THE DESERT GOAT AS MEAT ANIMAL

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ABSTRACT

This study is aiming to evaluate meat production as well as meat quality characteristics of mature fattened desert camel.

Fifty-two animals of similar degree of finish were selected from a herd fattened on sorghum grains and green sorghum stover. As indicated by the size of the pen and the age of the animals was about 8 years, while the live weight ranged from 355-456 kg.

Live animal measurements were taken by steel tape immediately before slaughter, they included heart girth, abdominal circumference, neck length, trunk length and hump circumference.

The average slaughter weight was 496 kg and the empty body weight was 404.8 kg. This slaughter weight gave a hot carcass weight of 239.8 kg and a cold carcass weight of 224.7 kg. The dressing percentage was 52.8 percent and 63.6 percent on live and empty body weight base respectively. Camel carcass composition was 56 percent muscles, 19 percent bone, 13.7 percent fat and 7.5 percent trimming. The muscle to bone ratio was 3.4.

Camel body components expressed as percentage of empty body weight indicated that the head was 3.5 percent, the hide was 8.6.
percent, liver was 2.0 percent, intestines were 3.8 percent, stomach was 2.6 percent and the gut fill was 13.7 percent.

The correlations between live animal measurements and body weight was highly positive between heart girth and live weight \((r = 0.74)\). The abdominal circumference measurements and body weight showed medium correlation. The hump depth showed a high correlation \((r = 0.76)\) with carcass side fat while significantly high correlation \((r = 0.97)\) was found between hump fat weight and total carcass fat.

Chemically casei LD muscle had significantly \((P < 0.01)\) lower moisture content than ST and TB muscles. The protein and fat content were not significantly different among the three muscles, but the LD had slightly higher amount of fat than ST and TB muscles. The ash content was significantly \((P < 0.05)\) higher in ST muscles with minimum amount of ash in the LD muscle.

Sarcoplasmic, myofibrillar and non-protein nitrogen were not significantly different among the three muscles studied.

Higher lightness colour values were found in LD while least values were found in the TB muscle. Redness value was significantly
(P < 0.01) higher in LD than ST muscle. Yellowness value was also significantly higher in LD than in ST and TR muscles.

Water-holding-capacity was not significantly different among the three muscles studied. Shear force which measures muscle tenderness was lower in LD muscle, intermediate in ST muscle and higher in TR muscle. Connective tissue strength showed the same trend as shear force values.
1. **Introduction**

According to recent estimates, there are approximately between 2.7 and 4.1 million domesticated camels (Camelus dromedarius) in Sudan. About 50% of the camel population is found in the West of Sudan and most of the rest in the Butana (Sudan, Live Stock Statistics, 1987). The camel represents the most valuable animal for nomadic pastoralists in arid, semi-arid, and tropical areas.

The estimated loss of world camels during 1970's drought amounted to 20-30 percent compared to 100 percent loss in cattle (Morton, 1984). In the last drought, strikes more severe occurred but, actual data are lacking.

Camels are good converters of feed into live weight, disease-tolerant, drought-tolerant, and easily domesticated. Camels are very reliable milk and meat producers and they are essential for the subsistence economy of the nomadic pastoralists. Introduction of camels into pastoralists societies that are smaller to sheep, goats, and cattle has been regarded with extra insurance against effects of drought, in addition commercial livestock numbers could increase without reduction in the numbers of cattle, sheep or goats (Morton, 1984).
The demand for camel meat appears to be increasing among many societies, large numbers of camels are exported from Sub-Saharan countries to Arab and Middle East countries for slaughter (Khoosa, 1976).

In the Sudan, camels represent an important national resource which is not properly managed or utilized. Camel meat consumption is confined to camel rearing districts and the utilization of the camel by-products is completely neglected.

Export trade has a great role where, camels are exported mainly to Egypt. The volume of the export trade varies seasonally and from year to year. The number of camels exported during 1977-80 varied between 196,742 and 338,102 per annum (Halilkar, 1984).

Recently camel meat is exported to Libya in the form of chilled quarters between May-September 1987 when more than 149 tons were exported by the Livestock Producers Co-Operative Corporation.

OBJECTIVE

This study attempted to evaluate the camel as a meat producing animal in the Sudan. Its carcass yield and characteristics as well as meat composition and quality were investigated.
2. LITERATURE REVIEW

2.3 World Camel Population:

The camel is distributed over large arid and semi-arid zones, in addition to that camel breeding which is mainly of nomadic nature make accurate statistics of this species is difficult.

World total camel population is estimated to be 17.5 millions of which 13.2 millions are found in Africa. (FAO, Production year book, 1986).

Sudan and Somalia contains about 50 percent of all world total population and 55 percent of all dromedaries which represent 70 percent of African camels. Sudan contains between 2.7 million camels (Sudan, livestock statistics, 1987). Ethiopia, Chad and Kenya contain 12.5 percent of all world total population. India contains the greatest camel population in Asia which represents 40 percent of the world total population. Pakistan has 18 percent while Afganistan, Iraq, Saudi Arabia and Yemen Arab Republic have important numbers of camels (FAO, 1986).
2.2 Geographical Location and Distribution

Generally the camel is considered as an animal of the tropical but, nowadays it is also found extra-tropical. Commonly the animal is found in arid and semi-arid regions, where low rainfall occurs for a short period. This is followed by a long dry season which is often hot for most of the time and last for over 6 months of the year (Fig. 1).

In the Sudan the camel can survive in a geographical zone of 1.5 million km², but the area inhabited by camels extend between latitudes 10° and 20° north and is bounded by the Ethiopia mountains and the Red Sea Hills on the East and by the Ineensant mountains and Bahr el-Arab in the South, while the topographical demarcation to the eastern and northern ranges is limited by the severity of the conditions that predominate in these parts (Fig. 2). This large area is differentiated into two regions: The Kirta in the East which is enclosed by the Atbara River, Nile and Blue Nile River; and the West comprising Darfur and Kordofan provinces (Sahihir, 1964).
Nowadays the animal is found deep south of these limits, as a result of recent droughts and seasonal migration.

2.3 Camel Pasture:

The dromedary is primarily a browser although grass and other ground vegetation is eaten. The pasture utilized by camels include semi-desert and desert communities such as thorn bushes and desert shrubs. Camels feed mainly from shrubs, bushes and desert trees which represent a very nutritious and reliable forage source.

In the Sudan rain fall in the camel areas occurs seasonally and it varies between 100 and 500 mm/year in southern parts and it goes to over 110 mm/year in the North (Makker, 1980).

This wide range allowed for the growth of different vegetation in both medium and rich savanna in southern extremities and typical desert conditions in the North.

Camel owning tribes are of nomadic nature. The various tribes have different traditional camel migration routes but the pattern is generally similar between tribes. In winter they migrate to the Gizan grazing land of the north west of Sudan at
the Sudan, Chad and Libyan border the plant species of grass
belong to various families as Cenecocollases, Leguminosae,
Succulentae, Mourndaceae, Cruciferae, Gramineae and Cyperaceae.
They all have in common a high percentage of water in their total
mass. The percentage of water content of the plants coupled with
the low winter temperature make the camels independent of free
water for long periods (Salvin, 1984). During summer (March and
June) they return to their homes where they spend the rainy season.

2.4. Camels Breeds:

Camels, or the family of camels, the Camelidae include
the one-humped dromedary camel (Camelus Dromedarius) and the two-
humped camel (Camelus Bactrianus). These two breeds inhabit the
arid regions of Africa and Asia. The dromedary is found in the
warmer areas of North and East Africa, the Near East, India,
Afghanistan and the southern region of USSR. The bactrian camel
is found in the arid colder regions of Asia adjoining the areas
of the dromedary camel (Wilson, 1984).

In the Sudan, the largest population of camels is classified
mainly into riding and pack camel according to the function.
The riding camels refer to the Bishari and Amali types (Bennett, John and Newson, 1943; Mason and Maule, 1960; Epstein, 1971).

The Bishari camel is mainly owned by the Baka tribe in eastern Sudan, where they have two types of riding camels, a southern type around Atbra and a northern type. The southern type has good body conformation than the northern one.

The Bishari camel has certain characteristic features which make it more popular than Amali, such as the short muscular neck with deep strong and well covered shoulder; the chest is wide with shorter back and well developed loin; the Bishari camel have broad thick thighs and muscular fore area.

The Amali type is owned mainly by the Bashida in the Katana area and to some extent by Shukri, Lhahsa and Baishin. This type of camel is higher than the Bishari and camel with a long narrow head (Wilson, 1951).

The pack camel of the Sudan usually referred to as the Arab camel which have heavier weight with well developed hung and short legs.
2.5 Growth and Development

2.5.1 Birth Weight:

The birth weight of the camel calf varies from 26.3 to 31.2 kg, with a mean of 37.3 kg in India (Shergava, Shrotri and Singh, 1969). In Tunisia and Kenya, calves are smaller, weighing on average 25.8 and 30.9 kg respectively (Burgess-Williams, 1975). In the Sudan, camel calves weigh between 22-37 kg (Tablak, 1984). Also Mi-Samin (1973) reported a birth weight between 30 and 60 kg.

Sex differences in birth weight is also encountered and males are slightly heavier than females, 38.2 kg compared to 37.2 kg (Yagil, 1972).

2.5.2 Pre-Weaning Growth Rate:

The pre-weaning growth rate of camel calf depends mainly on management and the quality of milk which is shared by the herd-mates family. In Kenya, in dry years camel calves were found to grow at a rate of 202 g/day up to 6 months of age and better growth rate was noticed during wet years (255 g/day) while gain was higher (655 g/day) when camel calves were allowed to suck their mothers freely (Yildiz, 1973). In Turkestan, the camel calves were reported to grow at a rate of 300 g/day to 3 months of age.
(Singer and Zadi, 1963), while in Tunisian, the growth rate reached up to 500 g/day to 7 weeks of age. Males calves grow at a faster rate than females (Burges-Winter, 1972).

