Phenotype and carcass characteristics of Shugor sheep in Rahad Scheme, Sudan

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ABSTRACT

Two experiments were conducted to study the phenotype and carcass characteristics of Shugor sheep which is an important meat producer in Rahad Scheme, Sudan. In experiment 1, phenotypic traits including body weight (BW), height at withers (HW), heart girth (HG), abdominal girth (AG), body length (BL), tail length (TL) and ears length (EL) were measured in 200 ewes at 1- 4 year old. Mean BW and phenotypic traits generally increased with age. Mean BW was 24.1 – 45.0 kg and mean HW, HG, AG, BL, TL and EL (cm) were, 69.58 – 79.72, 75.48 – 90.94, 90.23 – 110.34, 60.08- 66.72, 58.54 – 66.34 and 17.94 – 22.31, respectively. All animals were polled. There were significant ($P \leq 0.05$) correlations between BW and phenotypic traits. Different regression equations were used to predict BW from AG, HW and BL at different ages with no significant differences ($P \geq 0.05$) between actual (measured) and predicted BW. In experiment 2, eight Shugor sheep males were bought from Elfao livestock market at 6 months or 1 year old (4 in each group) and slaughtered to study body components and carcass characteristics. Body components percentages on empty body weight (EBW) basis decreased with increasing the slaughter age, except the kidneys, and the decrease was significant ($P < 0.05$) for the legs and the heart. Slaughter weight, EBW, hot carcass weight, total carcass muscles, bones, fat, muscle: bone and muscle: fat ratios significantly differed ($P < 0.05$) with slaughter age. Dressing percentages expressed on LBW and EBW basis were not significantly affected by slaughter age. Slaughter age had no significant effects on whole sale cuts percentages, except the leg and chump.

INTRODUCTION

Sheep production is important in the Sudan due to the high population, wide distribution and high milk, meat and skin production (Statistics and Information Department, Ministry of Animal Wealth

and Fisheries, Sudan, 2004). Local demand for mutton is increasing due to increased human population, improved living standards and it is the most preferred meat type. Furthermore, the international demand is increasing because the animals depend on natural pastures with no feed additives, especially of animal origin, or growth promoters endangering human and livestock health. It is, therefore, important to know the potentials of different sheep breeds in the country for optimum production and profits.

There are many sheep breeds in the Sudan and are classified according to tail type (Mason and Maule, 1960), tail length: height at withers and ecotypes (McLeroy, 1961). Desert sheep is the main ecotype and export sheep with many subtypes including Abrag (Burug) and Ashgar (Shugor) which are important in Butana, Gezira and White Nile areas. Rahad Scheme is the main irrigated scheme in Butana area where sheep production is important.

Body weight (BW) and measurements are important for sheep characterization and BW is important for efficient management and marketing. Linear regression equations are used to predict BW from some body measurements (Mukherjee *et al.*, 1982; Khalifa, 2002; Gibreel, 2003) and are useful when it is difficult to acqulire and maintain weighing machines. Carcass characteristics are important economic traits. Information on Shugor phenotype, carcass characteristics and linear regression equations to predict BW from some body measurements is not available for Shugor sheep at Rahad Scheme. Consequently, two studies were launched to furnish this vital information.

MATERIALS AND METHODS

Rahad Scheme was established in 1977 on the eastern bank of Rahad River in Gedarif State. It is about 120.000 ha in area and is irrigated from Rahad River and by pumps from the Blue Nile. It lies in the dry and semi dry zones and temperature is generally high, especially in April and May (40°C) and low in January (14°C – 35°C).

Annual rainfall is about 300 – 400 mm between June and October with a peak in late July to late August.

Experiment 1: **Shugor phenotype**

Animals

Two hundred Shugor sheep at about 1, 2, 3 and 4 years old, were selected at random from traditional flocks from 10 villages (8-18) in Elfao Province at Rahad Scheme, Sudan for this study. The age of the animals was estimated from the lower jaw incisors as described by Devendra and McLeroy (1982). They were grazed outside villages and fed crop residues.

