Meat recording systems in camelids

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Summary

There are very few data on meat recording systems in camelids, particularly on the relationships among production systems (conditions), growth, fattening, body size, and qualitative aspects. These aspects regarding camelids will be discussed. Furthermore, work on Tunisian dromedary will be presented for illustration and comparison. These researches were mainly conducted for several years at the Ecole Supérieure d'Agriculture Mateur . This works concerned growth, fattening and carcass and meat quality on camel reared from birth until on-station slaughtering. Data were collected each four weeks on conformation traits and animals were weighed each two weeks. Studies on growth of dromedaries revealed a significant relationship between daily gain (y = 282+5.4 x) (y in g) and daily intake of concentrate (x, in g per kg $lw^{0.75}$). The growth of youngest dromedary has been modeled and data on linear growth permitted to determine a prediction formula for live weight. After slaughtering 15 males aged from 15 to 50 months and weighing between 280-560 kg were used to examine the following aspects: slaughtering and jointing yield, carcass tissue composition, and meat quality. Results concerning growth, quality and yield of carcass are discussed in order to draw some practical conclusion regarding potential recording systems for camelids on production traits and eventually to identify future axes for research.

Key words: camel, carcass, meat, quality, weight and growth of camel, compensatory growth, meat characteristics.

Introduction

The camel can survive, reproduce and produce meat in a very harsh environmental conditions that are difficult for all other domestic livestock constituting an important source of meat and income in these arid regions. The potential of the camel as a meat producer has received little attention. The camel has a slow growth rate and has not been selected for meat production, so that it is very unlikely better than cattle breeds under intensive or semi-intensive conditions.

There are very few data on meat production potential of this species. The growth patterns, the efficiency of growth, fattening and carcass and meat quality, were not looked into in different breeds and under different ecological conditions. So and for want of specific data on meat recording

systems in camelids, these aspects will be inferred by analogy with study carried out, for several years, with camel herd of the experimental farm at Higher Agriculture School in Tunisia.

Factors affecting weight and growth of camel

Weight of dromedary camels at birth are in the range 27-45 kg and are affected by sex, parity of dam, period (month, season, year) and whether or not dams have been subjected to nutritional and health interventions or not (Wilson, 1992). Breed probably affects weight at birth but no studies have been performed on this variable.

Studies carried out at breeding farm in India with reference to Bikaneri camel breed has reported the following results: average birth weight was 37.2 kg (Bargava *et al.*, 1965), 41.6 kg with hertability 0.6 (Berhat and Choudhary, 1980) significant sire effect was observed. The average birth weight for males was 41.9 and for females 39.9 kg (Tandon *et al.*, 1988). In the last study, which involved 532 records, effect of birth parity of dam and sex was highly significant.

Studies carried out in Tunisia with reference to Maghrabi camel breed reported these, in experimental farm conducted by Kamoun (1993, 1995a) reported, the smallest calf weighed 24 kg that is the half the weight of the heaviest calf, which was 48 kg, the average birth weight was 33.1 kg. Burgemeister (1975) recorded the birth weight of camel reared on pasture as 25.8 kg, lower than the average weights of 33.1 kg given by Kamoun for the same breed.

Such differences reveal the variations in camel calf performances attributable to breed, strain, environment and management. The exact role of these factors in the camel has not been investigated.

Average daily weight gains as high as 870 g from birth to 30 days and 570 g from birth to 180 days can be achieved when nutrition is adequate (Wilson, 1992). Weight at specific ages and growth rate are important parameters, detailed knowledge of which is required if rapid improvement in camel productivity is to be achieved. Then Kamoun (1995a) studied postnatal growth performance of young dromedaries reared from birth on-station. The results of his observations are given in table 1. They showed that male calves tend to grow fasters than female ones. These calves achieved high average daily weight gains from birth to wean 760 g for male and 620 g for female. Suckling young are weaned between 8 and 10 month. Weaning weight varied from 200 to 260 kg.

Field (1979) observed the growth patterns of camel calves in north of Kenya. Two groups of animals were studied, one under pastoral conditions and the other one under special conditions where the young received a greater proportion of mothers milk. The first group showed daily average gain of 222 g and 255 g during the dry and wet seasons respectively, while gains ranged from 378 g to 655 g for second group. The Measurement of the growth rate of the young camels under different forms of management indicates that the amount of milk permitted for the calf is of fundamental importance in controlling the rate of growth.

Table 1. Live weight and daily weight growth in young camels reared in the experimental farm of the ESA Mateur (Source: Kamoun, 1995a).

	Live weight kg		Daily weight gains g	
	Males	Females	Males	Females
Age (month)	Number = 13	Number = 16	Number = 13	Number = 16
0	35 ± 6	32 ± 5	-	-
6	179 ± 9	156 ± 12	798	687
12	286 ± 22	244 ± 21	596	492
18	349 ± 10	295 ± 16	352	285
24	403 ± 26	348 ± 9	301	292
36	496 ± 15	421 ± 47	258	202

With dam producing least 1 550 liters of milk per year, camel calf can survive on daily suckling of at least 25% of milk if there is provision of water, good pasture and veterinary care and that beyond suckling 75% of dam milk, the milk suckled did not influence growth rate (Ouda, 1995). Calf milk levels intake need to be established in order to maximum on both the calf growth and amounts of milk taken by the owner.
At weaning, young camels were individually hobbled in a common barn. They were fed a standard concentrate ration (500-1 200 g/10 kg l.w.per day) and wheat straw *ad libitum*. Animals were weighed every 14 days. Under this experimental conditions the weight achieved by weaned male camel were 286, 349 and 403 kg respectively at 12, 18 and 24 month old. The calve multiply their birth weight three times during the first 90 days and achieved at 12, 24 and 36 month old respectively 47.6%, 63.0% and 82.7% of mature weight for male and 48.8%, 70.0% and 84.2% of mature weight for female. Male and female reached 88% and 95% of mature weight respectively at 4 years (Table 1).

Compensatory growth

In a study carried out at the experimental facility of the ESA Mateur in Tunisia Kamoun (1993), Kamoun and Wilson (1994) reported the growth patterns of camel calves. Two groups of animals were studied, one bought as wean in the market and another reared from birth on-station. At weaning animals born on-station were always heavier, and had greater linear measurements in relation to average mature size than those bought. These differences were maintained at 12 and 24 month of age. Compared to the station-born the market animals were about 6 month later in reaching a given weight (Table 2). Early restricted feeding in the market group had lasting effects on development. Compensatory growth was evident as market camels on station, at given age, had better conformation and weighed than their contemporaries in the traditional

system (Kamoun, 1993). Also Field (1979) showed a better performance by calves born during wet season than by calves born in the dry season in spite of compensatory growth. The early environment of camels, with full access to milk before weaning, is a determining factor in physical development.

Growth

Weight at specific ages and growth rate are important parameters, detailed knowledge of which is required if rapid improvement in camel productivity is to be achieved. Little work, however, appears to have been done on the growth rate of camel under different climatic conditions. But only few empirical and experimental data are available probably because there are considerable difficulties involved in weighing camels in both experimental and traditionally managed herds. Less than 1.3% of all camel literature references provide information on growth and weight underline these problems (Wilson, 1992). Previous investigations on growth in the camels have been inconclusive and difficult to compare because of differences in experimental conditions.

