time, increase in the consumption of polyunsaturated fatty acids which are considered beneficial to human health, due to anti carcinogenic, anti atherogenic and immune modulating properties (Mulvihill, 2001) This renders the camel meat with its low fat and cholesterol content a healthy food.

Moreover, camel meat is believed by Somalians and Indians to have remedial effects for as many as 13 different diseases, including hyperacidity, hypertension, pneumonia and respiratory diseases and also to be an aphrodisiac (Kurtu, 2004) Not only camel milk, but also camel meat in general is considered a functional food for cures and remedy for many ailments such as seasonal fever, sciatica, shoulder pain, asthma, removing freckles and for improved performance in many cultures around the world (Abrhaley and Leta, 2017). Camel meat can also be used as a cure for exhaustion and fatigue because it contains energy needed by body cells. Such energy comprises sugar not fat, since a camel's fat is concentrated in its hump whereas other animals store it in their muscles. In addition, camel meat contains glycogen, a carbohydrate which is easily absorbed and metabolized in the body and converted to glucose which in turn activates nerve as well as other cells. The camel is distinguished from other animals by the fact that the percentage of its intramuscular fat declines as the animal gets older (Kadim *et al.,* 2013) These qualities are only found in camels and makes their meat less fatty so its consumption is healthy and recommended for weight loss, reduces the risk of cardiovascular diseases, protecting against cancerous tumors, used as a cure for exhaustion and fatigue, and it is also used for activation of nerve as well as other cells (Kadim *et al.,* 2013).

CONCLUSION

The findings of sources reviewed are summarized as follows:
Camels are good producers of meat and they can yield optimum dressing percentage at age of greater or equal to seven years. The amount of camels slaughtered and meat produced rapidly increased since 1961. However, the contribution of camel meat to the world meat produced is only about 0.13% which could be due to marginalized settlement of camel producers, irregular census of camel number and rough record of amount of meat produced due to mobility of camel owner. In addition review showed that, the camel has high amount of moisture, protein and amino acid, in particular it is rich in lysine phenylalanine, leucine and valine. It is also loaded with varieties of minerals (high amount of phosphorus, potassium and sodium), unsaturated fatty acids and vitamins. Beside camel meat has low intramuscular fat, cholesterol and saturated fatty acids which are two especial characters. Moreover, from reviewed documents it can be concluded that the meat of camel is very important for treatment of atherosclerosis, hypertension, pneumonia, respiratory diseases, seasonal fever, sciatica, shoulder pain, asthma cardiovascular diseases. And it is the first choice to control obesity, and hyper cholesterolaemia, cancerous tumors and used as a cure for exhaustion and fatigue.

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