Body weight (BW) was measured using a spring balance (50 kg capacity) and the animals were held in a sac and hanged by the balance. Height at withers (HW), heart girth (HG), body length (BL), abdominal girth (AG), tail length (TL) and ears length (EL) were measured using a measuring tape.

Data were subjected to analysis of variance procedure Ten animals were selected at random from each age group and measured and predicted BW means were compared.

Experiment 2: **Carcass characteristics**

Animals

Eight Shugor male sheep (4 at six month old and 4 at one year old) were bought from Elfao livestock market at Rahad Scheme to study carcass characteristics. They were transported to Wad Medani by car, treated against internal and external parasites and housed for two weeks in a farm. They were fed grasses and groundnut haulm (Safear) *ad libitum* and offered clean drinking water.

The animals were fasted overnight and in the following morning, they were weighed and slaughtered according to Islamic rituals by severing the jugular vein, trachea and the oesophagus. Blood was collected and weighed and the head and legs were separated and weighed for each animal. They were skinned and the skin was weighed. They were then eviscerated and thoracic and abdominal organs were removed and weighed separately. The hot carcass was weighed with the kidneys and renal fat (HCW). The alimentary tract

was emptied and reweighed and the empty body weight (EBW) was calculated by subtracting the gutfill from BW. The tail, kidneys and renal fat were removed and weighed.

Whole sale cuts

The hot carcasses were split into two halves (left and right) along the vertebral column using a saw and the left side was split into whole sale cuts as described by MLC (1967).

Carcass composition

Whole sale cuts were dissected into muscles, bones, and fat, weighed and expressed as percentages of EBW. Muscle: bone and muscle: fat were calculated for each age group.

Statistical analysis

The data were statistically analysed according to Statistical Packages for Social Sciences (SPSS). The correlations between BW and measurement were calculated according to SPSS. Body components and carcass characteristics and composition were compared by student's t – test using MSTAT.

RESULTS

Mean BW and measurements generally increased with age (Table1). Age significantly ($P < 0.05$) affected BW and the increase was highest between 2 and 3 years and least between 1 and 2 years. The increases in HW, HG, AG and TL were highest between 1 and 2 years and least between 2 and 3 years. The increase in BL was highest between 1 and 2 years and least between 3 and 4 years. The increase in EL was highest between 3 and 4 years and least between 1 and 2 and 2 and 3 years.

The correlations between BW and phenotypic traits in Shugor sheep were generally significant at all ages, especially at 1 and 2 years, and were highest for AG (Table 2). Different regression equations were used to predict Shugor BW from AG, HW and BL at different ages (Table 3).

Table 4 shows that Shugor sheep measured and predicted BW from regression equations were not significantly different.

Table 5 shows Shugor males body components percentages at different ages. Shugor body components percentages decreased with increasing age at slaughter, except for the kidneys, and the decrease was significant for the legs and heart ($P \leq 0.05$).

Table 6 shows Shugor sheep slaughter weights and carcass characteristics at different ages in Rahad Scheme. The slaughter weight, EBW and HCW were significantly ($P \leq 0.05$) increased with increasing the slaughter age. Dressing percentages were higher on EBW compared to LBW and were not significantly affected by the slaughter age. Increasing the slaughter age significantly ($P \leq 0.05$) increased total carcass fat and reduced total carcass bones. It also increased total carcass muscles, but not significantly ($P \geq 0.05$). Increasing the slaughter age from 6 months to 1 year significantly ($P \leq 0.05$) increased muscle: bone and decreased muscle: fat ratios.

The effects of age at slaughter on male Shugor sheep whole sale cuts are shown in Table 7. The percentages of leg and chump, loin and best end of neck were increased with increasing the slaughter age from 6 months to 1 year and the effect was significant ($P \leq 0.05$) only for leg and chump. Single short forequarter, breast and neck were higher at 6 months than at 1 year old, but not significantly.

