

## **Carcass characteristics of male Desert goats in Elobeid area in North Kordofan State, Sudan**

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### **ABSTRACT**

Body components and carcass characteristics of the Desert goat, which is an important meat breed in the Sudan, were studied in Elobeid area in North Kordofan State in November 2005. Six males at < 1 and 1 year old (3 in each group) were bought from Elobeid livestock market and slaughtered according to Islamic rituals. There were significant differences ( $P \leq 0.05$ ) in weights of blood, leg, heart, mesenteric fat and testicles and no significant differences in the percentages of body components on empty body weight basis between the two age groups. Slaughter weight, empty body weight and hot carcass weights were increased significantly ( $P \leq 0.05$ ) with increasing slaughter age and were heavier at 1 year old. Dressing percentages on live body weight and empty body weight basis were higher at 1 year old with no significant differences between the two age groups and the empty body weights were higher compared to the live body weight. The percentages of total carcass muscles and fat were increased and that of bones were decreased with increasing age. There were no significant differences between the two age groups in ratio of muscle to bone, muscle to fat and whole sale cuts. There were significant ( $P \leq 0.05$ ) differences between the two age groups in carcass moisture, protein, fat and ash. *Longissimus dorsi* area was highly significantly ( $P \leq 0.01$ ) increased with increasing slaughter age.

## INTRODUCTION

Goats are important in the Sudan due to their high population, wide distribution and production of about 0.12 million tons of meat (FAO, 2002) and 1.15 million tons of milk (FAO,1999). Goat meat has a high nutritive value and low fat and is highly preferred in many countries in Asia, Africa and Europe (Devendra and Mcleroy,1982). The demand for goat meat is increasing in the western countries due to the dispute over the relationship between saturated fatty acids and cardiovascular diseases and increase in ethnic minorities preferring goat meat. Goat meat production in the Sudan should be improved and promoted to increase production and consumption leaving more sheep and cattle meat for export.

There are many goat breeds in the country including the Desert which is considered a meat breed renowned for high tenderness and juiciness. It is mainly found in arid and semi-arid areas and is highly adapted to them (Devendra and Mcleroy, 1982). Many exotic breeds are imported into the country endangering local breeds which are adapted to the environment and less susceptible to diseases. Information on the breed carcass characteristics is mainly based on animals from markets around the capital with unknown origin and may be crosses (El Khidir, 1989 ; Hassaballa, 1996). This study was launched to furnish information on the Desert breed carcass characteristics in Elobeid area in North Kordofan State where it is believed to be pure.

## MATERIALS AND METHODS

This study was conducted in Elobeid area in North Kordofan State in the west of the Sudan in November 2005. The State is located in the semi-desert zone between latitudes 12<sup>o</sup> 13'-16<sup>o</sup> 34'N and longitudes 26<sup>o</sup> 56'-32<sup>o</sup> 19'E and is about 187236.78 km<sup>2</sup> in area with an annual rainfall of 100–450 mm from mid July to the end of October and average temperature of 10<sup>o</sup>C in winter and 37<sup>o</sup>C in summer. Natural pastures are about 23.8 million feddans in the area and sufficient for 2.3 million animal units

### Animals

Six Desert goat males were bought from Elobeid livestock market at < 1 and 1 year old (3 for each age). They were fastened overnight and live weight and physical measurements were recorded before slaughter according to Islamic rituals by severing the jugular vein, trachea and oesophagus. Body measurements were taken using a measuring tape including height at withers (HW), heart girth (HG), back length (BL), abdominal girth (AG), and neck length (NL). Blood was collected and weighed and the head and feet were removed and weighed. The animals were skinned and the skin was weighed. They were then eviscerated, abdominal and thoracic organs were removed and weighed separately and kidneys and renal fat were left in the carcasses and the hot carcasses were weighed (HCW). The alimentary tract was weighed full and empty and the empty body weight (EBW) was obtained by subtracting the gutfill from the slaughter weight. The tail, kidneys and renal fats were removed and weighed. The weight of each body component was expressed as a percentage of EBW. The dressing percentage for each age group was calculated on LBW and EBW.