So some work conducted for several years in Tunisia on growth in dromedaries under determined growth conditions. This work aims to contribute to the knowledge has already been acquire on the growth, and to the determination of equations for weight prediction, based on measurements carried out on the growing dromedary.

Data are collected from the camel herd of the experimental farm of the Ecole Supérieure d'Agriculture of Mateur on 39 growing animals of the Maghrabi race (10 bought as wean in the market and 29 reared from birth on the station) fed concentrate and straw ration. Animal weighed every 14 days using adapted livestock scale. Linear measurements were carried out monthly using three instruments graduated in centimeters and manufactured in craftsman technique (a tape-measure three meters long, a large height-gage and a small height-gage). 973 series of 20 types

Table 2. Comparative age of camels born on Station and bought from the market as wean at 200 kg and at 350 kg Live Weight (Source: Kamoun, 1993)

	Age (day) at given live weight (kg)	
Live weight (kg)	200	350
Age of camels bought from the market as wean (day)	430±48	876±180
Age of camels born on ESA Mateur Station (day)	230±28	687±150
Age late to reaching givens live weight	200 days	189 days

Table 3. Morphometric measurements recorded.

Animal no……(Date:……)		
Age (months)	Breadth (cm)	Neck girth (cm)
Weight (kg)	Chest	at the 1st CV
Height (cm)	Shoulder	at the 4th CV
Shoulder	Hip	at the 7th CV
Hump	Trochanter	Metacarpal length (cm)
Sacrum	Length (cm)	Metatarsal length (cm)
Girth (cm)	Scapulo-ischial	
Chest	Neck length	
Hump	Head length (chignon-nostril)	
Spiral girth	Head wide (between eyes)	

measurements were thus available for calculations (Table 3). From the 20 types of measurement done, only 7 were finally chosen because of their precision and their strong correlation to the live weight. Morphometrics measurements, from birth to 3 years and above, of those camels were given in table 4.

From this data a growth function has been adjusted to sequential body weights. The compertz growth equation is the same as that used by Laird (1966):

$$P=P0Exp[A / a(1-Exp(-at))]$$

in which P is the weight at time t, P0 is the birth weight, and A and a are constants. The model gives the evolution of weight in relation to time with co-ordinate at inflexion point Pi, t_i. Pi, t_i were weight and age at maximum growth rate. In table 5 is summarised the growth constants for both camel sexes.

The growth constants indicate a general tendency for the camel female to pass through her growth period faster and to mature earlier than the male. There was strong evidence of allometric growth. Large ranges were observed among linear measurement for developing rate, the classification from earlier to later Shoulder height, Chest girth and Hump girth respectively. In the other hand, linear measurements were developed much more rapidly than live weight in terms of final mature values.

An indication of weight may be required for improvement of camel breeding. Several formulas to predict weight, at different ages and for different categories, combining different linear measurements, were established. These prediction formulas are shown in table 6. Most of the barymetric formulas are based on the idea that an animal weight is proportional to its volume and that the best expression of the latter is a

Table 4. Physical characteristics of Tunisian Maghrabi camels born and reared on station in northern Tunisia.

	Males					Females				
Age (months)	0	12	24	36	60 or more	0	12	24	36	60 or more
Weight (kg)	34.5	285.7	403.0	496.4	640–730	31.9	244.1	350.4	421.0	500-580
Height (cm)										
Shoulder	97.8	145.2	155.4	163.3	172-176	98.5	141.1	152.0	158.0	160-170
Hump	98.6	161.0	169.0	182.5	198-202	99.9	158.7	169.8	180.8	185-200
Sacrum	95.9	143.0	153.6	161.8	163-165	95.1	140.0	150.23	155.5	155-160
Girth (cm)										
Chest	76.9	165.5	181.4	212.8	220-247	74.9	156.4	180.8	207.3	210-220
Hump	79.0	209.4	241.0	264.8	290-328	76.6	195.0	236.4	250.0	260-270
Scapulo-ischial length (cm)	64.3	129.3	146.4	155.0	173-175	61.8	123.2	145.2	155.8	158-165

Table 5. Growth model constants of camels.

Growth constants	Camel male	Camel female
A	0.0099	0.0081
(a)	0.0048	0.0044
ti (day)	151	138
Pi (kg)	116	92.5
Maximum rate (g / day)	556	408

Table 6. Formulas for estimating camels live weight.

Live weight formulas	Animal number	Country or area	Source
P (kg) = 53*T*A*H	38	South Algeria	Boue, 1949
P (kg) = 52*T*A*H	-	Chad	Graber, 1966
P (kg) = 507*T-457	28	Sudan	Wilson, 1978
P (kg) = 3.06*A-290.6	81	Egypt	Bucci *et al.*, 1984
P (kg) = 6.46*10-7*S3.17	9	Kenya	Field, 1979

T: Chest girth (in m); A: Hump girth (in m); H: Shoulder height (in m) and S = T + A + H in cm.

product of order 3 of linear magnitudes. However, for constructing simple chart we must use only 2 linear measurements. Then, the data collected from the camel herd on station, have been used and permitted to determine some prediction formulas for live weight based on tow measurements:

1. For young calves: Live weight (kg) = $52.17*HB^{1.6374}*CT^{1.7171}+1.35$ which HB hump height, CT Chest girth in meters ($R^2_{(5\%)} = 0.96$),

2. For growing male: Live weight (kg) $=9*10^{-6}*HG^{1.8953}*CA^{1.4637}$ which HG Shoulder height, CA hump girth in centimeters ($R^2_{(5\%)} = 0.98$) and
3. For growing female: Live weight (kg) $=1.9*10^{-6}*HG^{2.7082}*CA^{0.9957}$ which HG Shoulder height, CA hump girth in centimeters ($R^2_{(5\%)} = 0.96$).

These formulas were used for building abacus.

Nutrition and growth

There have been relatively few investigations on feeding standards for growing camel and assessment of these standards remains very empirical and often extrapolated from cattle data.

Dry matter intake values for growing camels grazing natural pastures have been estimated to be 0.97-1.21 kg/d/100 kg l.w. (Kamoun and Steinmetz, 1995). These camels were, often subjected to poor grazing conditions and the feeding level is often at or below maintenance, with considerable weight losses during dry seasons. Feed supply is the top constraint to increased camel meat production.

In view of searching the best growth and diet ration for camel, some trials were conducted in the experimental facility of the ESA Mateur in Tunisia (Hashi *et al*., 1995; Kamoun, 1993; Kamoun 1995b; Kamoun *et al*., 1989a, b). 16 young dromedaries, distributed in several groups, were fed medium quality forage (wheat straw or oats hay) *ad libitum* and concentrates in different quantities (0.4-3.2 kg) and for different qualities (16, 22 and 28% CP on a DM basis). The animals were kept under hobbled stalling. Feed consumption (feed offered minus refusals) was measured and recorded every day. Their intake during the tethered period ranged from 1.4 to 1.8 kg DM per 100 kg live weight. Forage intake was higher for the hay (0.94-0.97 kg DM per 100 kg lw), but it may have been affected by the quantity and quality of concentrate. However, total DMI of this species remained, in any case, limited even with high concentrate level (over 50% of total diet on DM basis). In the other hand, these results indicate the opportunities for low-cost seasonal supplementation of camel to optimize growth. The average daily weight gain variation ranges from 285 g up to 525 g. An overall average daily gain of 285 g was achieved with low energy consumption (8.5 MJ ME per kg DM).