2.5.2 Maturity Weight:

Camels attain maturity comparatively slowly and mature weights are reached at about 8 years of age in males, and 6 years in females. Most breeds at maturity weight 450-550 kg, while the very heavy camels of India weigh up to 660 kg (Wilson, 1984). In the western Sudan, Wilson (1980a) reported mature weights of male camels of 443 kg and 415 kg for females and a mean of 420 kg. Hales (1984) reported mature weight in the range of 550-757 kg for well finished male camels.

2.5.3 Post-Weaning Growth Rate:

The post-weaning growth rate is affected by the husbandry practices and the climatic vegetation conditions during the period of growth. According to Field (1979), there is a marked growth retardation at weaning. Body weight increased almost linearly with age during the first year of life; the growth rate declined slightly at the beginning of the second year as a result
of the relative independence of the young from maternal milk and reliance on vegetable food (Babiker, 1984). Weight gain is maintained steadily well past sexual maturity (Wilson, 1978a).

Sex differences in age encountered where, males had higher weight gain than females (Sohier, Naseem and Wilson, 1985; Margomeister 1973).

2.5.3 Herd Growth Rate:

Herd growth rate varies from 0.3 percent in Asia to 2.0 percent in Africa with an average annual growth rate of 1.4 percent which allows an annual off take of 6.5 percent (Wilson, 1984). In Sudan camel annual off take is calculated to be 6.5 percent (Sudan Animal Resource Statistics, 1986).

2.6 Carcass Characteristics

2.6.1 Carcass Weights and Dressing Percentages:

Data relating to carcass weight and dressing percentage are almost completely lacking. Earlier Congiu (1953) made measurement on 10-12 year old camels. The average dressing percentage for 150 camels was 56.1 percent for males and 54.1 for females and the average carcass yield was 270 kg. The well finished Iranian male
Camel yielded 500-600 kg carcass (Khatami, 1979), while the best Kenyan camels yielded 250 kg carcass (Brennand, 1969). In the Sudan, Wilson (1978a) reported average carcass weight of male Darfur camel of 231.3 kg with a dressing percentage of 51.4 percent, while females had 196.2 kg carcass weight and 47.4 dressing percentage. Recently, Sabiker (1984) reported carcass weight of 351.1 kg for well finished male Sudanese camel.

Age affects on dressing percentage and carcass yield of camel was reported by Kulaeva (1964). He found that 32 month old females had a dressing percentage of 62.3 percent while 20 year old females had a lighter dressing percentage of 54.3 percent.

Compared with dromedary camel, the restricted male camel of Mongolia weighing 750–800 kg produce carcass of 375–425 kg, that contains about 100 kg of fat.

2.6.2 Camel Carcass Composition:

Camel product high-grade meat for human consumption.

Farrier Neari, El-Bahay and Nuniwy (1965) found that the meat content of the average carcass was in the range of 45–70 percent.

Bone in the average carcass will be equivalent to about 20 percent
(Wilson, 1984). The hump fat represents 1.9 percent of the dressed carcass of 24 months old and 5.19 percent of the carcass of 44 month old camel (Bahr et al. 1965).

2.6.3 Body Organs of the Desert Camel

Estimates of different body organs' weight were reported in the literature. In the Sudan southern Darfur camels were reported to have a liver weight of 7.3 kg. Lung and trachea, head (skinned) and feet were found to be 8.4, 12.1 and 14.6 kg respectively. Wet hides weighed between 24.5 and 47 kg with a mean of 34.8 kg which is equivalent to 10.2 percent of the live weight (Wilson, 1975a). The empty stomach and intestines averaged 17 kg and the gut fill averaged 75.4 and 88.2 kg in male and female respectively (Wilson, 1973a).

Habiker (1984) provided net weight of viscera in the range of 30 to 50 kg with a mean of 35.2 kg for Butana camels.

2.7 Desert Camel Meat Quality

Earlier Leopold (1968) described the meat of the camel as palatable, coarse than beef, varying in color from raspberry red to brown red and having white fat. Knowles (1977) and Muhesen (1981) reported that camel compares favorably with other live stock in
case in yield and quality. The quality of meat produced by younger animals (5 year or less) was comparable to beef in taste and texture. However, animals are usually slaughtered at the end of their productive life, therefore camel meat ordinarily available is usually tough. Mukuma (1981) in Kenya reported mean age for 26 animals slaughtered at one market was 14.5 year.

Compared with beef camel meat contained more moisture than beef. The protein content of the camel meat was also significantly \( P < 0.05 \) greater than that of beef. On the other hand intramuscular fat content of the camel meat was significantly \( P < 0.001 \) lower than that of beef. The camel meat was also found to have significantly \( P < 0.05 \) lower nonproteinic protein content. The colour of camel meat was reported to be paler than beef. Possibly due to their lower serum unsaturated fat concentration (Mokhtar and Uthman, 1988).

2.8 Muscle Composition

In proximate composition meat contains 75 percent of water, 10 percent of protein, 2.3 percent of lipid and 5.2 percent of soluble non-protein substances (Hame, 1979). The protein comprises
several components. sarcoplasmic protein (3.5 percent of fresh muscle weight) are soluble in water and dilute salt solution. Many of them are enzymes of the glycolytic pathway. The presence of the sarcoplasm around the muscle fibre note an amorphous barrier or membrane (Goos, 1970) within which the water soluble proteins are normally contained. The myofibrillar proteins (14 percent of fresh muscle weight) include myosin, the mostly abundant protein. This has a molecular weight about 500,000 D and is considered to make up about 54 percent by weight of the myofibrillar proteins (Laurie, 1972) and 6.5 percent of the fresh weight of the muscle (Forrest, Abkerman, Redrice, Judge and Merkel, 1972). it's molecule is built up of light (L) and heavy (H) meromyosines. Heavy meromyosine contains all the ATPase and actin-binding properties of the myosin and is situated at the so-called 'head' end of the ledges-like myosin filament. The back bone of the myosin filament is composed of light meromyosines. Actin which represents about 26 percent of the myofibrillar proteins exists in two form, G-actin, consisting of small globular units and F-actin, in which these globules aggregate end to end to form a double filament of helically oriented globules.
F-actin combines with myosin to form actomyosin during muscle contraction in vivo and in rigor mortis. Troponyosin (0.8 percent of fresh muscle weight) extends along the helical groove in the actin filaments. It forms a net work which joins the actin filaments to the Z-lines (Huxley, 1963). The myofibrillar proteins also include the troponin complex. The latter comprises troponin, C, (which reversibly binds calcium ions and forms an equimolar complex with troponin, T), troponin, I, (22,000 dalton, which inhibits actomyosin ATPase in the presence or absence of calcium ions) and troponin, X, (37,000 dalton) which binds troponins, C, and, T, to troponyosin. M-disco proteins mainly -actin, represents about 5 percent of the total myofibrillar proteins. These can bind F-actin together in vivo to form insoluble aggregates which have no ordered structure. However, in the muscle fibre -actin is found only at the edge of the actin filament where they are attached to Z-disc. The other disc protein is desmin which was found to be the major compound of smooth muscle (Lawrie, 1979).
Domain is probably not part of the Z-disc itself, but rather forms a proteinaeous net-work surrounding the Z-discs of each myofibril. Thus it is possibly responsible for the interlocking of actin filaments at the Z-disc level and thus maintaining their alignment in register (Learie, 1973).

Other minor myofibrillar proteins include M-line proteins (ca 1 percent of myofibrillar protein weight) which hold the L-meromyosin tails of the myosin molecules together in the centre region of each thick filament. γ-actinin, found in the thin filament, and several myosin light elements.

Connective tissue proteins, make up about 2 percent of fresh muscle weight and comprise mainly collagen, reticulin and elastin.

Inorganic components such as phosphorus, potassium, sodium, magnesium and trace elements comprise 0.55 percent of fresh muscle weight. Vitamins are quantitatively minute.

3.9 Meat Quality Attribute

3.9.1 Meat Colour:

Meat colour is known to be an important criterion specially for beef-buying consumers (Hood and Stiplan, 1973; Harrison, Kropf)
and Allen, 1980). Following dressing muscles gradually change colour as they are exposed to air. Initially muscles are purplish in colour, translucent and are jelly like in appearance, when they are fully oxygenated their purplish colour turns to bright red.

Fresh meat colour is defined by the concentration of the pigment myoglobin and by the relative proportions of its three common forms, oxymyoglobin (red), myoglobin (purplish) and metmyoglobin (brown). In both myoglobin and oxymyoglobin, the iron atom is in the ferrous form, but it can be oxidised to ferric state, the compound then receiving the prefix met, thus becoming metmyoglobin. The latter is practically undesirable, not only from the colour standard point of view, but also because ferric ions act as catalyst in the oxidation of unsaturated lipids (Brown and Toppel, 1988).

The concentration of the total pigment is a factor inherent to the type of the muscle (Gord and Woodrow, 1971). The musculature of the species while is almost black in appearance as their myoglobin concentration may reach 5-8 percent of the wet weight of the muscle. The myoglobin of these muscles act as an oxygen store that helps lengthy diving of this species.
species tend to differ in the appearance of their muscles. The low myoglobin content of rabbit muscles causes with superficial paleness of their flesh. Canine meat colour was found to be lighter than beef, that finding was in accord with the low concentration of canine sarcoplasmic proteins which suggest low myoglobin content in canine muscles compared with beef (Habiker and Tabin, 1985).

Within the same carcass different muscles tend to differ in appearance due to the relative proportion of "red" and "white" fibres in them. Muscles operating in short bursts are paler than those carrying sustained action. The diaphragm is more red and has more myoglobin than the L, dorsal muscles as it is constantly operating than the latter muscle (Lamie, 1979).

2.9.2 Water Holding Capacity:

A second important attribute of meat quality is its water holding capacity (MHC). MHC has been defined as the ability of meat to retain its own or added water during the application of some external force (Wang and Hao, 1987) water as present in meat as bound water (5 percent of total water) and free water. Bound water is attached to protein by hydrophilic group, while "free water" is immobilized by the physical configuration of meat protein. Changes
only take place in "free water" and are manifested as weep, drip or shrink.

