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MEAT QUANTITY AND QUALITY EVALUATION OF MAGHRABI AND SUDANI CAMELS (*Camelus dromedarius*)

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ABSTRACT

Six growing male one-humped camels (3 Maghrabi and 3 Sudani) were used to study their meat quantity and quality in terms of dressing percentage, boneless meat percentage, fat deposits, wholesale cuts, chemical composition and physical properties under Egyptian conditions.

Non significant difference was recorded between Sudani and Maghrabi camel in dressing out percentage without hump (59.81 vs. 59.26%). However, including the hump, Maghrabi breed had higher dressing out percentage than Sudani breed (65.33 Vs 62.12%).

The dissection per cent of the whole carcass of Sudani and Maghrabi camel breed were 67.47 vs. 63.33% for lean meat, 10.34 vs. 16.52% for fat, 22.19 vs. 20.16% for bone and 77.81 vs. 79.84% for boneless meat.

Shoulder, ribs, plat, flank, leg and hump cuts percentages differed significantly ($P<0.05$) due to breed of camel, while the other wholesale cuts showed similar percentages. Sudani camel had higher shoulder and leg percentage (21.88 and 29.07%) than Maghrabi camel (20.66 and 26.25%, respectively). While, Maghrabi camel had lower ribs, flank and hump percentages (19.84, 7.30 and 10.44%, respectively) than Sudani camel (17.73, 5.21 and 3.94%, respectively).

Significant differences between Sudani and Maghrabi camels were recorded in moisture (74.10 vs. 71.70%), fat (4.30 vs. 7.58%), collagen (1.10 vs. 0.72%) and ash (1.47 vs. 1.06%). However, the breed difference was not significant in protein content (20.12 vs. 19.66%). The pH values of meat were similar either immediately after slaughtering (6.34 vs. 6.37) or at 24 hrs (5.83 vs. 5.82) for Sudani vs. Maghrabi camel breed.

This study indicated that camel meat of both breeds had similar nutritive value to that of beef meat, even the Sudani camel breed contains more moisture than Maghrabi camel breed, while, the Maghrabi contains more fat than the Sudani breed. According to the present results, the Maghrabi and Sudani camel breed can be used as good source of animal protein and contribute to solving the problem of shortage of meat in Egypt.

Key words: Camel, meat, maghrabai, sudanese camel

The dromedary camel (*Camelus dromedarius*) is one of the most important domestic animals in the arid and semi-arid regions, for their potential to produce much cheaper meat and milk than other farm animals under extremely harsh environments (Knoess, 1977; Yagil, 1982; Yousif and Babiker, 1989). According to data of FAO's (2009), the camel population in Egypt, is about 129 thousand head; most of them are concentrated in desert governorates. The annual camel meat production was 40 thousand tonnes, while, camels slaughtered averaged 130 thousand head. The demand for camel meat appears to be increasing especially in arid regions. Camel breeds raised in Egypt were classified according to their phenotypic, production characters into four breeds namely Falahey, Sudani, Mowalled and Maghrabi (Gehad, 1995). Recently biochemical and molecular genetic techniques were used to study genetic variability within and between these camel breeds indicating that these camel breeds differ from each other (Abou-El-Hassan *et al,* 2005 and Ismial *et al,* 2006).

Camel meat breeds are characterised by the development of the hindquarters, large hump, rigid body, relatively short neck, large head, and heavy bones and muscles (Wilson, 1984 and Wardeh *et al,* 1990). It is important to consider the Maghrabi breed, being the local one in the North-Western Coast as it carries better traits and more adaptability for production in this area.

The study of camel meat quality characteristics will improve their marketing and acceptability. The

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aim of this study was to evaluate meat quantity and quality characteristics of the Sudani and Maghrabi camel breeds.

Materials and Methods

This study was carried out at Maryout Research station, 35 km south of Alexandria, Desert Research Centre, Ministry of Agriculture and Land Reclamation, Egypt.

Experimental Animals

Six growing male one-humped camels (3 Maghrabi and 3 Sudani) aged 24 – 30 months with average body weight 401±19.5 kg and 348±19.5 kg for Sudani and Maghrabi camel, respectively were used in this study. The Maghrabi animals were chosen from Maryout Research Station camels flock while the Sudani animals were bought from Brquash Market, El-Giza Governorate as they belonged to a private flock raised in Egypt. The two camel groups were kept on four months feeding period on similar feedstuffs of berseem hay (*ad libitum*) and supplemented with concentrates.