A significant relationship ($y=284+5.4x$) between daily gains (y, in g) and daily intake of concentrate (x, in g per kg $w^{0.75}$) is shown. An amazing growth rate (280 g per day) has been observed using a medium quality ration. There is a need to further investigation in order to find out the responses to different supplements across a wide range of feeding conditions.

It has been claimed that camels fatten rapidly when fed 15 to 20 kg of mixture of straw, beet pulp silage, molasses and 10 to 15 per cent barley grains and that camels feeding on growing sugar beet tops gain as mush as 1.5 kg per day and can be made ready for slaughter in 60 days (Wilson, 1989). The compensatory growth explained this high average daily weight gains. In an attempt to provide at least some realistic data on the potential of camels for meat production. Some fattening trials were conducted at

the experimental facility of the ESA Mateur in Tunisia between 1987 and 1995. A summary of the results is given in table 7, in which 15 young male camels and 20 young bulls were fed during 120 days oats hay *ad libitum* and received the same quantity of concentrate (1.2 kg per 100 kg/lw). The animals were kept under hobbled stalling. The average feed consumption (DM per 100 kg lw) and the average daily weight gains were ranged respectively between 1.72-1.90 kg DM and 797-806 g for camels and 2.83-3.21 kg DM and 1 151-1 172 g for Steers. These trials confirmed that camel voluntary intake is very low. There is some evidence that camel daily weight gain can be increased by better quality feed rather than an increase in quantity. The average daily gain can reach 1 000 g/day under the most favorable fattening conditions.

The carcass and camel meat characteristics

Camel meat is produced in around 537.7 thousand tons of meat, most of which is produced in Somalia, Sudan and Mauritania (Wardeh, 1992). A considerable number of camels are managed and bred specially for slaughter in the Near East, and North Africa. A large number of these camels are exported. Both Somalia and Sudan export large numbers of camels to Saudi Arabia, Egypt and the Gulf States, while Libya imports camels from Sudan, Mali, Algeria, and Mauritania every year for slaughter. The camel meat is relished as beef in Middle East and African countries, is highly appreciated in many parts of Arabia, Libya, Algeria and Tunisia. There is often some resistance to the consumption of camel meat in non-camel herding societies. However, in pastoral societies, camels are rarely slaughtered except during ritual ceremonies.

The potential of the camel as a meat producer has received little attention. The most problem relating to meat production concerns the lack of coordinated data. Slaughter enabled us to gather information on the way the animal is transformed into meat and in particular on the

Table 7. Comparison of dry matter intake and daily weight growth in young camels and steers receiving the same feeding ration (Source: Kamoun, 1995b).

Animals type	Camel		Steer	
Number	6	9	10	10
Duration (days)	120	120	120	155
Mean Live Weight (kg)	180±31	300±36	215±36	305±58
Average Daily Gains (g)	806±211	797±164	1151±155	1172±129
Dry Matter Intake (kg per 100 kg lw)				
Oats hay	0.64±0.22	0.72±0.18	1.52±0.29	1.96±0.10
Concentrate	1.26±0.14	1.00±0.08	1.31±0.31	1.25±0.06
Total intake	1.90±0.24	1.72±0.21	2.83±0.25	3.21±0.16
Kg DM per kg weight growth	4.56±1.57	6.7±1.35	5.34±1.14	7.60±1.19

importance of what is often called the 5th quarter, which represents more than 20% of the live weight. An indication of these parameters may be required to compare the meat production potential of these species, with different breed and under different management conditions.

Slaughtering and jointing yield

Actual slaughter weight, carcass weight and dressing percentage data are almost completely lacking.

There is a considerable phenotypic variation in the live weight of mature dromedaries, whose age at full growth ranges from 6 to 7 years for males and slightly earlier in females. For the same breed, animal weight varies with age, sex and depends mainly on husbandry practices and condition of the vegetation. Live weight is heavier and age at full growth is earlier when these animals were well managed from weaning to maturity. All recent figures are consistent with the average dromedary weights 450-600 kg, while the average bactrian camel is slightly heavier. Dong Wei (1979) stated that the economic importance of the Chinese bactrian camel is primarily in work output and wool production. However it was found that body weight ranged from 400 to 600 kg.

Average carcass weight of the Iranian dromedary was reported as 300-400 kg for males, with that females being 250-350 kg (Khatami, 1970). These Iranian camels must have been well fattened. The same author further gave a figure of 650 kg as a possible carcass weight for the Bactrian camel. In the other hand, Bremaud (1969) noted that the average carcass of Somali camels be estimated to weight 286 kg. A carcass weight of 231 kg was given for males and 196 kg for females in Sudanese camels (Wilson, 1978).

The dressing percentage varied from 55 to 70 per cent (Kamoun, 1989; Shalash, 1979). Camel males have a higher dressing percentage than females. In general the dromedary have a higher dressing percentage (in the range of 54-57%) than other domestic animals Wilson (1984). The dressing percent seems to be rather high and it is not clear the average dressing percentage on live weight or on empty body weight. Indeed, in the Sudan southern Darfur camels were found to have dressing percentage on live weight of 51.4 in males and 47.4 in females (Wilson, 1978).

Only few sources provide data relating to slaughter and carcass weight, dressing percentage on live weight and on empty live weight, carcass characteristics and age (Bahamou and Baylik, 1999; Biala *et al.*, 1990; El-Gasim and El-Hag, 1992; Kamoun, 1995a, b; Wilson, 1978; Youssif and Babiker, 1989). Main results are summarised in table 8.

In a Tunisian study involving 15 camels, well managed from weaning to slaughtering in ESA Mateur experimental station, Kamoun (1995a, b) derived some very useful results, which are shown in tables 9, 10, 11 and 12 for illustration and comparison. After slaughtering the fattened males, the following aspects were studied: slaughtering and jointing yield, and carcass tissue composition.

Table 8. Live weights, carcass and body components weight, and dressing percentage in camel males.