Water holding capacity of meat is affected by several factors which include species, age and muscle type and function. Pork, for instance has higher water holding capacity than beef. This was accompanied with increased muscle hydration and decreased cooking losses (Habier and Tibbo, 1986). The possible explanation for the superiority of MAD of camel meat over beef is an adaptation of the camel to its dry habitats.

The different domestic muscles differ in their composition. These intrinsic differences are reflected in the variation in muscles quality attributes as water-holding capacity (Laties, 1979).

24.3 Meat Tenderness

Perhaps the most important palatability attribute to the consumer is meat tenderness to which the texture of the meat may also contribute. Sensory perception of texture depends on the deformation resulting from the application of pressure and for surface properties such as toughness, smoothness or stickiness estimated by the sense of touch, while a consumer may develop some
idea of texture by handling the meat, it is more effectively indicated by contact sensation in the mouth. The hard palate determines most of the coarseness of food (Ramsay, 1972).

Visually texture is a function of muscle fibre bundle. The latter are dependent on the rate of growth, age, breed, size and sex. The large size of cattle, in relation to sheep is generally associated with a greater coarseness of their musculature (Ramsay, 1952). Texture may also be implicated in breed differences in tenderness. The relatively greater tenderness of the meat from Aberdeen Angus cattle can be partly explained by their small size. This being reflected in fine grist (Ramsay, 1932a). Carpenter, Palmer, Kirok Peacock and Koger (1953) showed that introduction of Brahman breed decreased beef tenderness.

The state and the nature of muscle proteins are the principal determination of tenderness. Thus there is an inverse relationship between meat tenderness and connective tissue content, but, the situation is complex, since the degree of cross-linkage of the poly peptides of the collagen chains also influences tenderness. The connective tissue content of veal, for instance, is greater than that of beef, yet veal is more tender than beef (Lawrie, 1979). This
contradictions can be explained by the fact that the connective tissue in young animals has a higher quantity of reticulin, and less cross-linking than collagen, (Gray and Hoeesta, 1963). With increasing age the proportion of salt and acid soluble collagen decreases in bovine muscles. The texture of intra- and inter-molecular cross linking between the polypeptide chains of collagen consistently increases (Carmichael and Laurie, 1967a,b). Further reflections of the changing character of collagen with increasing animal age include a decreasing solubility on heating (Sharp, 1963) and decreasing susceptibility to attack by enzymes (Coll, Hoeesta and Gray, 1964).

There are a distinct differences in tenderness between muscles. Shear force was found to be higher in the sternomembranous than in the faciae major. The faciae major was found to have the least hydroxy proline (hydroxy can be equated to connective tissue) content in the carcasse muscles (Laurie, 1963).
3. MATERIALS AND METHODS

3.1 Nature of the Study

The study comprised two parts. The first part was concerned with the chemical composition and quality attributes of the male camel meat, while the second part dealt with the chemical composition and quality attributes of the male camel meat.

3.2 Experimental Animals

Fifty two male, mature, well-finished single hump camels, with a live weight ranging from 395 to 525 kg and an age ranging from 5 to 7 years, were used. These animals were selected from a camel herd being fattened for export slaughter.

3.2.1 Nutritional Background of the Animals

These camels were purchased from the central livestock market at Al-Holeik situated 25 km west of Omdurman. They were then driven on the hoof to the fattening centre at Al-Hassaya on the west bank of the Nile 40 km north of Omdurman. Fattening was performed on a concentrated mix offered ad libitum and constituted of sorghum grains (38%), wheat bran (38%) and cotton seed cake (28%). Green sorghum stover was also offered ad libitum.
3.2 Live Animal Measurements:

All live animal measurements were taken in a recumbent position using a steel tape (Fig. 3). They included:

- Heart girth: was measured by passing the tape immediately anterior to the breast pad.
- Abdominal circumference: was measured at three different locations, anterior to hump, posterior to hump and at hump.
- Trunk length: measured with a steel tape from the first thoracic spine to the root of the tail (the junction of first coccygeal vertebrae).
- Neck length: was measured from atlanto-occipital joint to the first thoracic spine.
- Head length: was measured from the tip of nostrils to the atlanto-occipital junction.
- Hump circumference: was measured with a steel tape around the base of the hump.

3.2.3 Slaughter Procedure and Slaughter Data:

Following 48 hours fast (except for water) the animal was weighed - using a weigh bridge, modified to accommodate the camel on
FIG. 3  LIVE ANIMAL MEASUREMENTS
was weighed full then cleaned of contents and weighed empty. The weight of the gut contents (cul fill) was obtained by adding the stomach content weight to that of the intestines. Weighing of all organs and offals were carried out immediately after dressing to avoid evaporation loss, and the weights were recorded to the nearest gram.

3.1.3 Carcasse Preparation and Weighing:

The carcass was split along the mid-line to give left and right halves which were further divided into fore and hind quarters by cutting along the posterior edge of the 10th rib. The four quarters plus neck were weighed to give hot carcasse weight. Subsequently they were chilled at 4°C for 48 hours.

After chilling, the kidney and kidney knoh channel fat were removed and weighed separately, the left carcasse side was weighed and multiplied by two; the neck was weighed. The two weights were added to give cold carcasse weight.

3.2.3 Carcasse Measurements:

The depth of hump was measured by a steel tape from the highest point of the hump to base of the hump. Hump length was
measured from it's anterior end to it's posterior end along the vertebral column.

3.2.6 Carcase Cutting into Whole Sale Cuts:

Carcase was split into 13 joints (whole sale cuts) according to method 2 described by Meat and Live Stock Commission (M.L.S.C.) (1976) for beef carcases with the exception that the extended thin rib and thick rib joints were extended to include the brisket. The separation procedure of each joint was as follow:

- Neck: separated from the head by cutting at the atlanto-occipital articulation, while removal of the neck from the trunk was already achieved during slaughter by cutting at the first thoracic vertebra.
- Shin: was separated at elbow joint, by following the contour of the skin bone passing through the joint and cutting across the muscle.
- Thick rib (4 bones) and extended thin rib (6 bones):

The two cuts were separated by marking a point on the posterior edge of the 10th rib at a distance measured from the ventral tip of the eye muscle and equal to the double
length of the eye muscle, the two cuts were removed from the carcass by a straight cut from this point to a point on the first rib measured two inches from the ventral edge of the vertebral body. The thick rib was separated from the extended thin rib by a straight cut along the posterior edge of the 4th rib.

Chuck and blade (4 bones) and extended roasting rib (6 bones) were separated from the carcass by cutting vertically along the posterior edge of the 4th rib, while the separation anteriorly was already achieved by removal of the neck and shin. The chuck and blade were separated by a straight cut that extended from the 10th rib to the first rib (two inches from the ventral edge of the vertebral body).

- Hind quarter flanks removed from the carcass by cutting along a straight line extended from a point on the 10th rib located at a distance from the base of the eye muscle equal to the eye muscle length to the ventral tip of the rump muscle.

- Rump: removed by cutting along a straight line extending from a point just clear of the anterior edge of the hip bone-
and posteriorly from a point two inches anterior to the hip bone.

Thick flank plus hamside and silver sides were separated anteriorly by an incised line two inches anterior to hip bone, the thick flank was then separated by cutting along the ventral edge of the hip bone, following the contour of this bone to the ventral edge of the round bone.

Legs were removed from the carcass by cutting along a line parallel to the anterior edge and passing through the stifle joint.

Hump was separated from the sirloin by cutting along a line between the base of hump and the dorsal surface of longissimus dorsi muscle.

Sirloin was separated from the carcass by cutting along the posterior edge of the 10th rib anteriorly. Separation of the sirloin posteriorly and ventrally was already achieved by the removal of the rump and hind quarter flank respectively.

3.2.7 Joints: Preparation:

Joints were placed on wet towels. Using a scalpel (or knife) and forceps, the subcutaneous layer of fat was removed. Visible
blood vessels, nerves and lymph vessels were also removed. Subsequently the muscles were separated from the bone. Inter muscular fat and connective tissues were also dissected out of the muscles. As the different tissues separated they were placed on trays and covered with damp towels to avoid desiccation. Muscles, fat and trimmings (composed of connective tissue, fascia, blood and lymph vessels) were then weighed separately, using a digital balance (Metler PE 15).

The average time taken to dissect the whole carcass side was 4 hours.

1.2.8 Preparation of Data:

Empty body weight was calculated by subtracting the gut fill from the slaughter weight. The weight of body components were expressed as percentage of empty body weight. Whole sale cuts weight were expressed as percentage of sold carcass weight.

Dissection components as muscle, fat, bone and trimmings were expressed as percentage of joint weight.
3.3 Samples for Chemical Analysis and Quality Parameters:

Samples were taken from L. Dorsal, S. tendinous and T. brachii at 48 hours post mortem. Each muscle sample was freed from external visible fat and connective tissue and was sampled for chemical analysis and quality parameter.

Samples for chemical analysis were immediately minced and stored at -10°C awaiting analysis.

Samples destined for quality attributes were allowed to oxygenate for 2 hours at 4°C before color determination. Hunter color components L (lightness), a (redness) and b (yellowness) were recorded using a Hunter Lab tristimulus color meter D 22-2. Subsequently these samples were frozen stored for cooking loss and shear force determination.

3.4 Chemical Composition:
3.4.1 Proximate Analysis:

Determination of total moisture, ash, total protein and fat (other extract) were performed according to AOAC (1975) methods.

3.4.2 Protein Fractionation:

Samples for protein fractionation were trimmed of excessive
subcutaneous connective tissues before mincing. The fractionation procedure was as described by Lawrie (1961).