Slaughter Data

All camels were fasted for 24 hours before slaughtering. Range of ambient temperatures on slaughter days was 20 - 23°C. Dressing percentages, wholesale cuts, physical components of whole carcass, boneless meat percentage and fat deposits in the carcass camels were studied.

Cutting and Chilling of Carcass

Camel carcass was longitudinally split down at the middle line of the backbone into right and left sides. Right and left sides were divided into fore – and hind-quarters by cutting between the 11th and 12th ribs (Abouheif *et al,* 1990). Neck and hump were separated during cutting process. Hot weights of the fore – and hind-quarters, neck and hump were recorded. The carcasses were transferred to cooling room and kept for 24-hrs period at 4°C ambient temperature. The chilled carcass weight was recorded after cooling and before any further treatment.

Wholesale Cuts

Cutting procedure adopted was that of Abouheif *et al* (1990). The fore and hind-quarters for the left side of the carcass were cut into nine wholesale joints. The fore-quarter cuts were neck, shoulder, brisket, rib and plate, while the hind-quarter cuts were loin, flank, leg and hump. Weights of the wholesale cuts were recorded and percentages (of chilled carcass weight) were calculated.

Dissection of Wholesale Cuts

Wholesale cuts for the left sides of camel carcasses were dissected into their physical components (lean meat, fat and bone). The components weights were recorded and expressed as percentages of chilled cut weight. The weight of each component in different wholesale cuts were added together to get the dissection of the whole carcass. The weights of lean meat, fat, bone and boneless meat (lean meat plus fat) in whole carcass were obtained as percentages of the chilled carcass weight. Lean: fat and lean: bone ratios were also calculated.

Samples of Longsimus dorsi (L.D.) muscle were sliced out to determine the chemical composition and physical quality properties of the camel meat.

Meat Chemical Composition

Any visible fat was removed from the L.D. muscle samples before they were placed in plastic containers then they were ground to a homogenous mass in a grinder then used for chemical analysis (Kadim *et al,* 2006). Chemical composition (moisture, protein, fat and collagen) of the L.D. muscle was determined using Food Scan™ Pro meat analyser (Foss Analytical A/S, Model 78810, Denmark). Ash content was determined by ashing samples in a muffle furnace at 600°C for 8 h.

Meat Quality Properties

Meat quality measurements including colour, pH value, L.D area, cooking loss per cent, water-holding capacity (W.H.C), plasticity and expressible fluid per cent were determined.

Meat colour was measured using Croma meter (Konica Minolta, model CR 410, Japan) calibrated with a white plate and light trap supplied by the manufacturer. Colour was expressed using the CIE L*, a*, and b* colour system (CIE, 1976). A total of three spectral readings were taken for each sample on different locations of the muscle.

The pH value of camel meat was determined by using a pH meter (Portable Digital Waterproof HANNA model HI 9025) after slaughter immediately and 24 hrs from slaughter.

Area of the cross section of L.D. muscle was measured by tracing the exact area of the exposed muscles on acetate paper between 11th and 12th rib using polar planimeter.

Expressible fluid percentage was measured by weighing about 0.3 g of meat (W1) in filter paper (Whatman No .1) and subjected to pressure of 1000 g

for 10 minutes then it was weighed again (W2). The expressible fluid was estimated as the percentage of the difference between the two weights from the initial weight:

Expressible fluid % = (W1-W2)/W1*100.

Cooking loss was determined on about 100-grams of eye muscle samples (W1) which were boiled in water for 45 minutes, left to be cooled at room temperature and weighed again (W2) to calculate cooking loss percentage (Sami, 2001).

Cooking loss % = (W1-W2)/W1*100.

Water holding capacity (WHC) and plasticity of camel meat were estimated by the method of Wierbicki and Deatharage (1968) using the following equation:

$WHC = A_2 - A_1$

Where:

A_1= Inner area of plasticity (area of meat after pressing) cm^2

A_2= Outer area (area of meat plus area of free water after pressing) cm^2

Both areas were determined using a planimeter.

Statistical analysis

Data set was subjected to the analysis of variance using the general linear model (GLM) of Statistical Analysis System (SAS, 1999). The significant differences were tested according to Duncan's new multiple range test (Duncan, 1955).