The hot carcasses were split into left and right sides along the vertebral column with a saw and the left side was subdivided into five wholesale cuts according to MLC (1967). Each cut was weighed and dissected into muscles, fat and bones and were weighed.

### Characteristics of rib section

The rib section (10<sup>th</sup>–12<sup>th</sup>) was removed and weighed from each carcass. *Longissimus dorsi* (eye muscle) surface area at the 12<sup>th</sup> rib was measured using a tracing paper. The rib section samples were wrapped in polyethylene bags, frozen, stored, weighed and dissected into muscles, fat and bones which were weighed.

### Chemical analysis

Fresh samples of muscles, bones and fat were minced, mixed thoroughly and analysed for dry matter, crude protein and ash as described by AOAC (1984).

The collected data were statistically analyzed using the unpaired t-test with equal number of replications per treatment. The simple linear correlation coefficients for the different parameters were calculated using the means for the treatments (n=6).

## RESULTS

Table 1 shows mean body components weights and percentages on EBW in male Desert goat in Elobeid area, Sudan. All body components weights were higher at 1 year old except the spleen which was similar in the two groups. The differences between the two groups were significant ( $P \leq 0.05$ ) for blood, legs, heart, mesenteric fat and testicles. The percentages of the body components on EBW were higher at <1 year old except the legs, heart, mesenteric fat, testicles and tails (higher at 1 year old). There were no significant differences in the percentages of different body components on EBW between the two groups.

Table 1. Mean (SD $\pm$ ) body component weights (kg) and percentages on empty body weight (EBW) of male Desert goat in Elobeid area, Sudan.

Parameter	Age (years)					
	<1		t value	1		t value
	n=3 (weight)	n=3 (weight)		n=3 (%)	n=3 (%)	
Blood	0.68 $\pm$ 0.1	0.87 $\pm$ 0.03	3.13*	6.60 $\pm$ 0.89	5.78 $\pm$ 0.32	-1.32
Head	1.15 $\pm$ 0.21	1.48 $\pm$ 0.16	2.15	10.90 $\pm$ 0.99	9.86 $\pm$ 1.39	-1.06
Skin	0.97 $\pm$ 0.21	1.24 $\pm$ 0.13	1.88	9.20 $\pm$ 0.79	8.23 $\pm$ 0.76	-1.54
Legs	0.45 $\pm$ 0.04	0.65 $\pm$ 0.10	3.33*	4.34 $\pm$ 0.43	4.34 $\pm$ 0.65	0.00
Lungs	0.21 $\pm$ 0.05	0.25 $\pm$ 0.04	1.26	1.97 $\pm$ 0.45	1.67 $\pm$ 0.20	-1.09
Heart	0.09 $\pm$ 0.00	0.14 $\pm$ 0.02	5.03**	0.83 $\pm$ 0.12	0.92 $\pm$ 0.08	1.05
Liver	0.30 $\pm$ 0.06	0.36 $\pm$ 0.03	1.47	2.85 $\pm$ 0.31	2.38 $\pm$ 0.25	-2.07
Spleen	0.04 $\pm$ 0.02	0.04 $\pm$ 0.02	0.53	0.34 $\pm$ 0.15	0.29 $\pm$ 0.09	-0.55
Kidneys	0.08 $\pm$ 0.02	0.09 $\pm$ 0.01	0.67	0.77 $\pm$ 0.20	0.61 $\pm$ 0.10	-1.26
Stomach	0.53 $\pm$ 0.00	0.68 $\pm$ 0.05	2.22	5.06 $\pm$ 0.38	4.53 $\pm$ 0.58	-1.32
Intestines	0.51 $\pm$ 0.00	0.64 $\pm$ 0.18	1.04	4.93 $\pm$ 0.77	4.30 $\pm$ 0.41	-0.68
M fats	0.03 $\pm$ 0.02	0.10 $\pm$ 0.03	3.77*	0.29 $\pm$ 0.16	0.61 $\pm$ 0.22	2.03
Testicles	0.15 $\pm$ 0.02	0.26 $\pm$ 0.03	5.13**	1.43 $\pm$ 0.35	1.87 $\pm$ 0.13	2.03
Tail	0.02 $\pm$ 0.01	0.03 $\pm$ 0.01	2.14	0.17 $\pm$ 0.06	0.22 $\pm$ 0.05	1.16

\*, \*\* Significant at  $P \leq 0.05$  and  $P \leq 0.01$ , respectively.