All fractionation procedure were carried at 4°C. A 5 gram sample was weighed, put into a micro-blender jar maintained in an ice-bath and 50 ml of cold 0.05 M potassium phosphate buffer (pH 7.4) was added. The content of the micro jar were blended at low speed for 5 minutes. After homogenisation, the homogeniate was transferred to 100 ml centrifuge tubes and centrifuged for 20 min. (35000 rpm). The supernatant was kept and the residue was resuspended in another 50 ml of the same potassium phosphate buffer, homogenised and centrifuged as before. The supernatant was decanted and the two solutions obtained were combined and filtered through filter paper (Whatman No. 4) to remove fat and other particulate materials not removed by centrifugation. This combined filtrate contained both sarcoplasmic proteins and non-protein nitrogen reactions. Sarcoplasmic proteins were determined on a ml sample of this filtrate using Biuret method (Gornall, Baraonwell and David, 1949).
A 30 ml sample was mixed with 10 ml of trichloroacetic acid 20% (w/v) for 15 minutes and filtered through filter paper (Whatman No. 1) to obtain non-protein nitrogen in the filtrate. Ejs使人般方法 was used to determine the nitrogen content of this fraction which was then expressed as a percentage of the sample weight.

The residue remaining from the extraction with phosphate buffer was extracted once with 50 ml of cold 1.2M KI in 0.1M potassium phosphate buffer (pH 7.4) using the same method of sarcoplasmic proteins extraction. After centrifugation at 35000 rpm for 20 min., the supernatant was filtered through glass wool and the filtrate was used for subsequent protein determination by biuret method (Cornel et al., 1949).

BSA serum albumin was used as standard for making the calibration curve. The result was expressed as percentage of fresh meat weight.

3.4.3 Fractionation of Intramuscular Collagen:

Samples weighing 5 g were placed into 50 ml centrifuge tubes. 12 ml of 1/4 strength Ringer’s solution were added to each tube.
(Ringer's solution were reported to be more effective than water in weakening the inter molecular forms of collagen). The tubes were heated in a water bath at 77 °C for 70 min. and stirred occasionally. The tubes were then centrifuged at 3000 rpm for 20 min. After centrifugation the supernatants were decanted and the residues were washed with 8 ml 1/4 strength Ringer's solution (at room temperature) and recentrifuged. The supernatants were bulked together to give soluble collagen (Hill, 1966). While the residues represented insoluble collagen.

The hydroxy proline content of both supernatant and residues was determined according to the methods of Stoecken and Stadler (1967).

3.4.4 Hydrolysis:

100 ml of 6N HCl were added to each fraction of supernatant and residue in a digestion flask. The flask was heated to gentle boiling for 16 hours (preferably overnight). The hot hydrolysate was filtered through a filter paper (Whatman No. 1) containing a 1:1 mixture of purified depurinising charcoal and Dowex 1×8 (OH) (Whatman, England) to remove humin and depurinise it. The digestion flask was washed three times with a hot 6N HCl solution and the
samples were added to the hydrolysate. The hydrolysate could be kept at this stage for one week at room temperature.

3.4.5 Hydroxy Proline Determination:

The hydrolysate was diluted with distilled water to 200 ml. A suitable dilution of the hydrolysate was prepared so as to bring the hydroxy proline concentration within the range 1-4 ug/ml (by diluting 70 ml of supernatant and 20 ml of residue hydrolysate with water to 250 ml). Before bringing the volume of the diluted hydrolysate to 250 ml, it was neutralized with 100 NaOH solution to pH 6 using universal indicator.

4 ml of this diluted solution were transferred into a test tube and 2 ml of the reagent were added. The latter consists of 1.1 g chloranil, 10 ml H₂O, 10 ml N-propanol and 60 ml of a buffer solution made up of 50 g citric acid, 12 ml acetic acid, 120 g sodium acetate trihydrate, 34 g NaOH diluted to 100 ml with water and mixed with another 200 ml of H₂O and 300 ml N-propanol. After mixing it was left at room temperature for 20 ± 1 min.

2 ml of colour reagent (10 g 4-dimethylaminobenzaldehyde in 35 ml perchloric acid (60 %) plus 65 ml 40% propanol) were added to the test tube containing the oxidized hydrolysate. The test tube was
well mixed and capped with aluminium foil. It was then quickly transferred into a water bath at $60 \pm 0.5^\circ C$ and heated for exactly 15 min.

The test tubes were cooled in running tap water for at least 3 min. The absorption was measured at 520 nm in an optical glass cell of suitable path length (10 cm) in Spectrophotometer (Model UV-120-82).

For the blank determination the whole procedure was repeated starting with water in lieu of dilute hydrolysate. The hydroxyproline concentration was read from a calibration curve obtained with hydroxyproline standard solutions. A stock solution was prepared by dissolving 100 mg of hydroxyproline in distilled water. One drop of 6N HCl was added to it and the volume was made to 100 ml with distilled water. On the day of use, 1 ml of this stock solution was diluted to 100 ml with water in a volumetric flask. Three standard solutions were then prepared by diluting 30, 20 and 40 ml of the dilute stock solution to 100 ml with water to obtain hydroxyproline concentrations of 1.2 and 4 mg/ml respectively.

The whole hydroxyproline determination procedure was repeated with 4 ml of the 3 dilute hydroxyproline standard solutions.
Absorptions were measured, values were plotted against the concentrations of the hydroxy proline standard solutions and the line of best fit was constructed between the plotted points and the origin.

Hydroxy proline in \( \times \) sample absorption \( \times \) sample weight (g) \( \times \) sample volume (ml)

The collagen content of the sample was calculated from the hydroxy proline content \( X+0.25 \) (Sol et al., 1963).

Total collagen was taken as the sum of soluble and residual collagen.

Hydroxy proline solubility (%) = \( \frac{\text{Soluble hydroxy proline}}{\text{Total hydroxy proline}} \times 100 \)

3.4.6 pH Determination:

For pH determination, sample (weighing approximately 1 g) was homogenized in 50 ml distilled water for 1 min, the pH was then read on a laboratory pH meter, (adjusted with buffer, pH 7.0) at room temperature.

3.5 Quality Attriubutes:

3.5.1 Water Holding Capacity (WHC):

Samples (1 g) from the three muscle samples were used. Each sample was placed on humidified filter paper (Whatman No. 4 in a desiccator over saturated KCl solution) and pressed between two plexi-
glass plates for 3 min. at 25 kg load. The meat film area was traced with a ball pen and the filter paper was allowed to dry. Heat and moisture areas were measured with a compensating Planimeter. The resulting area covered by the meat was divided into the moisture area to give a ratio expressed as moisture-holding-capacity of meat. A larger ratio indicates an increase in the water condition of the muscle or a decrease in the moisture-holding-capacity.

\[
\text{Water holding capacity (MHC)} = \frac{\text{Loose water area}}{\text{Meat film area}}
\]

\[
\text{Meat film area}
\]

3.4.2 Cooking Loss Determination:

Muscle samples were thawed at 5 °C for 24 hours, cut into samples of equal dimensions and weighed. Samples were cooked in plastic bags in a water bath at 80 °C for 30 min., cooled in running tap water for 20 min., dried from fluids and reweighed. Cooking loss was determined as the loss in weight during cooking and expressed as a percent of pre-cooking weight.

\[
\text{Cooking loss} = \frac{\text{Weight before cooking} - \text{weight after cooking}}{\text{Weight before cooking}} \times 100
\]
3.5.3 Objective Measurement of Tenderness and Incisibility:

For shear force and connective tissue strength determinations, an Instron Model 1000 fitted with a Warner-Bratzler shear device was used.

Rectangular meat samples having cross-sectional area of 1 cm² were sheared across the muscle fibre to give shear force values of the muscle fibres. Cubical meat samples (1x1x1 cm) were also cut from the cooked meat and were used to determine connective tissue strength by shearing along the muscle fibre. Many shear force values were determined on each sample and their mean was taken.
### RESULTS

#### 4.1 Live Animal Measurements:

Data related to live animal measurements of mature male Sudanese camels are seen in Table (1). Chest girth ranged from 170 cm to 195 cm, with a mean of 182 cm. Abdominal circumference measured at three locations was highest at hump, intermediate anterior and minimum posterior to hump. Trunk and neck length were 150.5 cm and 112.6 cm, respectively. Hump circumference ranged from 87 cm to 145 cm, with a mean of 116 cm. Hump depth and length were 17.7 cm and 49.6 cm, respectively.

#### 4.1.1 Slaughter Weight and Carcass Characteristics:

Slaughter weight, carcass weight and carcass characteristics of mature male camels are shown in Table (2). Slaughter weight ranged from 393 to 512 kg, with a mean of 450 kg, which empty body weight was 401.8 kg. Hot carcass weight was 257.7 kg and cold carcass weight was 231.7 kg. The camel hot carcass dressed 56.6 percent on live weight base and 61.8 percent on empty body weight base. The cold carcass dressed 55.8 percent on live weight base and 63.8 percent on empty body weight base.
Table 1: External linear body measurements (cm) of the desert camel.