DISCUSSION

The increased BW and measurements with age was similar to that reported for Garag in Kenana Sugar Company (KSC) (Khalifa, 2002), Shorani sheep in Nuba Mountains (Gibreel, 2003) and Kababish and Hamari in Kordofan (Ali, 2003). The body weight at 4 years was less than that for Kababish, Meidob and Watish and higher than North Riverine or Dongola, Fung, Baggara and Nilotic sheep (Devendra and McLeroy, 1982) and Garag in KSC (Khalifa, 2002). The great variations in BW among Desert subtypes highlighted the importance of specifying subtypes in studies.

Height at withers was higher than Butana and Dongala and less than Kababish and Watish (Devendra and McLeroy,1982). It was higher than Shorani (Gibreel, 2003). and close to Meidob (McLeroy,1961a).

The variations in HW among sheep render it important for characterization. Shugor heart girth was higher than Garag in KSC (Khalifa, 2002), Shorani (Gibreel, 2003) and Kababish and Hamari (Ali, 2003) indicating that Shugor had a deep body. Shugor BL was longer than Garag (Khalifa, 2002) and Shorani (Gibreel, 2003) and AG was higher than Shorani at 1 and 4 years and less at 2 and 3 years. Tail length was longer than Shorani (Gibreel, 2003) and Nilotic (Devendra and McLeroy, 1982). Ears were longer than Garag (Khalifa, 2002) and Shorani (Gibreel, 2003). The results showed that BW and measurements are important for phenotypic classification of Sudanese sheep and should be supported with molecular biology.

The significant correlations between BW and phenotypic traits were similar to that for Garag (Khalifa, 2002) and Shorani (Gibreel, 2003). The finding that different regression equations predicted Shugor BW from some body measurements agreed with that in Garag (Khalifa, 2002) and Shorani (Gibreel 2003). This was mainly due to different correlations between BW and phenotypic traits and breeds conformation. The non significant differences between actual and predicted Shugor BW were similar to those for Garag (Khalifa, 2002) and Shorani (Gibreel, 2003) indicating that BW could be predicted from some body measurements. This is advantageous in rural areas where weighing machines are not available and difficult to maintain and move and this procedure should be promoted to improve sheep management and marketing.

The generally decreased body components percentages on EBW with increasing age was similar to that for Shorani in the age group less than one year and one year old except for the alimentary tract (Gibreel, 2003). The percentages of the kidneys on EBW were increased by increasing slaughter age and were not affected in Shorani (Gibreel, 2003) and may reflect genetic differences.

The significant increase in slaughter weight with increasing slaughter age was also found in Shorani (Gibreel, 2003). The slaughter weight was less than that of Shorani and Desert sheep (Mansour,

1987; Ali, 2003; Mohamed, 2005). The increased EBW and hot carcass weight with increasing the slaughter age were similar to that of Shorani (Gibreel, 2003). The empty body weight was less than that of Shorani (Gibreel, 2003).

Dressing percentages were higher on EBW than LBW confirming the results for Shorani (Gibreel, 2003) and Garag (Khalifa, 2002) and desert sheep (Devendra and McLeroy, 1982). Dressing percentages were increased with age and fattening (Palsson and Verges, 1952). Dressing percentages on EBW were higher than Shorani and less than Kabbashi, Dubasi and Wattish in Elhuda Research Centre (Elhassan, 1994), Desert sheep fed different levels of blood meal (Mansour *et al.*, 1988) and Shugor and Wattish in the Gezira (Abdul Elkarim and Owen, 1987), Zaghawa and Toposa (Ganim, 1979) and Kababish (Devendra and McLeroy, 1982). Dressing percentages on LBW were less than Shorani (Gbreel, 2003). This reflects genetic and /or nutritional differences.