The following statistical model was utilised:

$Yij = \mu + Xi + eij$

Where:

Y_{ij} = observation

μ = overall mean

X_i = variable (Breed), i =1,2

1 = Sudani 2 = Maghrabi

e_{ij} = random error

Results and Discussion

Carcass yield

Dressing out percentage

Dressing out percentage is an important measure of yield in meat animals, but it varies due to factors such as age, sex, breed, and slaughter weight, fatness, dressing procedures and degree of gut fills at slaughter (Kadim *et al,* 2008).

The dressing out percentage in Table 1 for the Sudani and Maghrabi breeds are within the range reported for camel (Knoess, 1977; Tandon *et al,* 1988 and Kamoun, 1995) ranged from 55% to 70%. Non significant differences between Sudani and Maghrabi camel were recorded in dressing out percentage without hump. Dressing per cent values without hump were much similar for Sudani and Maghrabi camel and were based on slaughter wt. (52.31 vs. 52.29%) or EBW (59.81 vs. 59.26%). While with hump, Maghrabi breed had significantly higher dressing out percentage than Sudani breed (65.33 vs. 62.12%). The latter difference in dressing out percentage may be due to hump weight variation. The hump fat is account for 8.6% of the carcass weight (Kamoun, 1995) and affecting dressing out percentage. Maghrabi camel had hump fat percentage of 6.08% of empty body weight; however, Sudani camel had only 2.32% of hump fat. The present results indicated that dressing out percentage of Sudani camels was higher to those reported by Wilson (1978) for Sudanese camels (51%) and similarly to that report by Babiker and Yousif (1987) in male Sudanese camels (54.4%).

Dressing out percentage in this study for the two breeds were lower to those reported by Shawket Safinaz (1999) and Shehata *et al* (2005). This variation may be due to fattening state.

The values of dressing percentages based either on the slaughter or empty body weight were superior to those reported in the literature, which ranged from 48.2- 56.8% and 60.1-63.6%, respectively (Dahi and Hajort, 1977; Morton, 1984; Wilson, 1984; Wardeh, 1989; Babiker and Yousif, 1990; and El-Gasim and El-Hag, 1992).

Physical Components of Whole Carcass

The means of physical components of whole carcass for the Sudani and Maghrabi camel breeds are given in Table 1. There were significant differences ($P < 0.05$) between the two breeds in lean meat, fat and Lean: fat ratio.

Sudani camel had higher lean meat percentage and lower fat percentage than Maghrabi camel (67.47% vs. 63.33 and 10.34 vs.16.52%). While, breed difference in bone, boneless meat % and Lean: bone ratio were non-significant. Maghrabi camel had higher boneless meat percentage (79.84 vs.77.81%) and lower bone percentage (20.16 vs. 22.19%) for Sudani camel.

Breed, sex, age and the nutritional status influence body composition in the camel (Kadim

et al, 2008). Breed has a significant effect on carcass physical components of camel. However, lean meat per cent of the present breeds were higher than the values of 54.3 - 57.0% reported by Yousif and Babiker (1989); Wilson (1987); Kamoun (1998) and Shehata *et al* (2005), but lower than the value of 71.0% reported by El-Hatmi *et al* (2009).

Babiker (1984) reported that the proportion of edible lean meat of camels was comparable to that of cattle.

Maghrabi camel, had fat percent of 16.52% which was similar to that reported by Kamoun (1995); Wilson (1998); Shawket Safinaz (1999); Shehata *et al* (2005) and El-Hatmi *et al* (2009), but higher than the value of 13.70% reported by Yousif and Babiker (1989). On the contrary, in the Sudani camel, the fat per cent was the lowest to be 10.34% that reported by the same authors.

The bone per cent of Sudani camel was 29.38% to be higher than the mean range values of 15-25.5% reported by Yousif and Babiker (1989); Kamoun (1998); Wilson (1998); Shawket Safinaz (1999); Shehata *et al* (2005) and El-Hatmi *et al* (2009), but lower than the value of 34.20% reported by El-Gasim and El-Hag (1992). In the present study, the boneless meat percentage of Sudani camel was less than 79.66 and 81.54%, which were reported by Shawket Safinaz (1999) and Shehata *et al* (2005), respectively.

It was noticed that lean meat: bone ratio increased with the decrease in carcass bone percentage, while the lean meat: fat ratio decreased with the increase in carcass fat percentage. The present values of lean meat: bone and lean meat: fat ratio for Maghrabi camel was in agreement with those reported by Yousif and Babiker (1989); Shawket Safinaz (1999) and Shehata *et al* (2005).