<table>
<thead>
<tr>
<th>Measurement</th>
<th>n</th>
<th>Mean (X)</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
<th>C.V.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart girth (1) (cm.)</td>
<td>52</td>
<td>205.08</td>
<td>170</td>
<td>195</td>
<td>25</td>
<td>3.23%</td>
</tr>
<tr>
<td>Abdominal circumference:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a- Anterior to hump (cm.)</td>
<td>52</td>
<td>204.42</td>
<td>188</td>
<td>222</td>
<td>33.6</td>
<td>3.4%</td>
</tr>
<tr>
<td>b- Posterior to hump (cm.)</td>
<td>52</td>
<td>160.54</td>
<td>145</td>
<td>182</td>
<td>37.54</td>
<td>5.8%</td>
</tr>
<tr>
<td>c- Around hump (cm.)</td>
<td>52</td>
<td>230.7</td>
<td>207</td>
<td>255</td>
<td>48</td>
<td>4.4%</td>
</tr>
<tr>
<td>Trunk length (cm.)</td>
<td>52</td>
<td>150.52</td>
<td>135</td>
<td>170</td>
<td>35</td>
<td>5.9%</td>
</tr>
<tr>
<td>Neck length (cm.)</td>
<td>52</td>
<td>113.63</td>
<td>95</td>
<td>158</td>
<td>63</td>
<td>9.07%</td>
</tr>
<tr>
<td>Head length (cm.)</td>
<td>52</td>
<td>22.31</td>
<td>20</td>
<td>40</td>
<td>20</td>
<td>4.73%</td>
</tr>
<tr>
<td>Hump circumference (cm.)</td>
<td>52</td>
<td>116.35</td>
<td>89</td>
<td>145</td>
<td>56</td>
<td>11.93%</td>
</tr>
<tr>
<td>Hump depth (2) (cm.)</td>
<td>16</td>
<td>17.21</td>
<td>14</td>
<td>21</td>
<td>7</td>
<td>12.38%</td>
</tr>
<tr>
<td>Hump length (3) (cm.)</td>
<td>22</td>
<td>49.55</td>
<td>28</td>
<td>69</td>
<td>41</td>
<td>21.6%</td>
</tr>
</tbody>
</table>

(1) Immediately anterior to breast pad
(2) and (3) Measured on the cold carcass
Table 2: Mean, range and co-efficient of variation (CV) of slaughter weight, carcass weight, and carcass characteristics of the desert camel.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>$\bar{x}$</th>
<th>min</th>
<th>max</th>
<th>C.V.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slaughter weight (kg)</td>
<td>50</td>
<td>486.08</td>
<td>295</td>
<td>512</td>
<td>7.19%</td>
</tr>
<tr>
<td>Empty body weight (kg)</td>
<td>22</td>
<td>364.79</td>
<td>229</td>
<td>473.5</td>
<td>10.03%</td>
</tr>
<tr>
<td>Hot carcass weight (kg)</td>
<td>22</td>
<td>259.73</td>
<td>207.5</td>
<td>295</td>
<td>8.7%</td>
</tr>
<tr>
<td>Cold carcass weight (kg)</td>
<td>22</td>
<td>281.88</td>
<td>200</td>
<td>388.5</td>
<td>9.12%</td>
</tr>
<tr>
<td>Hot dressing percentage (live weight base) (%)</td>
<td>22</td>
<td>59.28</td>
<td>47.22</td>
<td>62.8</td>
<td>6.55%</td>
</tr>
<tr>
<td>Hot dressing percentage (empty body weight base) (%)</td>
<td>22</td>
<td>65.90</td>
<td>53.07</td>
<td>74.86</td>
<td>8.97%</td>
</tr>
<tr>
<td>Cold dressing percentage (live weight base) (%)</td>
<td>22</td>
<td>55.81</td>
<td>51.02</td>
<td>69.15</td>
<td>8.53%</td>
</tr>
<tr>
<td>Cold dressing percentage (empty body weight base) (%)</td>
<td>22</td>
<td>63.56</td>
<td>52.49</td>
<td>74.21</td>
<td>8.96%</td>
</tr>
<tr>
<td>Muscle percentage (%)</td>
<td>9</td>
<td>33.98</td>
<td>43.63</td>
<td>57.39</td>
<td>11.41%</td>
</tr>
<tr>
<td>Bone percentage (%)</td>
<td>9</td>
<td>18.99</td>
<td>13.39</td>
<td>25.52</td>
<td>17.3%</td>
</tr>
<tr>
<td>Fat percentage (%)</td>
<td>9</td>
<td>21.73</td>
<td>6.98</td>
<td>18.37</td>
<td>25.09%</td>
</tr>
<tr>
<td>Trimming percentage (%)</td>
<td>9</td>
<td>7.53</td>
<td>4.35</td>
<td>10.29</td>
<td>26.14%</td>
</tr>
<tr>
<td>Muscle : Bone ratio</td>
<td>9</td>
<td>2.98</td>
<td>2.66</td>
<td>3.33</td>
<td>8.76%</td>
</tr>
</tbody>
</table>
4.1.3 Desert Camel Carcass Dissection:

Data related to camel carcass dissection are also given in Table (2) and appendix (1). The proportion of muscle was 56 percent with a minimum of 43.6 and a maximum of 67.6 percent that of bone was 19 percent with a range of 13.4 to 25.3 percent. Carcass fat was 13.7 percent which ranged from 7 to 18.4 percent. Carcass trimmings had a mean of 7.8 percent. Muscle to bone ratio ranged from 2.7 to 3.3 with a mean of 3.0. Higher coefficient of variations were observed in carcass fat and carcass trimmings, while least variations were observed in carcass muscle.

4.1.3 Wholesale Cuts (WWC) Yield and Composition:

Camel wholesale cuts are shown in Table (3) and appendix (2), where absolute joints weights were given. As seen in Table (3) the thick rib, extended roasting rib and topside and silver side weights as a proportion of the cold carcass weight were the heaviest joints in the carcasses followed by chuck and blade, extended thin rib, rump, neck and sir loin. Carcass joints having lighter weights were the shin, hind quarter flank and leg. The hump weight represented 13.3 percent of the cold carcass weight.
Table 3: Yield of wholesale cuts (%BC) from the desert camel carcass (% of cold carcass side weight)

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
<th>Range</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin</td>
<td>9</td>
<td>4.11</td>
<td>3.66</td>
<td>4.72</td>
<td>8.37</td>
</tr>
<tr>
<td>Chuck and blade</td>
<td>9</td>
<td>7.03</td>
<td>6.51</td>
<td>9.77</td>
<td>12.49</td>
</tr>
<tr>
<td>Thick rib</td>
<td>9</td>
<td>15.38</td>
<td>13.08</td>
<td>17.79</td>
<td>10.68</td>
</tr>
<tr>
<td>Extended thin rib</td>
<td>9</td>
<td>7.98</td>
<td>5.22</td>
<td>9.6</td>
<td>19.52</td>
</tr>
<tr>
<td>Extended roasting rib</td>
<td>9</td>
<td>12.92</td>
<td>10.02</td>
<td>15.75</td>
<td>23.34</td>
</tr>
<tr>
<td>Leg</td>
<td>9</td>
<td>3.25</td>
<td>2.95</td>
<td>3.54</td>
<td>6.04</td>
</tr>
<tr>
<td>Topside and silver side</td>
<td>9</td>
<td>12.68</td>
<td>11.54</td>
<td>14.37</td>
<td>5.3</td>
</tr>
<tr>
<td>Thick flank</td>
<td>9</td>
<td>4.88</td>
<td>3.85</td>
<td>6.15</td>
<td>16.56</td>
</tr>
<tr>
<td>Rump</td>
<td>9</td>
<td>5.61</td>
<td>3.85</td>
<td>9.71</td>
<td>30.98</td>
</tr>
<tr>
<td>Hind quarter flank</td>
<td>9</td>
<td>3.52</td>
<td>1.7</td>
<td>6.12</td>
<td>34.66</td>
</tr>
<tr>
<td>Neck</td>
<td>9</td>
<td>9.95</td>
<td>7.82</td>
<td>10.07</td>
<td>5.57</td>
</tr>
<tr>
<td>Sir loin</td>
<td>9</td>
<td>7.22</td>
<td>5.98</td>
<td>9.77</td>
<td>15.13</td>
</tr>
<tr>
<td>Rump</td>
<td>9</td>
<td>13.34</td>
<td>9.31</td>
<td>19.33</td>
<td>27.49</td>
</tr>
</tbody>
</table>
Joints composition given in Table (4) indicated that joints as thick flank, topside and silver hide and neck had a muscle proportion above 70 percent of the joint weight, in fact the thick flank had a muscle proportion of 82.2 percent. Joints as thick rib, caudal and blade and rump had a muscle proportion which ranged between 60 percent and 66.7 percent. The proportion of bone in (230) was highest in leg and shin joints and minimum in thick flank joint. The proportion of fat higher in the sirloin joint which reached 49.5 percent while minimum fat content of 2 percent was found in the thick flank. The leg and shin joints had the highest proportion of trimming while sirloin had the minimum trimming proportion.

4.1.4 Present Camel Body Components:

Camel body components are given in Table (5) and Appendix (5). The camel head had an average weight of 14.7 kg which represented 3.3 percent of the empty body weight. Camel hide had a weight of 35.5 kg which represented 8.6 percent of the empty body weight. Liver and gut fill weights were 8 kg and 34 kg respectively. As a proportion of the empty body weight the liver was 2 percent and the gut fill was 13.7 percent. The camel heart had a weight of 2.7 kg representing 0.7 percent of the empty body weight.
### Table 4: Desert camel joint composition
(\% of joint weight)

<table>
<thead>
<tr>
<th>Joint</th>
<th>Muscle</th>
<th>Bone</th>
<th>Fat</th>
<th>Trimming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shin</td>
<td>43.01</td>
<td>40.43</td>
<td>-</td>
<td>14.91</td>
</tr>
<tr>
<td>Chuck and blade</td>
<td>64.25</td>
<td>22.46</td>
<td>3.46</td>
<td>8.48</td>
</tr>
<tr>
<td>Thick rib</td>
<td>68.65</td>
<td>13.45</td>
<td>4.41</td>
<td>5.48</td>
</tr>
<tr>
<td>Extended thin rib</td>
<td>50.77</td>
<td>19.9</td>
<td>20.16</td>
<td>9.39</td>
</tr>
<tr>
<td>Extended roasting rib</td>
<td>49.27</td>
<td>24.55</td>
<td>17.18</td>
<td>8.48</td>
</tr>
<tr>
<td>Leg</td>
<td>34.16</td>
<td>43.7</td>
<td>-</td>
<td>22.43</td>
</tr>
<tr>
<td>Topside and silver side</td>
<td>77.33</td>
<td>14.73</td>
<td>3.37</td>
<td>5.32</td>
</tr>
<tr>
<td>Thick flank</td>
<td>82.18</td>
<td>2.71</td>
<td>2.8</td>
<td>21.83</td>
</tr>
<tr>
<td>Pump</td>
<td>60.09</td>
<td>21.28</td>
<td>12.43</td>
<td>6.57</td>
</tr>
<tr>
<td>Hind quarter flank</td>
<td>55.64</td>
<td>9.14</td>
<td>21.48</td>
<td>32.01</td>
</tr>
<tr>
<td>Neck</td>
<td>72.36</td>
<td>20.66</td>
<td>-</td>
<td>7.47</td>
</tr>
<tr>
<td>Sir loin</td>
<td>52.17</td>
<td>14.43</td>
<td>49.39</td>
<td>3.3</td>
</tr>
</tbody>
</table>
Table 3: Desert camel body components
(% of empty body weight)