Source	Kamoun 1995	Biala *et al.*, 1990	El-Gasim and El-Hag 1992	Youssif and Babiker 1989	Wilson 1978	Bahamou and Baylik 1999
Country	Tunisia	Libya	Saudi Arabia	Sudan	Sudan	Algeria
Place	Experimental station	Experimental station	Experimental station	Slaughter house	Slaughter house	Slaughter house
Number	15	6	12	22	21	47
Age (years)	3	2	2	Mature	Mature	Mature–castrato
Type	Well-fattened	Fattened	Non-fattened	Well-fattened	Non-fattened	Non–fattened
Live weight kg	413.8	288	226.8-271.0	456.1	447.9	459.7
Empty weight kg	351.5	241.3	194-235	404.8	367	-
Carcass weight kg	231.1	146.8	119.5-132.5	239.9	231.3	244.2
Carcass % Live weight	55.8	51.0	52.1-56.1	56.6	51.4	53.3
Carcass % Empty weight	65.4	60.7	60.0-65.5	63.8	63	-
Hump weight kg	20.1	9.1	2.3-4.2	30.8	4.0	8.8
Digestive tact content % lw	15.1	16.1	13.2-14.4	11.2	23.2	-
Body components kg						
Head	12.5	7.7	6.7-8.6	14.1	12.1	12.9
Four feet	13.0	8.4	-	14.4	14.6	15.3
Stomach+Intestines(empty)	18.5	12.6	11.5-12.4	25.7	-	21.9
Liver	5.4	4.2	3.8-4.6	8.0	7.5	7.3
Lung and trachea	3.9	2.2	2.0-2.3	5.9	-	2.8
Heart	1.8	1.4	1.4-1.6	2.7	-	3.4
Kidneys	1.3	0.91	1.9-2.0	1.7	-	1.8
Spleen	0.4	0.3	0.3	0.5	-	0.3
Hide	35.2	19.8	-	35.8	34.8	25.3

The slaughter weight and carcass weight of mature Sudanese desert camels were in no –fattened male 306 - 581 kg and 144-310 kg, yielding dressing percentage on body weight and on empty body weight of 46.2-55.6% and 55.7-65.1% and in well fattened male 395-512 kg and 208-295 kg, yielding dressing percentage on body weight and on empty body weight of 47.2-62.8% and 53.1-74.7 respectively. Wile the mature castrato Algerian camels for the same slaughter weight give heavier carcass. For average camels carcass weight of 231-244 kg there are a great variation in the weight of humps, 4-31 kg (Table 8). The discrepancy on the live weight of this Sudanese desert camels breed may be explained by the weight of the digestive tract content, it self influenced by the duration of fasting between last weighing and slaughtering.

The slaughtering males, aged from 15 to 50 months and weighing 280-560 kg provide between 150 and 343 kg of carcass. The 5th quarter, blood and digestive tract content represent 22.6±1.7; 6.8±3.5 and 15.1±5.1 of the live weight, respectively. Slaughtering yield, expressed as the carcass

weight on body weight and on empty body weight were 55.67±2.77% (52.3-61.4%) and 65.40±3.74% (60.30–72.12%), respectively. The hump, fat included, accounts for 8.4% (5-13%) of carcass weight. The rate of live growth did cause a change in the camel carcass yield and characteristics. Carcass weight and yield and hump increased as right increased. The fact that dressing percentage varies with live weight, carcass weight, age, sex, breed and the digestive tract content (Table 9). Camel body components are also summurised in Table 8 and 9. The camel head and four feet had an average weight of 12.5±2.8 kg and 13.0±2.7 kg, they represent about 3.5% of the empty body weight. Camel hide had a weight of 35.2±9.5 which represent 10% of the empty body weight. Liver, Lung with trachea, heart and kidneys weight were 5.4±0.8 kg, 3.9±0.9 kg, 1.8±0.4 kg and 1.3±0.2 kg and represent 1.5%, 1.1%, 0.5% and 0.4% of the empty body weight respectively. As for the empty digestive tract (stomach + intestines) it weighed 18.5±3.2 kg and represent 5.3% of the empty body weight. The relative proportion of body weight components indicated that the heaviest body component was the hide followed by digestive tract. The relative proportion of body component agreed with values reported by Bahamou and Baylik (1999), Wilson (1978) and Youssif and Babiker (1989). Compared with body components for bulls reared under the same conditions and weighing the same empty body weight, the camel had a lighter head and digestive tract but heavier hid.

Camel wholesale cuts are shown in table 10. The cut, into wholesale cuts are not set up in standard manner and change from one author to another. So the comparisons between authors are not easy. But, generally, the leg and shoulder weights as proportion of the hot carcass weight were the heaviest joints in the carcass followed by thoracic region (dorsal+flank) and neck. Carcass joints having lighter weights in the lumbar region and abdominal flank.

According to traditional cutting (Figure 1), the wholesale yield cuts have been studied on fifteen fattened males camels slaughtered at different body shape (Kamoun, 1995a, b). The neck, the fore limb, the thoracic-back region, the ribs, the lumbar region, the hind limb, the flank, the hump and others (kidney fat + tail + diaphragm muscle) represented respectively, 9.4%; 22.6%; 8.1%; 10.8%; 7.5%; 24.5%; 5.7%; 8.4% and 3.0% of carcass weight. In all cases, forequarters were heavier (51 and 49% of carcass weight), than the hindquarters.

Carcass tissue composition

The camel carcass and camel meat characteristics are important parameters, detailed knowledge of which is required if rapid improvement in camel meat production is to be achieved. Some work, however, appears to have been done on camel meat but only few experimental data are available. This can be attributed to the lack of the same reference methods for the assessment of carcass and meat characteristics which to be used at the end of camel production experiments.

Table 9. Comparison of carcass weight and dressing percentage of camels and steers.

	Kamoun 1995b Experimental Station in Tunisia						
	No. = 15 fattened Magharabi camels			No = 6 Steers (FFPN)			
	Mean	± SD	Range	Mean	± SD	Mean	± SD
Age (month)	30	12	15–50	9	1	13	1
Live weight kg	413.8	104.4	280–560	283.5	1.5	405.6	5.4
Empty weight kg	351.5	85.1	240–476	218.8	0.4	345.3	8.6
Carcass hot weight kg	231.1	63.1	149.5–343.3	134.0	0.1	219.0	9.2
Carcass % Live weight	55.67	2.77	52.33–61.41	47.3	0.2	54.0	2.2
Carcass % Empty weight	65.40	3.74	60.30–72.12	61.2	0.1	63.4	1.7
Hump weight kg	20.1	9.4	8.5–44.0	-	-	-	-
Hump % carcass	8.4	2.2	5.1–12.8	-	-	-	-
Digestive tact content % lw	15.1	5.1	11.2–18.5	22.8	-	14.9	-
Body components kg							
Head	12.5	2.8	8–18	14.7	1.1	21.0	0.5
Four feet	13.0	2.7	9.5–18.5	8.7	0.3	11.7	0.5
Stomach + intestines (empty)	18.5	3.2	13.5–23.7	17.7	0.3	29.3	2.5
Liver	5.4	0.8	4.3–7.1	3.3	0.1	5.7	0.2
Lung and trachea	3.9	0.9	2.2–5.5	2.2	0.1	5.1	0.1
Heart	1.8	0.4	1.2–2.6	1.3	0.1	1.6	0.1
Kidneys	1.3	0.2	1.0–1.6	0.8	0.1	0.9	0.1
Spleen	0.4	0.1	0.3-0.5	0.5	0.1	0.8	0.1
Hide	35.2	9.5	21.5–50.0	16.8	0.4	29.0	0.8

Youssif and Babiker (1989) reported that the mean composition of 9 carcass was 56% (43.6-67.6%) meat; 19% (13.4-25.3%) bone and 13.7% (7-18.4%) fat. In these 9 carcasses muscle: bone ratio ranged from 2.7 to 3.0. On the other hand Kamoun (1995a, b) determined the tissue composition by dissection of twelve camel male carcasses. He reported that these carcasses which weighed 256.6 kg (181-343 kg) contain, in average of 60.9% (57.3-64.9%) meat, 20.9% (16.2-23.7%) bone and 18.2% (12.5-24.0%) fat. However, the meat: bone ratio decreased while body shape increased. The muscle: bone ratio was ranged from 2.48 to 3.76 with mean of 2.95±0.39 (Table 11).