Fat deposits

Fat deposits in camel body as percentages to empty body weight are presented in Table 1. There were significant differences between the two breeds in carcass, hump and total body fat but no significant differences were found in fat% of kidney, heart, abdomen and testis. It was clear that the Maghrabi camel had higher total body fat than Sudani camel. Values were in agreement with those reported by Shehata *et al* (2005).

Wholesale Cuts

Percentages of wholesale cuts of chilled carcass weight are shown in table 2. Shoulder, ribs, plat, flank, leg and hump cuts percentages differed significantly (P<0.05) due to the breed of camel, while the other wholesale cuts showed no significance. Sudani camel had higher shoulder and leg percentages than Maghrabi camel (21.88 and 29.07% vs. 20.66 and 26.255%). While, Maghrabi camel had higher ribs, flank and hump percentages than Sudani camel (19.84, 7.30 and 10.44% vs. 17.73, 5.21 and 3.94%). Maghrabi camel, had hump cut per cent of 10.44% which was similar to that reported by Shawket Safinaz (1999) and Shehata *et al* (2005).

Table 1. Mean values of Slaughter wt, empty body wt, hot carcass wt, physical components of whole carcass and fat deposits for Sudani and Maghrabi camel breed.

Items	Sudani	Maghrabi	±SE
Slaughter wt (kg)	404.33[a]	348.67[a]	20.24
Empty body wt (kg)*	353.57[a]	307.43[a]	16.62
Hot carcass wt	211.13[a]	181.85[b]	7.01
Dressing% without hump (1)	52.31[a]	52.29[a]	1.18
(2)	59.81[a]	59.26[a]	1.08
Dressing % with hump (1)	54.33[b]	57.64[a]	0.70
(2)	62.12[b]	65.33[a]	0.65
Chilled carcass wt (kg)	207.78[a]	179.66[b]	7.10
Physical components (%)3 of whole carcass :			
Lean meat	67.47[a]	63.33[b]	0.50
Fat	10.34[b]	16.52[a]	0.50
Bone	22.19[a]	20.16[a]	0.50
Boneless meat	77.81[a]	79.84[a]	0.83
Muscle: fat ratio	6.57[a]	3.85[b]	0.32
Muscle: bone ratio	3.05[a]	3.15[a]	0.12
Fat deposits (%)4 :			
Carcass fat	6.07[b]	9.68[a]	0.48
Hump fat	2.32[b]	6.08[a]	0.64
Kidney fat	0.40[a]	0.69[a]	0.08
Abdominal fat	0.38[a]	0.73[a]	0.24
Heart fat	0.19[a]	0.24[a]	0.05
Test fat	0.01[a]	0.02[a]	0.002
Total body fat	7.05[b]	11.36[a]	0.35

* Empty body weight = slaughter weight – digestive tract contents, (1): Based on slaughter weight, (2): of empty body weight, (3): based on chilled carcass weight, (4): based on empty body weight. Within the same row, Lsm with different superscripts a, b are significant in P <0.05.

On the Maghrabi camel, the leg and neck percentages recorded highest values, but shoulder and ribs percentages recorded lowest values compared to the reported by Shawket Safinaz (1999) and Shehata *et al* (2005).

Chemical Composition of Camel Meat

The mean values of chemical composition of Sudani and Maghrabi meat are given in Table 3. The values obtained for moisture, protein, fat and ash were within the range reported for camel meat (Babiker and

Yousif, 1990; El-Faer *et al,* 1991; Elgasim and Alkanhal, 1992; Al-Ani, 2004; Cristofaneli *et al,* 2004 and Kadim *et al,* 2006). However, the collagen content was less than that reported by Kamoun *et al* (2009). The moisture, fat and ash percentages were significantly ($p< 0.05$) affected by camel breed, while, breed difference in protein per cent was non-significant. Camel meat varies in chemical composition according to breed type, age, sex, condition and site on the carcass (Kadim *et al,* 2008). The mean moisture for Sudani camel breed was 74.1% which was within the range values of 73 – 78% reported by Shalash (1988); El-Faer *et al* (1991); Elgasim and Alkanhal 71.7% (1992); El-Hatmi *et al* (2009) and Kamoun *et al* (2009). However, the mean moisture for Maghrabi camel breed was similar to the findings reported by Dawood and Alkanhal (1995); Shehata (2005) and Kadim *et al* (2006). These differences may have resulted from variations in pre- and post-slaughtering handling, breed and age of camels. The importance of moisture in meat lies in its pronounced effects on the shelf life of meat, its processing potential and sensory characteristics (Kadim *et al,* 2006).