Table 2 shows slaughter weights and carcass characteristics of male Desert goats. The slaughter weight, EBW and HCW were significantly ( $P \leq 0.05$ ) heavier at 1 year old. Dressing percentages on

LBW and EBW were higher at 1 year old and were significantly ( $P \leq 0.05$ ) higher on EBW compared to LBW. The percentages of muscles and fat were increased and bones were decreased with increasing slaughter age with no significant differences. Muscle to bone ratio was increased and muscle to fat ratio was decreased with increasing slaughter age. Table 3 shows wholesale cuts weights as percentages of hot carcass weight in male Desert goats. The percentages of leg and chump, single short forequarter and best end of neck and breast were higher at 1 year old and the loin and neck were higher at < 1 year old with no significant age effects.

Table 2. Mean ( $SD \pm$ ) slaughter weight and carcass characteristics of male Desert goat in Elobeid area, Sudan.

Parameter	Age (years)		
	< 1 n = 3	1 n = 3	t value
Slaughter weight (LBW) (kg)	13.30 $\pm$ 1.47	18.17 $\pm$ 0.67	5.08**
Empty body weight (EBW) (kg)	10.49 $\pm$ 1.49	15.03 $\pm$ 0.86	4.57**
Hot carcass weight (HCW) (kg)	5.33 $\pm$ 0.76	8.33 $\pm$ 0.04	4.02*
Dressing (%):			
On LBW basis	40.10 $\pm$ 3.85	45.79 $\pm$ 4.41	1.74
On EBW basis	50.83 $\pm$ 0.27	55.32 $\pm$ 2.30	1.95
Total carcass muscle (%)	68.51 $\pm$ 4.29	71.28 $\pm$ 1.89	1.02
Total carcass bone (%)	27.91 $\pm$ 5.40	22.98 $\pm$ 2.02	-1.48
Total carcass fat (%)	1.90 $\pm$ 0.70	4.29 $\pm$ 1.41	2.63
Muscle: bone	2.53 $\pm$ 0.60	3.12 $\pm$ 0.34	1.49
Muscle: fat	39.45 $\pm$ 14.03	17.88 $\pm$ 5.84	-2.46

\*, \*\* Significant at  $P \leq 0.05$  and  $P \leq 0.01$ , respectively.

Table 3. Mean ( $SD \pm$ ) weights of wholesale cuts as % of hot carcass weight in male Desert goat in Elobeid area, Sudan.

Parameters	Age (years)		
	< 1 n = 3	1 n = 3	t value
Leg and chump	30.57 $\pm$ 2.36	31.67 $\pm$ 1.78	0.64
Single short fore quarter	37.57 $\pm$ 0.73	38.39 $\pm$ 3.54	0.40
Loin	7.43 $\pm$ 3.68	7.11 $\pm$ 2.33	-0.13
Best end of neck and breast	12.30 $\pm$ 1.63	13.07 $\pm$ 3.31	0.36
Neck	10.29 $\pm$ 0.83	8.32 $\pm$ 1.40	-2.10

Table 4 shows the mean composition of rib section cuts of male Desert goats. *Longissimus dorsi* area was highly significantly ( $P \leq 0.01$ ) increased with increasing slaughter age. Weights of rib section, muscles, bones and fat were generally increased with increasing slaughter age. The differences in the percentages between the two groups were significant for rib section, bones and muscles and were not significant for the total meat fat. There were no significant differences in the percentages of muscles, bones and the total meat fat between the two age groups. Table 5 shows the carcass and rib section composition in male Desert goats. There were no significant differences in the composition "total muscle bone and fat" of whole carcass and rib section at <1 and 1 year old. Table 6 shows mean carcass chemical composition of male Desert goats. Moisture and CP were higher at less than 1 year old and fat and ash were higher at 1 year old with significant differences ( $P \leq 0.05$ ) between the two age groups. Table 7 shows the correlations between carcass chemical

components of male Desert goats. Moisture was positively correlated ( $P \leq 0.01$ ) with CP and negatively correlated with fat and ash. Crude protein was negatively correlated with fat and ash. Fat was positively correlated ( $P > 0.05$ ) with ash.