Wholesale yield cuts and joint composition are shown in table 12. The tissues were unevenly distributed in the carcass. Meat, bone and fat composition were respectively 66.9±1.3; 26.8±3.7% and 6.3±3.6% for the fore half and 54.5±3.2%; 14.8%±1.7% and 30.7±3.9% for the hind half.

Table 10. Yield of wholesale cuts from camel carcass (% of carcasses).

Source	Kamoun 1995	Biala *et al.*, 1990	Bahamou and Baylik 1999	Wilson 1978	El-Gasim and El-Hag 1992	
Country	Tunisia	Libya	Algeria	Sudan	Saudi Arabia	
Place	Experimental station	Experimental station	Slaughter house	Slaughter house	Experimental station	
Number	15	6	47	21	12	
Age (years)	3	2	Mature–castrato	Mature	2	
Type	Well-fattened	Fattened	No-fattened	No-fattened	No-fattened	
Forequarter	50.9	63.2	58.5	57.5	-	
Neck	9.4	10.4	10.2	-	Neck	7.5
Shoulder	22.6	22.8	23.6	-	Shoulder	31.6
Thoracic region	18.9	30.0	24.7	-	Rib	14.6
Hindquarter	49.1	36.8	41.5	40.5	Loin	6.0
Lumbar region	7.5	16.3	9.3	-	-	
Leg	24.5	20.5	28.7	-	Leg	28.8
Abdominal flank	5.7	-	-	-	-	
Hump	8.4	-	3.5	2.0	Hump	5.2
Tail-int.fat - m.Onglet	3.0	-	-	-	Others	6.3
Total carcasses	100.0	100.0	100.0	100.0	Carcass%	100.0
Carcasses kg	231.1	147.0	244.2	231.3	Carcass kg	126.0

The hump fat included, accounted for 60.0±4.7% of the hind half fat. The meat: bone ratio were respectively 3.73-2.55-4.30-3.59-2.67-2.49-1.53 in the hind half, fore half, fore limb, hind limb, neck, lumbar region, thoracic back region and ribs.

Joint composition indicated that the shoulder and leg had a muscle proportion around 75%. The joints, neck and lumbar region had a muscle proportion of 71% and 60% respectively. The proportion of bone in wholesale cuts was highest in the thoracic, dorsal and flank regions and a minimum in the flank joint. The proportion of fat was higher in the abdominal flanks which ranged between 25 and 45% while a minimum fat contents was found in the neck, shoulder and leg joints.

Quality of camel meat

The quality of meat has received little attention. Earlier camel meat was described as palatable, but coarser than beef, varying in color from raspberry red to brown red and having white fat (Leupold 1968). Khatami (1970) indicated that in appearance and color, texture and palatability, camel meat is very similar to beef.

Table 11. Live weight and carcass characteristics in males camel.

Sources	Kamoun 1995	Biala *et al*., 1990	Youssif and Babiker 1989
Country	Tunisia	Libya	Sudan
Place	Experimental station	Experimental station	Slaughter house
Number	12	6	9
Age (years)	3	2	Mature
Type	Well-fattened	Fattened	Well - fattened
Live weight kg	455.0	288	456.1
Carcass weight kg	256.6	146.8	239.9
Hump weight kg	20.1	9.1	30.8
Meat % carcass	60.9	60.5	57.8
Bone % carcass	20.9	28.1	18.8
Fat % carcass	18.2	9.2	13.7
Trimming % carcass	-	2.2	9.7
Muscle : Bone ratio	3.31	2.20	2.95

The quality of meat produced by younger animals was comparable to beef in taste and texture. With increased age, however, there is an increase in meat toughness; the meat also becomes less testy and of inferior quality. There is a great reluctance on the part of camel owners to sell their young stock. Since animals are usually slaughtered at the end of their productive life. Most trade therefore consist of meat from much older animals the low quality of which has a direct bearing on the extent of demand for camel meat outside the camel herding societies. Camel meat is often labeled inferior in urban societies, and its consumption is considered fit only for poor.

Unfortunately, in spite of all the indication of the superior quality of meat from young animal, objectives data on change of camel meat quality with age are almost completely lacking. In recent years the potential of the camel as a meat source has received creased recognition but only few investigation on the chemical composition and eaten quality of this meat have been published.

Meat differs in composition according to type and condition and the fat content of tissues varies. The chemical composition of camel meat has been studied. Nasr *et al*., (1965) indicated that the meat of young camels (below 5 years) has a higher moisture content (78.3%) than that of older animals (76.2%) and estimated the crude protein, fat and ash contents of the two age groups as 20 and 22%, 0.92 and 1.01%, and 0.76 and 0.86% respectively, with no significant difference between the sex.

Kamoun (1995b) found that quality of camel meat varies with age. The mean chemical composition was presented in table 13.

Table 12. Traditional wholesale cuts and joint composition in camel carcasses.

Source	Kamoun 1995a, b				Biala *et al.*, 1990			
Country	Tunisian cut				Libyan cut			
Number	12				6			
Age (years)	3				2			
	Weight kg	Tissue composition			Weight kg	Tissue composition		
Cut pieces		% Muscle	% Bone	% Fat		% Muscle	% Bone	% Fat
Forequarter	131.3±26.6	66.9±1.3	26.8±3.7	6.3±3.6	73.4-113.1	61.3-62.3	27.7-31.0	7.7-10.0
Neck	24.4±6.4	71.3±3.8	27.5±4.0	1.2±0.5	11.0-19.7	69.0-72.3	25.3-31.0	0.0-2.4
Shoulder	57.1±12.1	76.7±3.6	18.2±2.6	5.1±2.4	27.0-38.6	67.8-71.3	27.2-30.7	1.5
Thoracic dorsal region	22.7±4.2	56.0±3.2	36.4±7.9	7.6±5.5	35.4-54.8	51.1-53.1	29.7-31.1	15.8-19.2
Thoracic flank (Rib)	27.1±5.0	51.6±4.3	36.7±8.6	11.7±6.4				
Hindquarter	125.3±27.3	54.5±3.2	14.8±1.7	30.7±3.9	42.7-64.2	61.8-66.4	24.6-30.3	7.9-9.1
Lumbar region	16.9±2.8	60.4±7.6	25.6±4.8	14.0±3.6	18.8-28.6	51.8-55.6	24.7-29.3	18.9-19.7
Abdominal flank	16.2±3.8	66.1±6.8	0.0±0.0	33.9±6.8				
Leg	61.8±12.6	74.5±2.7	21.0±2.3	4.5±1.5	23.9-35.6	69.2-74.9	24.5-30.8	0.0-0.6
Hump	23.6±8.4	0.0±0.0	0.0±0.0	100±0	-	-	-	-
Tail + Kidneys fat + m. onglet	6.8±1.7	-	-	-	-	-	-	-
Total carcasses	256.6±53.3	60.9±2.1	20.9±2.5	18.2±3.5	116.1-177.3	61.6-63.5	26.5-30.1	8.3-10.0