<table>
<thead>
<tr>
<th>Component</th>
<th>n</th>
<th>X</th>
<th>min.</th>
<th>max.</th>
<th>C.V.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>22</td>
<td>3.5</td>
<td>2.7</td>
<td>4.32</td>
<td>15.17</td>
</tr>
<tr>
<td>Hide</td>
<td>22</td>
<td>5.57</td>
<td>7.15</td>
<td>11.75</td>
<td>11.67</td>
</tr>
<tr>
<td>Front feet</td>
<td>22</td>
<td>3.55</td>
<td>2.91</td>
<td>4.44</td>
<td>15.53</td>
</tr>
<tr>
<td>Stomach weight (full)</td>
<td>22</td>
<td>15.16</td>
<td>9.83</td>
<td>19.65</td>
<td>22.58</td>
</tr>
<tr>
<td>Intestine weight (full)</td>
<td>22</td>
<td>5.63</td>
<td>3.45</td>
<td>7.38</td>
<td>13.22</td>
</tr>
<tr>
<td>Stomach weight (empty)</td>
<td>22</td>
<td>2.55</td>
<td>2.93</td>
<td>4.63</td>
<td>17.38</td>
</tr>
<tr>
<td>Intestine weight (empty)</td>
<td>22</td>
<td>3.51</td>
<td>2.92</td>
<td>4.78</td>
<td>19.73</td>
</tr>
<tr>
<td>Mesenteric fat</td>
<td>22</td>
<td>1.43</td>
<td>0.16</td>
<td>2.27</td>
<td>1.36</td>
</tr>
<tr>
<td>Kidney</td>
<td>22</td>
<td>0.4</td>
<td>0.16</td>
<td>0.7</td>
<td>30.06</td>
</tr>
<tr>
<td>Liver</td>
<td>22</td>
<td>2.03</td>
<td>1.26</td>
<td>2.76</td>
<td>19.13</td>
</tr>
<tr>
<td>Heart</td>
<td>22</td>
<td>0.71</td>
<td>0.13</td>
<td>1.56</td>
<td>32.26</td>
</tr>
<tr>
<td>Reproductive organs</td>
<td>22</td>
<td>0.13</td>
<td>0.1</td>
<td>0.21</td>
<td>18.76</td>
</tr>
<tr>
<td>Tail</td>
<td>22</td>
<td>0.36</td>
<td>0.19</td>
<td>0.49</td>
<td>19.96</td>
</tr>
<tr>
<td>Lung and trachea + diaphragm</td>
<td>22</td>
<td>1.47</td>
<td>0.09</td>
<td>2.3</td>
<td>22.19</td>
</tr>
<tr>
<td>Spleen</td>
<td>22</td>
<td>0.18</td>
<td>0.04</td>
<td>0.18</td>
<td>23.12</td>
</tr>
<tr>
<td>Gut fill</td>
<td>22</td>
<td>13.56</td>
<td>3.39</td>
<td>20.62</td>
<td>33.55</td>
</tr>
</tbody>
</table>
4.2 Simple Correlation Coefficient Between Slaughter Weight, Live Animal Measurements and Carcass Fat Weight:

Simple correlations between slaughter weight, live animal measurements and carcass fat of mature male Sudanese steers are given in Table (6). Heart girth had significantly ($P<0.001$) high correlation ($r = 0.7$) with slaughter weight. A significantly ($P<0.01$) medium correlation of 0.41 was observed between abdominal circumference posterior to hump and slaughter weight. Although significant ($P<0.05$), the correlation between hump circumference and slaughter weight was low ($r = 0.38$). Medium non-significant correlations were found between slaughter weight and total hump fat weight and total carcass fat weight including that of hump.

4.3 Simple Correlation Coefficient Between Carcass Fat and Hump Measurements:

Table (7) shows simple correlations between carcass side fat and hump measurements. The hump depth had significantly ($P<0.01$) high correlation with carcass side fat including and excluding hump fat and side hump fat weight. The respective correlations were 0.84, 0.84 and 0.86. The correlations between hump circumference and carcass side fat including hump fat, carcass side fat excluding
Table 6: Simple correlation coefficient between slaughter weight ($x_1$), live animal measurement ($x_2$), carcass fat ($x_3$) and total hump fat ($x_4$) of the desert camel.

<table>
<thead>
<tr>
<th>$x_1$</th>
<th>$x_2$</th>
<th>$r$</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slaughter weight</td>
<td>Heart girth</td>
<td>0.667</td>
<td>0.001</td>
</tr>
<tr>
<td>Slaughter weight</td>
<td>Trunk length</td>
<td>0.235</td>
<td>NS</td>
</tr>
<tr>
<td>Slaughter weight</td>
<td>Abdominal circumference (anterior to hump)</td>
<td>-0.12</td>
<td>NS</td>
</tr>
<tr>
<td>Slaughter weight</td>
<td>Abdominal circumference (posterior to hump)</td>
<td>0.406</td>
<td>0.01</td>
</tr>
<tr>
<td>Slaughter weight</td>
<td>Abdominal circumference (fat hump)</td>
<td>0.233</td>
<td>NS</td>
</tr>
<tr>
<td>Slaughter weight</td>
<td>Total hump fat weight</td>
<td>0.508</td>
<td>NS</td>
</tr>
<tr>
<td>Slaughter weight</td>
<td>Total carcass fat (excluding hump fat)</td>
<td>0.277</td>
<td>NS</td>
</tr>
<tr>
<td>Slaughter weight</td>
<td>Total carcass fat (including hump fat)</td>
<td>0.431</td>
<td>NS</td>
</tr>
<tr>
<td>Slaughter weight</td>
<td>Hump circumference</td>
<td>0.281</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Table 7: Simple correlation co-efficient between carcass side fat and hump measurements of the desert camel

<table>
<thead>
<tr>
<th>X1</th>
<th>X2</th>
<th>r</th>
<th>significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcass side fat</td>
<td>Hump depth</td>
<td>0.341</td>
<td>0.01</td>
</tr>
<tr>
<td>(including hump fat)</td>
<td>Hump circumference</td>
<td>0.47</td>
<td>NS</td>
</tr>
<tr>
<td>Carcass side fat</td>
<td>Side hump fat weight</td>
<td>0.276</td>
<td>0.003</td>
</tr>
<tr>
<td>(including hump fat)</td>
<td>Hump depth</td>
<td>0.345</td>
<td>0.03</td>
</tr>
<tr>
<td>Carcass side fat</td>
<td>Hump circumference</td>
<td>0.467</td>
<td>NS</td>
</tr>
<tr>
<td>(excluding hump fat)</td>
<td>Side hump fat weight</td>
<td>0.346</td>
<td>0.001</td>
</tr>
<tr>
<td>Carcass side fat</td>
<td>Hump depth</td>
<td>0.359</td>
<td>0.01</td>
</tr>
<tr>
<td>(excluding hump fat)</td>
<td>Hump circumference</td>
<td>0.47</td>
<td>NS</td>
</tr>
</tbody>
</table>
Hump fat and total side hump fat was medium \( r = 0.47 \). Significantly \( P<0.001 \) highly positive correlations were observed between overall side weight including and excluding hump fat and side hump fat weight.

4.4 Chemical Composition of the Desert Canol Meat:

The chemical composition of the muscle L. dorzi, SF and TB of mature male camels are given in Table (8).

L. dorzi muscle had significantly \( P<0.001 \) lower moisture content than (SF) and (TB) muscles, which they have nearly equal moisture.

The protein and fat content of the three muscles were not significantly different among the three muscles.

The ash content was significantly \( P<0.05 \) different among the three muscles studied. SF muscle has the highest amount of ash, (TB) muscle had the least ash content while (SF) had intermediate amount of ash.

Serum globulin protein concentration, though significantly not different, was higher in (TB), lower in (LB) and of intermediate value in (SF) muscle. Myofibrillar protein were not significantly different among the three muscles. Non-protein nitrogen was
Table 8: Chemical composition of the dorsal, longissimus, and brachial muscles.

<table>
<thead>
<tr>
<th></th>
<th>L. dorsal</th>
<th>S. longissimus</th>
<th>T. brachii</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture (%)</td>
<td>72.36b</td>
<td>73.81a</td>
<td>74.27a</td>
<td>0.45</td>
</tr>
<tr>
<td>Protein (%) (N X 6.25)</td>
<td>21.53</td>
<td>21.61</td>
<td>22.13</td>
<td>0.35</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>0.58</td>
<td>0.55</td>
<td>0.57</td>
<td>0.11</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>1.05a</td>
<td>1.33a</td>
<td>1.22a</td>
<td>0.38a</td>
</tr>
<tr>
<td>Sarcoplasmic protein</td>
<td>6.45</td>
<td>6.91</td>
<td>5.76</td>
<td>0.24</td>
</tr>
<tr>
<td>Myofibrillar protein</td>
<td>11.33</td>
<td>11.48</td>
<td>11.31</td>
<td>0.15</td>
</tr>
<tr>
<td>Non-protein-Nitrogen</td>
<td>0.76d</td>
<td>0.52e</td>
<td>0.52d</td>
<td>0.01</td>
</tr>
<tr>
<td>Hydroxy proline solubility</td>
<td>2.37h</td>
<td>1.72h</td>
<td>0.66h</td>
<td>0.28</td>
</tr>
<tr>
<td>Total collagen (%)</td>
<td>9.22d</td>
<td>4.92c</td>
<td>6.44d</td>
<td>0.69</td>
</tr>
<tr>
<td>Muscle pH</td>
<td>5.89</td>
<td>5.72</td>
<td>5.63</td>
<td>0.03</td>
</tr>
</tbody>
</table>

* % of fresh muscle weight

Means on the same line with different superscripts differ significantly

(P < 0.001 for a, b, P < 0.05 for c, d, e, and
P < 0.01 for f, g, h, i, j, k)
significantly \((P<0.01)\) higher in (LD) muscle than in (ST) and (TB) muscles.