Table 4. Mean (SD $\pm$ ) measurements of rib section in male Desert goats in Elobeid area, Sudan.

Parameter	Age (years)		t value
	< 1 n = 3	1 n = 3	
<i>Longissimus dorsi</i> muscle	6.52 $\pm$ 0.91	9.49 $\pm$ 0.65	4.61**
Area (eye muscle) (cm <sup>2</sup> )			
Rib section weight (kg)	0.077 $\pm$ 0.01	0.131 $\pm$ 0.01	7.54**
Muscle weight (kg)	0.055 $\pm$ 0.009	0.093 $\pm$ 0.002	6.73**
Bone weight (kg)	0.019 $\pm$ 0.003	0.032 $\pm$ 0.001	6.46**
Fat weight (kg)	0.002 $\pm$ 0.002	0.005 $\pm$ 0.002	2.14
Total muscle (%)	71.71 $\pm$ 1.93	70.89 $\pm$ 1.72	-0.55
Total bone (%)	25.36 $\pm$ 0.65	24.90 $\pm$ 0.12	-1.20
Total fat (%)	2.91 $\pm$ 2.56	4.41 $\pm$ 1.68	0.85

\*\* Significant at  $P \leq 0.01$ .

Table 5. Mean (SD $\pm$ ) of carcass and rib joints composition of male Desert goats in Elobeid area, Sudan.

Parameter	Age (years)				t value	
	< 1 n = 3		t value	1 n = 3		
	Whole carcass	Rib joint		Whole carcass		Rib joint
Total muscle%	68.51 $\pm$ 4.29	71.71 $\pm$ 1.94	- 1.18	71.28 $\pm$ 1.89	70.89 $\pm$ 1.72	0.27
Total bone %	27.91 $\pm$ 5.4	25.36 $\pm$ 0.65	0.81	22.98 $\pm$ 2.02	24.90 $\pm$ 0.12	- 1.65
Total fat %	1.90 $\pm$ 0.70	2.91 $\pm$ 2.56	- 0.66	4.29 $\pm$ 1.41	4.41 $\pm$ 1.68	- 0.10

Table 6. Mean (SD±) of chemical composition (%) of carcass of male Desert goats in Elobeid area, Sudan.

Parameter	Age (years)		t value
	< 1 n = 3	1 n = 3	
Moisture	65.33±2.31	60.00±0.00	-4.00*
Protein	21.07±0.40	18.60±0.53	-6.42**
Fat	3.00±0.20	4.83±0.42	6.88**
Ash	3.53±0.93	6.17±1.26	2.92*

\*, \*\* Significant at  $P \leq 0.05$  and  $P \leq 0.01$ , respectively.

Table 7. Correlations between carcass chemical composition in male Desert goats in Elobeid area, Sudan.

Parameter	Crude protein	Fat	Ash
Moisture	0.929**	- 0.906**	- 0.700
Crude protein		- 0.998**	- 0.763
Fat			0.763

\*\* Significant at  $P \leq 0.01$ .

## DISCUSSION

The generally increased body components of male Desert goat with increasing slaughter age were similar to those in Tagger goats (Mudawi, 2002), Nubian goats (Khalifa, 2002) and Ingessana goats (Abdalla, 2004) and were mainly due to increased body weight with age. All components at 1 year old were heavier than fattened Desert goat except lungs, diaphragm, trachea and mesenteric fat (El Khidir, 1989) although our animals were lighter at slaughter, and were also heavier at <1 year old than Desert goat fattened for about 147 days except the lungs and mesenteric fat (Hassaballa, 1996).