Table 2. Mean value of wholesale cuts weights (kg) and percentages[1] for Sudani and Maghrabi camel breeds.

Items	Cuts weights (kg)			Cuts percentages (%)		
	Sud.	Magh.	±SE	Sud.	Magh.	±SE
Neck	16.66^{a}	15.59^{a}	0.75	8.02^{a}	8.67^{a}	0.24
Shoulder	45.43^{a}	37.10^{b}	1.37	21.88^{a}	20.66^{b}	0.29
Ribs	36.73^{a}	30.07^{a}	4.91	17.73^{b}	19.84^{a}	0.83
Brisket	16.46^{a}	11.33^{a}	1.55	7.87^{a}	6.31^{a}	0.57
Plat	7.79^{a}	8.35^{a}	0.37	3.75^{b}	4.65^{a}	0.13
Flank	10.91^{a}	13.19^{a}	1.06	5.21^{b}	7.30^{a}	0.36
Loin	13.40^{a}	11.28^{b}	0.25	6.48^{a}	6.28^{a}	0.29
Leg	60.40^{a}	47.16^{b}	2.13	29.07^{a}	26.25^{b}	0.25
Hump	8.27^{b}	18.90^{a}	2.59	3.94^{b}	10.44^{a}	1.22

1: Based on whole chilled carcass weight. Within the same row, Lsm with different superscripts a, b are significant in P <0.05

The mean protein value of 20.12% for Sudani breed is higher than the value of Elgasim and Alkanhal (1992) and Kamoun *et al* (2009) and lower than the values 21.4 and 23% reported by Kadim *et al* (2006) and El-Hatmi (2009). While, the mean protein value for Maghrabi breed (19.66%) was similar to those reported by Dawood and Alkanhal (1995) and Shehata (2005); Alowaimer (2009) and Kamoun *et al* (2009). This level of protein indicates that the camel meat is a source of high quality protein in harsh climate arid regions. The mean collagen of 1.09% for Sudani breed is significant to Maghrabi breed of 0.72%. Collagen content was less than 5.57% as reported by Kamoun *et al* (2009).

The mean fat of 4.31% fat for Sudani camel was similar to those (4.40% of camels slaughtered at 1-3 year) Kadim *et al* (2006) but lower than the values (5.18 – 8.30%) reported by Shehata (2005); Kadim *et al* (2006) and Kamoun *et al* (2009). It was higher than the range values of (1.60 – 2.33%) reported by Alowaimer (2009) and El-Hatmi *et al* (2009). While, the mean fat for Maghrabi camel (7.58%) was similar to that (6.70%) of Dawood and Alkanhal (1995) and Kamoun *et al* (2009).

The mean ash value of 1.47% for Sudani camel was non-significant to Maghrabi camel which was in agreement with those of Dawood and Alkanhal (1995).

Table 3. Mean values of moisture, protein, fat, ash and collagen components for sudani and maghrabi camel meat.

Component %	Sudani camel	Maghrabi camel	SE
Moisture	74.10^{a}	71.70^{b}	±0.07
Protein	20.12^{a}	19.66^{a}	±0.06
Fat	4.31^{b}	7.58^{a}	±0.02
Ash	1.47^{a}	1.06^{b}	±0.08
Collagen	1.10^{a}	0.72^{b}	±0.05

Within the same row, Lsm with different superscripts a, b are significant in P <0.05

Meat quality properties

Results in Table (4) show the meat quality characteristics (pH, eye muscle area, expressible juice, cooking loss, W.H.C., plasticity and colour) as affected by camel breed.

The pH of muscle is a major determinant of meat quality and is largely determined by the depletion of glycogen and accumulation of lactic acid pre- and post-slaughter (Kadim *et al,* 2008). There were no significant differences between Sudani and Maghrabi Camels in pH values of meat just after slaughter and at 24 hrs of slaughter. The present pH values of meat were in agreement with those reported by Babiker and Yousif (1990), Elgasim and El-Hag (1992) Shehata (2005) and Kadim *et al* (2006). The range of the ultimate pH values of dromedary camel meat ranged between 5.7 and 6.0 (Cristofaneli *et al,* 2004 and Kadim *et al,* 2006). The pH values of Sudani and Maghrabi Camels meat are within the normal range of most meat animals (Cristofaneli *et al,* 2004 and Kadim *et al,* 2006). The pH value of meat is the result of combination of many factors including pre-slaughter handling, post-mortem treatment and muscle physiology (Thompson, 2002).