Total muscles were relatively higher than those of Shorani (Gibreel, 2003), Hamari (Mohamed, 2005) and Desert sheep (Mansour *et al.*, 1988). The general increase with increasing the slaughter age was similar to that for Shorani (Gibreel, 2003). The increased Total fat with increasing the slaughter age was similar to that for Shorani (Gibreel, 2003) and is mainly due to the increased fat deposition with increasing slaughter age. It was lower than Shorani (Gibreel, 2003) and Desert sheep fed blood meal (Mansour, *et al.,* 1988). The decreased bone percentages with increasing the slaughter age were similar to that for Shorani (Gibreel, 2003). At 6 months old it was close to Shorani and was relatively less than Shorani at 1 year old.

The decreased muscle: fat ratio with age was similar to that for Shorani (Gibreel, 2003) and is due to increased fat with age. It was less than that of Desert sheep (Mansour, 1987, Sulieman, 1986) and Hamari fed Roselle seeds (Mohamed, 2005). This ratio was very high in Shugor compared to other Desert sheep breeds and their crosses (Elhassan, 1994) indicating that Shugor had a high muscle: fat ratio and should be exploited where low fat animals are required. The

muscle: bone ratio was also less at 1 year old in Shorani (Gibreel, 2003) and Desert sheep fed blood meal (Mansour, *et al.*, 1988).

Increasing the slaughter age increased the slaughter weight and dressing percentages and the generally non significant effects of age at slaughter suggested that Shugor sheep can be slaughtered at relatively young ages (< 1 year).

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Table 1. Body weight and phenotypic traits of Shugor sheep at Rahad Scheme, Sudan.

Age (years)	Body weight (kg)	Height at wither (cm)	Heart girth (cm)	Abdominal girth (cm)	Body length (cm)	Tail length (cm)	Ears length (cm)
1	24.1 ± 6.81[a]	69.58 ± 11.14[a]	75.48 ± 7.89[a]	90.23 ± 12.38[a]	60.08 ± 5.14[a]	58.54 ± 7.08[a]	17.94 ± 1.49[a]
2	29.0 ± 6.21[b]	75.32 ± 5.17[b]	82.52 ± 8.12[b]	99.06 ± 10.30[b]	63.94 ± 6.07[b]	62.92 ± 5.44[b]	18.58 ± 1.16[a]
3	37.41 ± 4.57[c]	75.60 ± 5.13[b]	85.42 ± 5.54[c]	103.41 ± 5.78[c]	66.56 ± 3.09[c]	63.16 ± 6.99[b]	19.24 ± 1.27[a]
4	45.0 ± 5.19[d]	79.72 ± 4.32[c]	90.94 ± 7.73[c]	110.34 ± 6.29[d]	66.72 ± 9.55[c]	66.34 ± 6.17[c]	22.31 ± 1.25[b]

Means followed by the same letter(s) in columns are not significantly different at $P > 0.05$.

Table 2. Phenotypic correlations between body weight and some measurements in Shugor sheep in Rahad Scheme, Sudan.

Parameters	Age (years)			
	1	2	3	4
Heart girth	0.66 **	0.10*	0.15*	0.11*
Abdominal girth	0.69 **	0.40**	0.09	0.29 **
Body length	0.55 **	0.40**	0.16**	0.07
Height at withers	0.35 **	0.23**	0.21**	0.16**

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

Table 3. Regression equations predicting the body weight of Shugor sheep at Rahad Scheme, Sudan.

Age (years)	Regression equations
1	$Y = 0.272\ X_1 + 0.085\ X_2 + 0.026\ X_3 - 14.146$
2	$Y = 0.96\ X_1 + 0.356\ X_2 + 0.05\ X_3 - 33.029$
3	$Y = 0.066\ X_1 + 0.368\ X_2 + 0.577\ X_3 - 5.019$
4	$Y = 3.091\ X_1 + 6.503\ X_2 + 0.082\ X_3 - 55.415$

Y= Body weight (kg), X_1= Abdominal girth (cm), X_2= Height at withers (cm) and X_3= Body length (cm).

Table 4. Measured and predicted mean (± SD) body weights (kg) of Shugor sheep at different ages in Rahad Scheme, Sudan.