Body components of male Desert goat in Elobeid were heavier than Tagger goats components in EL Dilling area except the heart, skin, spleen and mesenteric fat and Tagger goats was fatter than Desert goats (Mudawi, 2002). Body components of male Nubian goat at <1 year old in Kenana Sugar Company (Khalifa, 2002) were heavier than at similar ages in our study. These variations are probably genetic and/or nutritional and should be confirmed by molecular studies.

Desert goats percentages of body components on EBW in this study were higher than Tagger goats percentages except the heart, spleen and mesenteric fat (Mudawi, 2002) and less than Ingessana goats percentages at <1 year and 1 year old except the stomach, small intestines and kidneys (Abdalla, 2004). The non significant differences in the percent-ages of body components on EBW between < 1 and 1 year old were similar to those for Ingessana goat (Abdalla, 2004).

The increased slaughter weight, EBW and HCW with increasing slaughter age were similar to those in Ingessana goat (Abdalla, 2004) and increased HCW with increasing slaughter weight in Desert goat in the Butana (Gaili, 1976). The increased dressing percentages on body weight and EBW with increasing age were similar to those in male Desert goat (Gaili *et al.*, 1972) and Ingessana goat (Abdalla, 2004). The significantly higher dressing percentages on EBW than on body weight were similar to those in Desert goats (Hassaballa, 1996), Ingessana goats (Abdalla, 2004) and Tagger goats (Mudawi, 2002 ; Elbukhary, 1998) and were due the low EBW.

Dressing percentages on LBD and EBW at < 1 year old were less than in Desert goat fattened at about 8 months old (Hassaballa,1996), Ingessana goats (Abdalla, 2004), early weaned Nubian kids in Kenana Sugar Company (Khalifa, 2002) and Tagger goats (Mudawi, 2002). These variations were probably genetic and nutritional. The low dressing percentages in Desert goat could be due to their shallow conformation and long legs. Dressing percentages on LBW were higher than the unfattened Desert goats reported by Gaili *et al.*(1972) and at 1 year old were higher than for the Desert goats in Khartoum at 20 kg (Gaili,1976).

The increased percentages of total carcass muscles and fat and the decreased bones with increasing age confirmed the results of Wood *et al.*(1980). However, Abdalla (2004) found no differences in muscle and fat in Ingessana goats between < 1 and 1 year old reflecting nutritional and or genetic differences between the two breeds. Desert males had higher muscles and bones and less fat at 1 year old than the fattened at about 13 months old (El Khidir,1989) and at < 1 year old than the fattened at about 8 months old (Hassaballa,1996).

The percentages of muscles in this study were higher than those for Tagger goats in El Dilling (Mudawi, 2002) and Rashad (Elbukhary, 1998) and Ingessana goats (Abdalla, 2004) at < 1 and 1 year old. The decreased bone percentages with increasing age in Desert goat in Elobeid area were contrary to that in Ingessana goats reflecting differences in bone growth pattern. At < 1 year old the bone percentages of male Tagger goats in El Dilling (Mudawi, 2002) and Rahsad (Elbukhary, 1998) were less than Desert goat.

The increased total carcass fat percentages in Desert goats with increasing age were different from Ingessana goats where it was not changed suggesting it is a late maturing breed. Higher fat percentages in male Tagger goats in El Dilling at < 1 year old and Rashad than Desert goats in Elobeid showed that Desert male goats have less fat than other breeds.

The increased muscle to bone ratio with increasing slaughter age was different from that in Ingessana goats (Abdalla, 2004). It was higher than that reported for the Desert goats by El Khidir (1989) and Hassaballa (1996). It was higher in Tagger males goats at < 1 year in El Dilling (Mudawi, 2002) and Rashad goats (Elbukhary, 1998) than our study because the percentage of bones was less in Tagger goats. It was less at < 1 year old and higher at 1 year old compared to Ingessana males goats (Abdalla, 2004).