Difference between Sudani and Maghrabi Camel in eye muscle area was non-significant, but Sudani breed had higher eye muscle area than Maghrabi breed (71.53 cm² vs. 82.20 cm²). The difference between the two breeds in eye muscle area might be attributed to the variation in carcass weight and lean meat percentage (Bendary *et al,* 1992). The present values of eye muscle area were higher than those reported by Shawket Safinaz (1999); Elgasim and Alkanhal (1992) and Shehata *et al* (2005).

Table 4. Mean and standard error for some meat quality characteristics of Sudani and Maghrabi camel breed.

Measurement	Sudani	Maghrabi	±SE
pH value: pH just after slaughtering	6.34[a] (33.4°C)	6.37a (39.8°C)	0.09
pH at 24 hrs of slaughtering	5.83[a] (3.4°C)	5.82[a] (5°C)	0.02
Eye muscle area (cm^2)	82.20[a]	71.53a	3.69
Expressible fluid %	44.38[a]	32.96[b]	1.39
Cooking loss %	48.11[a]	43.67[a]	1.88
W.H.C. (cm^2)	10.12[a]	7.09[b]	0.54
Plasticity (cm^2)	2.14[b]	2.61[a]	0.14
Colour parameters			
L (lightness)	46.20[a]	45.99[a]	1.04
a (redness)	13.61[a]	15.63[a]	0.87
b (yellowness)	5.07[a]	6.89[a]	0.72

Lean meat area, water holding capacity and plasticity measurements (cm^2). Within the same row, Lsm with different superscripts a, b are significant in P <0.05

Expressible juice is an important meat quality characteristic because of its influence on the nutritional value, appearance and palatability (Kadim *et al,* 2006). Expressible juice was significantly affected by camel breed; Sudani camel had higher expressible juice value than Maghrabi camel (44.38 vs. 32.96%). The difference may have been due to variation in fat content. From present results of chemical composition of meat; the Sudani camel had lower fat than Maghrabi camel (4.31vs.7.58%). Values of expressible juice obtained in this study were higher than those reported by (Kadim *et al,* 2006).

The dromedary camel meat contains higher expressible juice than of Camelidae such as the llama and alpaca probably because of the lower relatively fat in the dromedary (Cristofaneli *et al,* 2004).

Cooking loss of camel meat as affected by camel breed is also shown in table 4. Sudani camel had higher values of cooking loss than Maghrabi camel (48.11 vs. 43.67%), but this difference was non-significant. Values of cooking loss % obtained in this study were higher than those reported earlier (Babiker and Yousif, 1990; Dawood and Alkanhal, 1995; Shehata *et al*, 2005 and Kadim *et al*, 2006).

The W.H.C. for Sudani camel of 10.12 cm² was similar to the finding reported by Shehata (2005). While, the Maghrabi camel recorded lower value. The present values of plasticity of camel meat were in agreement with those reported by Shehata (2005). The volume of dromedary camel meat was reduced by 44.3% and weight by 48.2% after boiling in water for 40 min (Kamoun, 1995). However, Results indicated significant difference ($p< 0.05$ between Sudani and Maghrabi camel in W.H.C. (10.12 vs. 7.09 cm^2) and Plasticity (2.14 vs. 2.61 cm^2).

Meat of Maghrabi camel was darker (lower L*) and redder (higher a*) than that of Sudani camel. In the present study, the lightness (L*) of camel meat was high, but the redness (a*) and yellowness (b*) were similar to those reported by Babiker and Yousif (1990) and Kadim *et al* (2006). Many factors causing darker colour include myoglobin content, muscle fibre type and cooling rate (Lawrie, 1979 and Abril *et al,* 2001).

Camel meat quality characteristics in general are comparable to those of beef (Knoess, 1977; Kadim *et al,* 2006; Shariatmadria and Kaivar, 2006). Camel (2-4 year) and beef (2-3 year) longissimus muscle had 6.98 and 6.45 shear force value, 21.3 and 34.79 cm² /g expressed juice, 31.69 and 33.58 L*, 16.18 and 18.19 a* and 7.26 and 6.40 b*, respectively (Kadim *et al,* 2006).

Conclusion

According to the present results, the Maghrabi and Sudani camel breed can be used as a good source of animal protein and contribute to solving the problem of shortage of meat in Egypt. Physical and chemical quality properties of camel meat were improved by finishing of camels for 3-4 months prior to slaughter. Breed of camel is an important factor affecting meat quantity and quality.

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