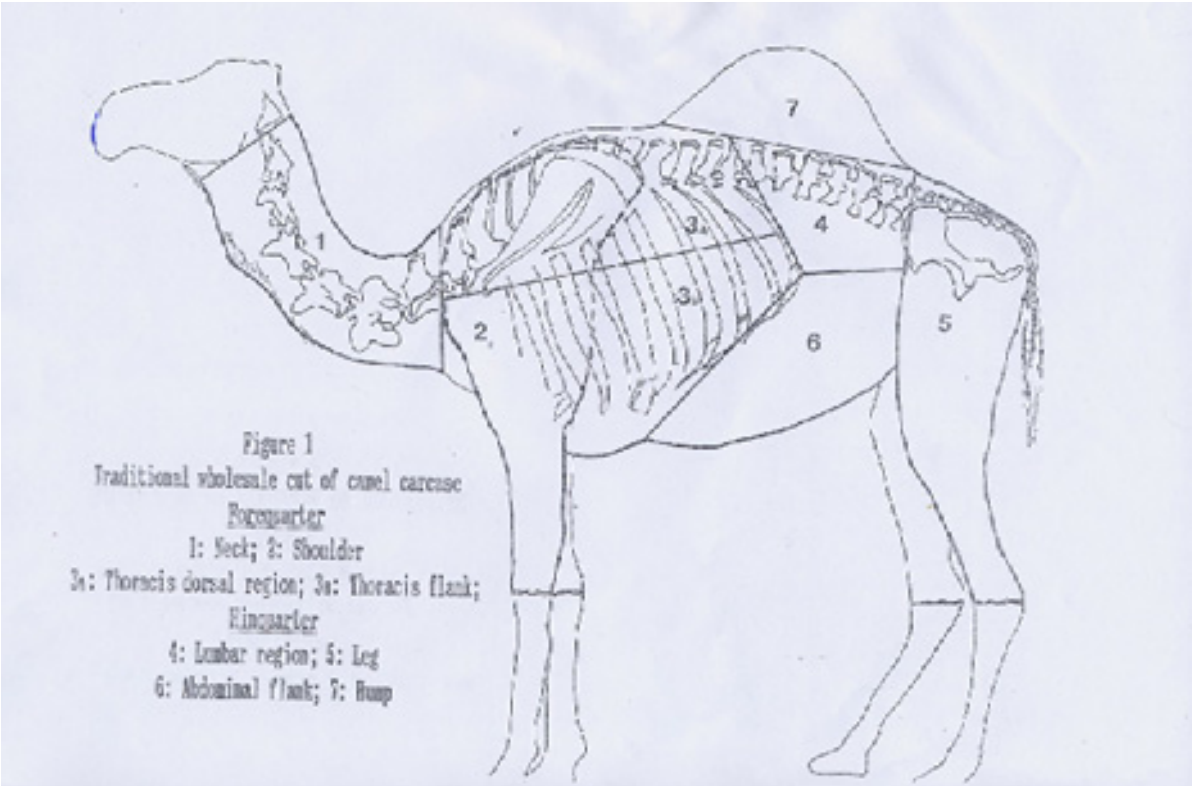

Figure 1. Traditional cuttings of camel meat.

Table 13. Chemical composition of camel and steers meat.

Type	Steer meat	Camel meat	Camel meat	Camel meat	Camel meat means
Age (month)	15	20±4	34±2	49±1	30±12
Moisture %	73.0±0.9	77.5±0.8	78.1±1.4	76.9±1.7	77.6±1.7
Dry matter %	27.0±1.30	22.5±1.3	21.9±2.0	23.1±2.2	22.4±1.7
As dry matter %					
Protein	77.0±2.9	91.4±3.3	91.2±4.0	89.6±9.0	91.0±5.1
Fat	18.5±3.3	3.55±3.25	4.25±3.69	5.89±8.77	4.2±4.9
Ahs	4.5±0.1	5.1±1.1	4.5±1.1	4.5±0.9	4.8±1.1
Collagen	2.69±0.95	2.35±0.9	2.54±0.76	2.47±0.79	2.4±0.8
Myoglobin	2.20±0.43	1.65±0.41	2.10±0.61	2.64±0.54	1.97±0.63
% collagen soluble	18.3±2.9	39.6±15.3	31.4±11.6	22.7±10.9	34.1±13.0

It was observed that the moisture content of fresh camel meat was 77.6% and camel meat contain 20.4% protein but only about 1% fat. The chemical composition varies with age: percent fat, increased as body shape increased while moisture decreased. Chemically, camel meat was compared with meat of steer 15 month old. The result indicated that camel meat contains more moisture, more protein, less intra muscular fat, the same level of collagen (Tenderness) and the same percentage of ash. However, few differences between meat were observed for protein excluding fat. It was also found that myoglobin (color), increased in camel meat as body shape increased. At four years old camel meat, reached the same color than that from steer below 2 years old.

Hamman *et al*., (1962) found that the LD muscles obtained from 5 year old camels had an average 19.4% protein, 76.2% moisture, 2.6% fat and 1.1% ash, the round muscles (ST) had 19.8% protein, 78.3% moisture and 3.8% fat while shoulder muscles (TB) had 22.3% protein, 76.1% moisture, 0.95% fat and 0.79% ash.

It was of interest to test the meat quality in different cuts. Then chemical and sensory properties of the following six muscle from fifteen young fattened males camel were evaluated by Kamoun (1995b): Psoas major (PM), Longissimus dorsi (LD), Semimembranosus (SM), Semitendinosus (ST), Vastus lateralis (VL) and Triceps brachii caput longum (TB). These camel muscles weight and characteristics are given in table 14 and mean chemical composition in table 15. In the other hand, Babiker and Youssif (1990) compared the chemical composition and the eating quality attributes to LD, ST and TB muscles obtained from nine mature well finished camels, while El Kady and Fahmy (1985) studied the effect of aging by cold storage on some physical and chemical properties of buffalo and camel meat. A summary of these results is given in table 16.

Table 14. Weight and characteristics of six camel muscles.

Muscle removed from	Muscle	Weight kg	As percentage of	
			Total carcasses	Total carcass meat
Shoulder				
	Triceps brachii (TB)	3.60±0.93	1.39±0.11	2.22±0.22
Lumbar region (loin)				
	Longissimus dorsi (LD)	3.05±0.60	1.20±0.17	1.98±0.28
	Psoas major (PM)	1.70±0.22	0.68±0.10	1.11±0.16
Leg				
	Semitendinosus (ST)	1.07±0.37	0.41±0.08	0.68±0.14
	Semimembranosus (SM)	2.17±0.50	0.85±0.07	1.39±0.13
	Vastus lateralis	2.22±0.34	0.88±0.10	1.44±0.14

Table 15 Chemical composition and eaten quality attributes of the six major camel muscles (Source: Kamoun 1995b).