4.3 Eating Quality Attributes of the Desert Camel Meat:

(Table 9) shows the eating quality attributes of camel carcass muscle on (LD), (ST) and (TB). Hunter lightness \((L)\) value though not significantly different between the three muscles was higher in (LD), intermediate in (ST) and lower in (TB). Redness \((a)\) value was significantly \((P<0.01)\) higher in (LD) than in the (ST) muscle. In fact (ST) muscle had the least value of that colour component. Yellowness \((b)\) value was significantly \((P<0.01)\) higher in (LD) than in (ST) and (TB) muscles.

Water Holding Capacity (WHC) was not significantly different among (LD), (ST) and (TB) muscles. Cooking loss was significantly \((P<0.01)\) lower in (LD) than in (ST) and (TB) muscles.

Shear force which measures muscle fibre strength though not significantly different was higher in (TB) muscle intermediate in (ST) muscle and lower in (LD) muscle. Connective tissue strength measured by shearing along the muscle fibre showed the same pattern of change as shear force. (TB) muscle had significantly \((P<0.001)\) weak connective tissue than (ST) and (TB) muscles.
Table 9: Desert camel meat quality

<table>
<thead>
<tr>
<th></th>
<th>L. dorsal</th>
<th>S. tendinosus</th>
<th>T. brachii</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour *</td>
<td>32.23</td>
<td>30.67</td>
<td>29.69</td>
<td>0.96</td>
</tr>
<tr>
<td>L</td>
<td>17.12</td>
<td>13.77</td>
<td>15.89</td>
<td>0.6</td>
</tr>
<tr>
<td>a</td>
<td>9.81</td>
<td>7.11</td>
<td>7.79</td>
<td>0.36</td>
</tr>
<tr>
<td>Water holding capacity</td>
<td>2.2</td>
<td>2.1</td>
<td>2.32</td>
<td>0.23</td>
</tr>
<tr>
<td>Cooking loss (%)</td>
<td>39.95</td>
<td>33.23</td>
<td>39.07</td>
<td>1.06</td>
</tr>
<tr>
<td>Shear force (kg/cm²)</td>
<td>4.84</td>
<td>5.67</td>
<td>5.75</td>
<td>0.29</td>
</tr>
<tr>
<td>Connective tissue strength (kg/cm²)</td>
<td>3.48</td>
<td>4.13</td>
<td>0.15</td>
<td></td>
</tr>
</tbody>
</table>

Colour: L = degree of whiteness,
        a = degree of redness
        b = degree of yellowness

* e, d, c, b, f, P<0.01
* g, h, i, j, P<0.001
5. DISCUSSION

5.1 Slaughter Weight

The average slaughter weight was 426.2 kg with a minimum
of 305 kg and a maximum of 542 kg. Wilson (1978) reported a mean
weight of 16 mature male camels of Southern Darfur of 476 kg with
a range of 340 to 581 kg. He also reported a mean weight of 447.9 kg
of 21 male camels from the same area. This discrepancy in Wilson's
work may be due to the small sample size in the two reports. The
average slaughter weight reported here agrees with values (450 kg)
reported earlier by Nason and Mawla (1960) for the Sudanese camels,
but is greater than the value given by Burnett, Julian, Astin and
Karkour (1964) for Sudanese Kishk and Abasal camels. The latter
camel breeds being race animals are famous for their lighter
weights. Compared with other African and Asian camels, the Sudanese
camels are heavier than the Bedouin-Ophra type animals of Kuwait
whose live weights are between 400–500 kg but, lighter than the
heavy race Indian and Somali camels which reach the weight of 600–
700 kg at the age of 6 years (Selam and Wilson, 1983).
5.1.1 Dressing Percentage:

The mature, well finished Sudanese male camels were found to have hot and cold dressing percentage of 55.6 percent and 63.6 percent on live weight base and 55.6 percent and 63.6 percent on empty body weight base. Wilson (1972) reported a hot dressing percentage of 51.5 percent for Southern Damar male camels which is lower than the value reported here. This is possibly due to differences in the degree of finish as Wilson's study was performed in camels slaughtered for rural consumption which are generally lean animals while this research was conducted in well finished animals destined for export slaughter.

Kulasekara (1964) found that the dressing percentage of the dromedary varies from 55-70 which encompasses the value reported here for the Sudanese camels. Similarly Shalosh (1978) reported a dressing percentage in the range of 55 to 70 percent for camels which also embraces the dressing percentage values calculated for the Sudanese camels.

5.1.2 Carcass Weight:

The hot and cold carcass weights of mature male camels given in Table (2) indicated that a dromedary having a live weight of 400 kg
can yield a hot carcase of 259.8 kg, which after chilling weight 251.7 kg. A carcase weight of 231 kg was given for males and 196 kg for females in Southern Darfur camel (Wilson, 1977). These values are lower than the carcase weights reported in this study and here again differences in the degree of finish may be implicated.

Babiker and Yousef (1987) reported hot and cold carcase weights of seven Sudanese male camels as 261 and 255 kg which are similar to the finding of this study.

5.1.5 Carcase Composition:

As seen in Table (2) camel carcase dissection yielded 56 percent muscles, 19 percent bone, 13.7 percent fat and 9.3 percent trimmings. Babiker (1984) reported that the proportion of red muscles in seven Sudanese camels was 60 percent which is slightly higher than the value reported in this study. Nair et al., (1985) and Kusnecev and Tretjakov (1970) reported camel carcase composition similar to the value found in this study.

Compared with beef camel carcase has less lean 68.6 percent for beef and 56 percent for camel carcase (Allen and Kilkenny, 1984). The proportion of the bone in the camel carcase was found to be 29 percent which was similar to values reported by Wilson (1984) for
average camel carcass but, was higher than that of beef (17%) due
to the long legs and neck of the camel. The fat percentage of the
camel is similar to that of the beef carcass (14%) but, partitioning
of fat differ. Unlike beef camel fat is deposited mainly in the hump.
The muscle to bone ratio of the camel carcass was found to be 3.0
which is similar to values reported for beef cattle in the Sudan
(Gaill and Osman, 1977). Carcass trimming averaged 7.4 percent with
a range of 4.4 to 10.3 percent. These values are higher than values
reported for cattle in the same locality (Gaill and Osman, 1977),
possibly due to the large frame of camels which necessitates a lot
of tendons and ligaments for the attachment of muscles to bones.

5.1.4 Wholesale Joint Yield:

Similar to beef heavier wholesale joints as topside and
silver side, rib, and extended roasting rib were obtained from the
proximate part of the hind quarter and the dorsal area posterior to
the 5th rib (Preston and Willka, 1975). The proportion of the high
price cut on the sirloin and rib was similar to that in the beef
carcass (MIL, 1974). The neck represented about 20 percent of the
carcass due to its long length which reaches 180 cm. The hump which
in a fat depot weighed 16 kg which represented 33.3 percent of the
condition weight. These values agree with values reported for Somali
camel breeds weighing 270 kg (Coquir, 1953). Wilson (1978) reported
a weight of 4 kg for the hump of Southern Berber camels. This value
is far below the one reported here possibly due to differences in the
nutritional status of the animals in the two studies. The hump being
a fat depot that is used for maintenance when grazing is poor
(Mekasa, 1981) tend to fluctuate in size according the level of
nutrition of the camel, this is clearly seen in the range of camel
hump weight. In this study hump weight ranged from 7.3 kg to 18.3 kg
with a coefficient of variation of 27.4 percent. Coquir (1953) gave
range of 3 kg to 9 kg for the weight of the hump of the Somali camel.
Wilson (1974) questions estimates of the contribution of the hump
fat to total carcass weight greater than 5 percent. This work tends
to disagree with Wilson and in line with the earlier findings of
Coquir.

3.1.5 Joint Composition:

In beef the desirable muscles which make up first quality meat
(big muscle suitable for grilling or roasting) are situated in the
proximity parts of the hind limbs and the dorsal area posterior to the
5th rib. These muscles are found in whole aged joints as top side and silver side, rump, loin and extended roasting rib. Camel carcass yields high prized cuts from the proximal part of the hind limbs as top side and silver side, rump and from the dorsal area posterior to the 5th rib as thick rib and extended roasting rib. Contrary to beef camel loin joint is the fattest joint in the whole carcass. Its fat content is 49.4 percent of the whole joint due to the presence of the hump. The neck joint has a high proportion of muscle 72 percent and is devoid of fat. The shin and leg have low proportion of muscle and high proportion of bone as the tibia and fused radius and ulna are very long in the camel.

5.1.6 Desert Camel Body Components:

The desert camel's head weighed 15.1 kg which represented 1.5 percent of the slaughtered weight, agreeing with values reported for Southern Barbar camels (Wilson, 1978a). Hide, foot and liver weights given in Table (1) correspond those given by Wilson (1978a) for Southern Barbar camels, however, the liver weight was lower than the value reported by Craigie (1953) for Somali camels having a carcass weight of 270 kg. The Somali camels in this study are expected to have...
Heavier live weights than the ones involved in this study, which explain the differences in liver weight.

Compared with mature zebu cattle from the same locality Galli and Canan (1977), the camel was found to have similar head weight (14.1 kg for camel and 13.6 kg for cattle), heavier hide weight (35.8 kg for camel and 27 kg for cattle) and heavier feet weight (14.4 kg for camel and 6.7 kg for cattle). This difference in skin and feet may be due to the large frame of camels. The camel was also found to have heavier heart, alimentary tract and lung and trachea weights than mature zebu cattle values reported by Galli and Canan (1977). In fact the weight of lung and trachea of the camel was almost double that of cattle and here again the long neck of the camel compared with cattle which necessitates long trachea must be implicated. The fact that the genital organs of the camel weighed 0.6 kg which represented 0.12% of the empty body weight is far lighter than the weight of genital organs of zebu cattle reported by Galli and Canan (1977). In addition to that camel genital organs weight showed greater variability (Table 5). These findings can be explained by the seasonality of the camel sexual activity. The
camel testicles undergo fluctuations in weight where maximum testicular weights are reached during the rutting months (Osen, Modee and Tingari, 1979; Tingari, Ramos and Biali, 1984).