The decreased muscle to fat ratio with increasing slaughter age was mainly due to increased fat deposition. At 1 year old, the Desert goats in this study were higher than that reported by El Khidir (1989) and at < 1 year it was higher than that reported by Hassaballa (1996). It was higher than male Tagger goats at < 1 year in El Dilling (Mudawi, 2002) and Rashad (Elbukhary, 1998) and was mainly due to high carcass fat in Tagger males. These differences are mainly genetic or nutritional. Variations in carcass composition were mainly nutritional and genetic and variations between and within breeds are not conclusive since the numbers were small and management and nutrition were different.

The non significant differences in wholesale cuts due to slaughter age in this study were similar to those in Ingessana goats (Abdalla, 2004). The percentages of wholesale cuts except the neck were higher in Desert goats at <1 year old than Ingessana goats and at 1 year old were less than Ingessana except single short forequarter and best end of the neck and breast. At <1 year old it was higher in this study except single short forequarter and loin than male Desert goats (Hassaballa, 1996) and at 1 year old was higher except loin compared to those bought from Omdurman market (El Khidir, 1989). The variations between Desert goat in Elobeid and those bought from Omdurman market and fattened were mainly nutritional and genetic.

Desert male goats had higher percentages of wholesale cuts for single short fore-quarter, best end of the neck and breast and the neck than Tagger males in El Dilling area at < 1 year old (Mudawi, 2002). Desert males at < 1 year old were higher than Tagger goats in Rashad area (Elbukhary, 1998) in the percentages of single short fore quarter and the neck. The percentages of wholesale cuts of male Desert goats in Elobeid area were higher for single short fore quarter, best end of the neck and breast and the neck than male Desert goats at < 1 year old results reported by Babiker *et al.* (1985).

The increased *Longissimus dorsi*, muscles, bones and fat with increasing age under good feeding was found by John *et al.* (1975). The non-significant differences in total carcass fat between < 1 and 1 year old were mainly due to the low muscle fat. The non-significant difference in carcass composition determined directly or indirectly from the rib cut implies that the latter could be used to predict carcass composition and reduce research costs and efforts. Similar conclusions were reported for sheep and cattle (Powell and Huffman, 1968). The high moisture and crude protein (CP) and low fat and ash at < 1 year old were because more fat is deposited with increasing age (Jonh *et al.*, 1975). At 1 year old moisture and CP were lower and fat and ash higher than values for Desert goat reported by El Khidir (1989) and Hassaballa (1996). The highly negative correlation between moisture and fat is acceptable since increased fat deposition reduces moisture content with increasing age (John *et al.*, 1975 and Gaili *et al.*, 1972).

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## صفات ذبيحة الماعز الصحراوي في منطقة الأبيض في ولاية شمال كردفان بالسودان

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### الخلاصة

درست مكونات الجسم وصفات الذبيحة في الماعز الصحراوي كسلالة هامة لإنتاج اللحوم في السودان في منطقة الأبيض في ولاية شمال كردفان حيث يتوقع أن تكون نقية وراثياً في نوفمبر 2005. تم شراء ست ذكور بعمر أقل من عام وبعمر عام (3 من كل مجموعة) وذبحت بالطريقة الإسلامية. أظهرت الدراسة وجود إختلافات معنوية في أوزان الدم ، الأرجل ، القلب ، شحم المساريقي والخصي ولم توجد إختلافات معنوية في النسب المنوية لمكونات الجسم على أساس وزن الجسم الفارغ بين المجموعتين. إزدادت أوزان الذبح والجسم الفارغ ووزن الذبيحة الساخنة معنوياً بزيادة عمر الذبح وكانت أثقل بعمر عام. إرتفعت نسب التصافي على أساس الوزن الحي أو الفارغ بعمر عام مع عدم وجود إختلافات معنوية بين المجموعتين وكانت أعلى على أساس الوزن الفارغ. زادت نسب العضلات والشحم وإنخفضت العظام بزيادة العمر ولكنها غير معنوية. لم توجد إختلافات معنوية بين العمرين في نسب العضلات: العظام والعضلات: الشحم والقطع الإجمالية للذبيحة. وجدت إختلافات معنوية بين المجموعتين في الرطوبة والبروتين والدهن والرماد. إزدادت مساحة العضلة العينية معنوياً بزيادة عمر الذبح.