	PM	LD	SM	ST	VL	TB	Muscle means
Moisture %	77.7	75.1	78.1	78.4	78.3	77.8	77.6±1.7
Dray matter %	22.3	24.9	21.9	21.6	21.7	22.2	22.4±1.7
As dry matter %							
Protein	91.8	82.9	92.4	93.4	93.2	92.1	91.0±5.1
Fat	3.5	12.2	2.8	1.9	2.2	2.8	4.2±4.9
Ashes	4.9	4.8	4.8	4.7	4.7	5.0	4.8±1.1
Collagen	1.5	1.7	2.3	3.5	3.1	2.5	2.4±0.8
Myoglobin	1.75	1.64	2.63	1.59	1.89	2.29	1.97±0.63
Eaten quality							
Color :Myoglobin mg/g FM	3.9	4.1	5.8	3.4	4.1	5.1	4.4±1.4
Tenderness							
Collagen mg/g fm	3.3	4.1	5.0	7.5	6.6	5.6	5.5±1.8
Sensory tenderness	7.2	6.6	3.7	3.6	1.9	3.9	4.5±1.8
Percent collagen soluble	29.4	29.1	29.7	33.9	42.0	40.5	34.1±13.0
Sensory juiciness	6.2	6.8	5.2	3.8	4.1	5.8	5.3±1.1
Cooking weight loss %	44.6	45.0	49.3	48.2	51.1	50.8	48.2±2.5
Cooking volume loss %	41.1	42.0	45.6	44.3	47.8	44.7	44.2±2.2

Kamoun (1995b) observed few differences between muscles for dry matter excluding fat. However, a large range in percent fat (determined on lean tissue trimmed of all external fat) was observed: the LD the highest fat content (12.24±8.07 as % dry weight) and ST the lowest (1.94±0.78 as dry weight %). The six muscle PM, LD, SM, ST, VL and TB were ranked by percent fat, total myoglobin (color) and total collagen (Tenderness). Large ranges were observed among muscles for percent fat, total myoglobin and total collagen, the classification were: leaner to fatty (ST-VL-SM-TB-PM-LD), pale pink to bright red (ST-PM-LD-VL-TB-SM) and most tender to least tender (PM-LD-SM-TB-VL-ST), These muscle enclosed (0.42±0.17; 0.47±0.20; 0.61±0.26; 0.63±0.29; 0.73±0.39; 3.16±2.45) percent fat and (3.47±1.07; 3.89±0.79; 4.10±1.24; 4.12±0.97; 5.09±1.43; 5.77±1.72) mg of myoglobin and (3.34±0.64; 4.10±1.10; 5.01±1.00; 5.60±1.18; 6.62±1.36; 7.66±1.80) mg of collagen per gram of fresh meat respectively.

In all case, crud fat and total myoglobin increased while moisture and collagen solubility decreased as body shape increased. Chemical composition of LD is the one that varies the most with age, fat content increased as body shape increased while moisture decreased. After 3 years, intra-muscular fat deposited, coming from the hump, makes meat richer in fat, producing, as a result, marbled meat.

Table 16. Chemical composition and eaten quality in camel, steers and buffalos muscle.

Source	Kamoun (synthesis)			Kamoun (1995a, b)						Youssif and Babiker (1989)			El-Kadi and Fahmi (1985)	
Animal Types	Steer			Camel									Buffalo	Camel
Ages	Under 2 years			From 1 to 2 years			From 3 to 4 years			5 years or more			3 years	
Muscle	LD	ST	TB	LD	ST	TB	LD	ST	TB	LD	ST	TB	LD	LD
Chemical composition														
Moisture %	71.5	73.4	74.4	75.8	78.1	77.7	73.1	77.4	77.2	75.9	75.81	75.2	76.1	79.6
Dray matter %	28.5	26.6	25.6	24.2	21.9	22.3	26.9	22.6	22.8	24.1	24.2	24.8	23.9	20.4
Protein (% dm)	74.4	80.8	78.9	85.8	93.2	91.8	74.3	92.7	92.2	89.7	88.5	89.2	87.3	85.5
Fat (% dm)	21.4	15.0	16.8	9.2	2.0	2.9	21.1	2.5	3.1	5.9	5.8	5.7	9.32	11.1
Ahs (% dm)	4.2	4.1	4.3	4.9	4.9	5.3	4.6	4.8	4.7	4.4	5.7	4.9	3.38	3.44
Collagen (% dm)	1.8	3.2	4.1	1.5	3.4	2.5	1.8	3.8	2.5	3.8	2.0	2.6	1.25	2.04
Elastin (% dm)	-	-	-	-	-	-	-	-	-	-	-	-	0.94	1.26
Myoglobin (% dm)	1.7	1.0	2.0	1.4	1.3	1.8	2.3	2.3	3.1	-	-	-	-	-
Eaten quality														
Color														
Myoglobin (mg / g wm)	4.8	2.7	5.1	3.3	2.8	4.1	6.2	5.2	7.0	-	-	-	-	-
Degree of redness	-	-	-	-	-	-	-	-	-	17.2	13.8	15.9	-	-
Absorbance at 542 nm	-	-	-	-	-	-	-	-	-	-	-	-	0.640	0.252
Tenderness														
Shear force kg	3.5	3.7	3.9	-	-	-	-	-	-	4.8	5.7	5.8	2.5	2.3
Collagen mg / g wm	5.0	8.3	10.5	3.5	7.4	5.6	4.8	8.5	5.7	9.2	4.9	6.4	3.0	4.2
Sensory tenderness	6.2	5.5	5.6	6.8	3.1	3.3	6.5	2.1	2.3	-	-	-	-	-
% Collagen soluble	24	17	19	33	41	49	21	17	36	25	34	10	-	-
Sensory juiciness	6.1	4.7	5.9	6.8	3.1	5.9	7.2	2.8	5.3	-	-	-	-	-
Cooking loss %	34	37	41	42	47	49	46	49	51	38	33	37	-	-

Comparing the chemical composition and the eating quality attributes to LD, ST and TB camel muscles, Babiker and Youssif (1990) found that those muscles had similar moisture (75.2-75.9%) protein (21.4-22.4%) and fat (1.40-1.43) content (Table 16). The concentrations of sarcomplasmic and myofibrillar proteins were not significantly different among the three muscles studied. The LD muscle appeared brighter red than the other two muscles and total collagen content was greater in LD than in ST or TB muscles. In this case LD and ST collagen data will be rather in inverse order, seeing that shear force and connective tissue strength were lower in LD than values for ST and TB muscles. Indeed Kamoun (1995b) found that total collagen content is lowest in the LD than ST as well as in camel meat and in Steer meat.