5.2 External Linear Body Measurements:

5.2.1 Heart Girth:
The mean heart girth value reported in this work was 182.08 cm. higher than the values reported by Wilson (1978) for southern Darfur camel (150-193 cm) probably due to variation in body conformation and degree of finishing. In this work heart girth did not correlate well (r = 0.69) with slaughter weight and this was in accord with value (r = 0.99) reported by Bucci, et al., (1984) for Nubian (Sachari and Abbadi) breeds.

5.2.2 Abdominal Circumference:
Abdominal circumference posterior to hump is smaller than that anterior to hump as the volume of the camel abdomen is smaller than that of it's coat, in addition to abdominal shrinkage as a consequence of pre-slaughter fasting. The abdominal circumference around hump varied from 209 to 255 cm. and this was due to the variability in hump depth Table (1). Bucci, et al., (1984) reported a mean abdominal circumference takes around hump of 231 cm. which is similar to
the mean abdominal circumference value found in this work.

1.3.3 Hump Measurements:

Hump circumference, depth and length were the most variable measurements recorded. These measurements are affected with the nutritional state of the camel. Under good feeding conditions the hump size increases and degenerates considerably during starvation.

5.3 Simple Correlation Coefficients Between Live Animal Measurements and Slaughter Weight:

The correlation between heart girth and slaughter weight was 0.67 which was highly significant. Bucci et al., (1984) reported a correlation of 0.59 for heart girth and body weight of Sudanese camel kept in Egypt. However, Wilson (1978a) gave a significantly high correlation coefficient of 0.62 between heart girth and live weight of male camel and of 0.58 for both male and female camels. Low non-significant correlation was found between abdominal circumference at hump and slaughter weight which contradicted the value (r = 0.4) reported by Bucci et al., (1984) for Sudanese camel kept in Egypt.
5.4 Simple Correlation Coefficient Between Hump Measurement and Carcass Fat:

The correlation between hump measurements and carcass fat given in Table (7) indicated that hump depth was a satisfactory predictor of carcass fat and hump fat weight. Hump depth was strongly correlated with carcass side fat ($r = 0.84$, $P < 0.01$) and side hump fat weight ($r = 0.86$, $P < 0.01$) while hump circumference did not significantly correlate with carcass side fat ($r = 0.47$), probably due to variability in hump conformation.

5.5 Meat Chemical Composition:

5.5.1 Protein and Fat:

There was no significant different in the protein and fat content among the three muscles studied (Longissimus Dorsi, Semitendinosus and Triceps Brachii) and the result reported in this work were in accord with corresponding values reported by Nasr al et al. (1965) Abde Mani (1973) and Huweil, H plumber, Sherif and Yousif (1962).

5.5.2 Moisture:

Moisture content was significantly ($P < 0.001$) higher in ST muscle than in TB and L. Dorsal muscle this was explained by the lower content of intramuscular fat of this muscle.
5.3.3 Ash

Ash content was significantly (P<0.05) higher in D than that of L. dorsi and ZL muscles.

The values for moisture, protein, fat and ash contents of these muscles were similar to values reported by Abdel Baki et al. (1997); Hammou et al. (1992) and Naar et al. (1969). They found that the chemical composition of the L. dorsi obtained from camels over 5 years of age had an average 19.4 percent protein, 72.2 percent moisture, 2.6 percent fat and 1.1 percent ash while the round muscle had 19.3 percent protein, 78.3 percent moisture and 3.61 percent fat. On the other hand, shoulder muscle were reported to contain 23.3 percent protein, 70.2 percent water, 0.9 percent fat and 0.79 percent ash.

5.3.4 Protein Fractionation

There is no significant different in the concentrations of sarcoplasmic and myofibrillar proteins among the three muscles, the concentrations reported here were in line with corresponding values reported by Bakker and Shibuya (1965) for camel L. dorsi muscles.

However, the concentration of non-protein nitrogen was significantly (P<0.01) higher in L. dorsi muscles. This possibly due to intramuscular difference in chemical composition reported by Larría (1975).
Compared with beef, camel meat had significantly lower sarcoplasmic proteins and non-proteins nitrogen. However, the concentration of sarcoplasmic protein was similar in the L. dorsi of the two species. Camel meat had more moisture and significantly (P < 0.01) less fat content than that of beef (Bakker and Thon, 1985).

No significant different was observed in the water holding capacity among the three muscles. However, cooking loss was significantly (P < 0.1) higher in S1 muscle than L. dorsi and TB muscles, probably due to the lower content of intra-muscular fat of this muscle.

2.6 Eating Quality Attribution of the Desert Camel Meat—

The fact that camel L. dorsi muscle is lighter in colour compared with the other muscles, semitendinosus and triceps brachii, agrees with the findings that the concentration of sarcoplasmic proteins in L. dorsi muscle is lower than that in the other muscles. Table (2) muscle sarcoplasmic which affects colour in meat is an important fraction of the sarcoplasmic proteins which suggests lower concentration of this colour component in the L. dorsi muscle than in the other two muscles studied.
Significantly (0.01) lower cooking losses were found in
small tenderness muscle than in L. dorsi and triceps brachii muscles
possibly to its superior water holding capacity (pH).

Shear force values were lower in the L. dorsi than in ST and
TB muscles similarly connective tissues were significantly (P<0.01)
weaker in small L. dorsi than in ST and TB muscles indicating that
the former muscle was tender than the latter two muscles. The
toughest muscle was the TB. The latter muscle had the highest shear
force and connective tissue strength as well as the least soluble
collagen.
CONCLUSION

The camel is disease-tolerant, drought-tolerant and efficient converter of feed into meat. At a mature weight of 456 kg the camel can produce a carcass of 260 kg whose composition is 56% meat, 18% bone and 14% fat.

At an offering rate of 6.5% the world total meat production can be estimated to be 287300 tons of meat. In the Sudan the expected meat production from camels is 45630 tons. The amounts of meat can contribute in solving animal protein shortage particularly in least developed and drought-striken areas.

Increase camel numbers will increase production from marginal lands and habitats difficult to other livestock as cattle and sheep. Also will help in the survival of pastoralists. In addition to that sale of excess camels whether for local consumption or for export trade will augment pastoralists and country income.

The camel carcass yielded wholesale cuts whose composition is similar to that of beef wholesale cuts. For instance high priced cuts as topside and silver side has a muscle proportion of 77% and the rump has a 60% muscle proportion. In encouraging camel meat consumption will result in surplus beef for export trade.
The fact that the camel fat is deposited mainly in the hump is an advantage which ease joint preparation with minimum amount of trimming. Also, fat processing can easily be established if centralized cutting and preparing of camel carcass is performed.

Chemically the camel meat had low fat content (6.57 %) which makes it an ideal health food.

The meat produced from camels slaughtered for local consumption is alleged to be of low quality. This is possibly due to old age and poor nutrition state of slaughtered camels. Finishing of camels on improved diets is expected to improve meat yield and quality. In addition to that, feeding young camels under feed lot conditions is expected to shorten the period to the attainment of slaughter weight and greatly improve meat yield and quality.

Recommendations for research:

1. Collection of basic data on camel meat production from arid and semi-arid zones.
2. Camel ranching schemes should be initiated in marginal lands unsuitable for other livestock.
3. Performance of weaned camel calves under intensive systems compared with that under browsing condition
should be studied.

4. Comparative study of the performance of camel and
cattle under intensive and extensive systems should be
studied.

5. Comparative study of camel meat composition, quality
and processing properties with that of beef need to be
investigated.
يهدف هذا البحث إلى تقييم انتاجية ونوعية لحوم الأسماك الصحراء الأسلمة.

استغلت التجربة على (22 حرفًا) تم اعتبارها من ظل رضيع للتدريب حيث تم تحسينه بواسطة الشتر والرطوبة المعتدلة (أوعي الفصيحين) وواستغلال الأوزان المبكرة بين 120 و60 كجم بإعداد فرق تكاثرية

التي قادت كل من البهتم عند نقطة الصدر والرقبة والسيما.

وتم قراءة كل من الرقيق والعصر بواسطة مقياس ضئيج قبل الذبح.

وقد تمت إجراءات التحليلات عن طريق انجزي جهاز ديجيتال. حسب رئيسي وسبيس وسبيس وكاشف. وتم قياس نسبة الحمض في هذه الرسالة 8.5% عند الأوزان المبكرة 128 و 138.8/3 على أساس الوزن المثالي.

عند تحليل النتائج كانت نسبة اللحم 56% للعظم 44%، الدهن 12.8 ومر 2 للشفت نسبة اللحم للعظم 3

كانت البذور النباتية (10 من الوزن المثالي) لكل من الأوزان ورج ورج، 20.3% من النباتات، البدن والكبد 12.7 % و20.3% في النباتات المتاحة الأحماض.

هكذا أن العلاقة بين الوزن الحي والدهن عند البشرة الطيرية محدودة (82%) بالرطوبة بين الوزن الحي والدهن عند الطيور ملائمة طريقة وراءية، ويتراوح نسبة سرطان الأوزان طريقة من كمية الدهن في البهتم وواستغلال نظام الحمام تأسيسياً طريقة مع كمية الدهن في البهتم.

من الناحية الكيميائية، وجد أن عملية الطيور حشرة على نسبة أعلى من النباتية عند مطابقتها بنظام السعر والأعمال كما لا يوجد اعتماد واضح بينها تحويل هذه الخلايا من البروتين والدهون.
REFERENCES


Appendix 1: Mean, co-efficient of variation (C.V.) and range of the desert camel carcass composition

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<td>5.04</td>
<td>12.37</td>
<td>28.26</td>
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</table>
Appendix 1: Mean, co-efficient of variation (C.V.) and range of the desert camel carcass composition

<table>
<thead>
<tr>
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<td>Side muscle weight (kg)</td>
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### Appendix 3: Mean co-efficient of variation (CV) and range of the desert camel body component weight (kg)

<table>
<thead>
<tr>
<th>Component</th>
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* list unskinned