Otherwise El Kady and Fahmy (1985) have been studied the effect of aging by cold storage on some physical and chemical properties of buffalo and camel meat. They indicated that fresh camels meat has higher moisture content (79.6%) than that of buffalo (76.1%) and estimated the crude protein, collagen, elastin and ash contents (as % dry weight) of buffalo and camel as 87.3 and 85.5%, 1.25 and 2.04%, 0.94 and 1.26% and 3.38 and 3.44% respectively. For color it was noticed that buffalo meat was darker due to more myoglobin content than that of camel meat. They noted too, that after storage at 4°C for 7 days the tenderness increased and reached 112% -113% of the original value indicating that the increase of tenderness was continued through aging while water holding capacity (WHC) decreased. They mentioned, that the WHC and tenderness of buffalo meat where better than for camel meat during cold storage. In the other hand, crude protein, collagen and elastin value decreased slightly during aging while ash increased (Table 16).

Eating quality

The LD muscle was found to have more soluble collagen than the ST and TB muscle. TB had the highest shear force values, maximum connective tissue strength and least collagen solubility indicating that it will be the toughest muscle in this group (Babiker and Youssif, 1990).

Meat eating quality was assessed, the meat having been cooked in traditional way (40 minutes in boiling water. Theses six muscles (PM, LD, SM, ST, LV, TB) were ranked by eating quality, sensory tenderness, sensory juiciness, thermal solubility of collagen and cooking loss (Kamoun, 1995b). The ranking was given in table 15. A large range in percent cooking losses was observed, the VL had the highest weight and volume losses (51.1% and 47.8%, respectively) and PM the lowest (44.6% and 41.1% respectively).

The TB and LV muscle were found to have more soluble collagen than ST, PM, LD and SM muscles, possibly indicating less thermal stable bond between collagen molecule and weaker connective tissue structure of those muscles. Muscles of the lumbar region (loin) were more tenders and had less detectable connective tissue than muscle from shoulder and leg. The PM and LD were the most tender muscle and had less detectable connective tissue than all other muscles. However, few tenderness

differences were observed between SM, ST and TB muscles and they were also ranked acceptable for this trait. The VL was the least tender muscle. The LD had the highest juiciness score and the ST and LV were less juicy than PM, SM and TB muscles. The eaten quality of meat from young camels did not change between 1 and 4 years age wile the location of the cut determines to a great extent the tenderness of the meat.

As compared to Steers muscle (LD, ST and TB), camel muscles losses more weight when they were cooked (48±2% versus 37±2%). The camel boiled meat was less juicy than boiled beef meat, however no tenderness differences were observed between meat of the camel and beef. Wile Babiker and Tibin (1986) have reported that camel meat samples have less cooking losses and higher water holding capacity when compared with the beef samples.

With increased age there is an increase in meat toughness; the meat also becomes less testy and of inferior quality. However, Kamoun (1995a, b), noted that age is not a predominant factor in yield variation and meat quality, in the case of dromedaries fed on the same diet and slaughtered between 15 and 51 month of age. Results concerning growth, quality and yield of carcass are discussed in order to draw some practical conclusions regarding, for instance, the best age for slaughtering. This author suggested that the young males must be complemented and slaughtered at 2 years, although it is traditionally done when the animals are 3 years old, a figure consistent with the 3 years given by Dina and Klintegerg (1977). At this age the animals were not yet fully grown, they averaged about 60-70% of full live weight. Their meat is young and tender.

Camel fat

The hump fat and abdominal fat were also used for culinary purposes. The edible fats of the camel are obtained from hump, the mesentery and kidney area. The fat derived from the camel is of very great nutritional importance in meeting the need for fat in the human diet.

Fatty acids composition of the meat and the hump of the camel were studied by Rawdah *et al*., (1994) and the results indicate that the saturated fatty acids in the meat account for 51.5% of total fatty acids, which is higher than the levels found in cattle meat (40.0%), wile the monounsaturated and polyunsaturated chains constitute 29.9 and 18.6%, respectively. The ratio of the polyunsaturated chains to the saturated ones is 0.36 as compared with 0.22, 0.26, and 0.36 in beef, mutton and goat respectively. The major fatty acids in camel meat are palmitic (26.0%), oleic (18.9%) and linoleic (12.1%). The main fatty acid of the hump fat is palmitic (34.4%) followed by oleic (28.2%), myristic (10.3%) and stearic (10.3%). In the other hand Babiker and Tibin (1989) reported that in the pad fat, hump fat and abdominal fat the cholesterol content is 0.16 g/100 g, 28 g/100g and 2.7g/100 g, respectively. So camel meat seems to have low fat and cholesterol content and high level of polyunsaturated fatty acids.

Camel meat product

When camels are slaughtered at the end of their productive live, these old animals often give toughest meat. The conversion of this toughest camel meat to minced meat or to sausages eliminated toughness and reduced the required cooking time.

Camel meat provides an excellent basis for various manufactured and cured forms of meat. It has highly desirable features as a sausage constituent and because of its superior performance, pigmentation and water holding, kebab and kefta makers often incorporate it with other meats.

The camel meat has greater total protein than beef and superior water holding capacity as well as low fat content which make it an ideal lean source for comminuted meat processing (Babiker and Tibin, 1986). Camel meat sausages can form a highly acceptable cooked meal. Then the physical, chemical and palatability aspects of camel sausage and beef were compared by Tibin an Babiker (1989) and they stated that emulsion type sausage camel with 10% and 15% fat were acceptable to the panelists and not significantly different from the beef sausage. Therefore camel and beef meat can successfully replace each other in sausage manufacture.

Conclusion

Despite the paucity of available data, the dromedary appears to be the most advantageous animal for the protein supply of population in arid zone. There is an urgent need to investigate the meat production potential of this species under different management conditions. Further standardization of the methods is necessary to point out the growth patterns, the efficiency of growth, dressing percentages and quality of camel meat.

An indication of weight may be required to determine the exact role of these factors. But, even under conditions where normal facilities are available camel are difficult animals to weight, and on open rangeland the problems are often insuperable.

In the other hand, with this complete chemical analysis, it has been shown that dromedaries have lean meat with high moisture level. In appearance and color, texture and palatability, camel meat is very similar to beef. Total collagen content and percent soluble collagen my be an important factors relating to cooked meat tenderness, although a trend was observed for muscles with higher percent fat to be more tender and more juicy. These data indicate that some muscles could have a potentially greater value if they were separated and used independently.

Camel meat is relatively rich in polyunsaturated fatty acids (18.6%) and its fat content (0.42-3.16%) is significantly low compared with beef (4.0-8.0%). Furthermore the meat is a good source of protein and is rich in mineral constituent. Hence the camel as a meat source seems to present a viable alternative to cattle.

The habit of eating fatty meat may predispose to health risks. The reduction of saturated fat level in the diet is a primary step in avoiding artery-sclerosis. Consequently, now, the general trend in the word is to

have biological meat and labeled lean meat as it is synonymous with good health. Thus the camel meat with its low fat and cholesterol content and high level of polyunsaturated fatty acids is an ideal health food. The camel meat is consumed locally either fresh or preserved. The eaten proprieties of camel and cattle meat are comparable. Nevertheless, evidence is accumulating which indicates that when quality standards are set and adhered to, camel meat can be successfully marked alongside that of cattle, sheep and goat.

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