Age (years)	Measured body weights	Predicted body weights
1	24.10 ± 6.81	24.01 ± 4.81
2	29.04 ± 6.21	28.7 ± 1.79
3	37.41 ± 4.57	36.01 ± 2.91
4	45.00 ± 15.88	44.31 ± 25.27

Table 5. Body components (% of empty body weight) of different age groups of Shugor sheep in the Rahad Scheme, Sudan.

Parameters (%)	Age		
	6 months	1 year	Significance
Head	10.45 ± 0.67	9.38 ± 1.60	NS
Skin	11.03 ± 1.33	9.53 ± 1.18	NS
Legs	4.93 ± 0.26	3.98 ± 0.43	*
Lungs	2.65 ± 0.52	2.33 ± 0.40	NS
Heart	1.25 ± 0.13	0.76 ± 0.09	*
Liver	2.63 ± 0.53	2.43 ± 0.20	NS
Spleen	0.83 ± 0.10	0.66 ± 0.18	NS
Kidneys	0.76 ± 0.04	1.27 ± 0.49	NS
Stomach	4.48 ± 0.46	4.18 ± 0.74	NS
Small intestine	1.40 ± 0.36	1.22 ± 0.60	NS
Blood	6.03 ± 0.61	5.50 ± 1.22	NS

* and NS indicate significance at $P \leq 0.05$ and not significant differences, respectively.

Table 6. Slaughter weight and carcass characteristics of Shugor males at Rahad Scheme, Sudan.

Parameters	Age		Significance
	Six months	One year	
Slaughter weight (kg)	16.25 ± 0.67	26.50 ± 3.12	*
Empty body weight (kg)	12.39 ± 0.77	21.73 ± 2.12	*
Hot carcass weight (kg)	6.63 ± 0.95	11.63 ± 1.11	*
Dressing (%) on LBW basis	40.80 ± 5.76	43.38 ± 1.21	NS
Dressing (%) on EBW basis	51.3 ± 4.18	53.52 ± 1.74	NS
Total carcass muscle (%)	71.52 ± 6.18	76.7 ± 3.34	*
Total carcass bone (%)	27.05 ± 3.20	20.6 ± 2.39	*
Total carcass fat (%)	1.4 ± 0.58	2.68 ± 52	*
Muscle : bone ratio	2.64 ± 0.35	3.72 ± 0.57	*
Muscle : fat ratio	51.08 ± 7.59	28.62 ± 4.12	*

EBW= Empty body weight. LBW= Live body weight. * and NS indicate significance at P< 0.05 and not significant, respectively.

Table 7. Whole sale cuts (% of hot carcass weight) in Shugor males at the Rahad Scheme, Sudan.

Parameters	**Age**		
	Six months	**One year**	**Significance**
Leg and chump	31.63±4.15	33.48±0.82	*
Single short forequarter	30.92±4.50	30.12±5.29	NS
Loin	9.46±2.38	10.50±2.35	NS
Best end of neck	7.16±2.91	8.70±1.15	NS
Breast	6.67±1.15	6.01±0.62	NS
Neck	10.83±0.70	9.60±0.97	NS

* and NS indicate significance at P< 0.05 and not significant, respectively.

الصفات الشكليةو صـ فات ذبـ يحة أغنام الشقر في مشروع الرهد ، السودان

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الخلاصة

تمت دراسة الصفات الشكلية وصفات ذبيحة أغنام الشقر المهمة لإنتاج اللحوم في مشروع الرهد بالسودان. في الدراسة الأولى تم قياس الصفات الشكلية متضمنة وزن الجسم والارتفاع عند الكتف ومحيط الصدر ومحيط البطن وطول الجسم والذيل والأذنين في 200 من أغنام الشقر بعمر 1- 4 أعوام. عموما زادت الأوزان وقياسات الجسم بزيادة العمر. وكان وزن الجسم 24.1- 45.0 كجم. وكان متوسط الارتفاع عند الكتف ومحيط الصدر ومحيط البطن وطول الجسم وطول الذيل وطول الأذن (سم) 69.58 – 79.72 ، 75.48- 90.94 ، 90.23- 110.34، 60.08- 66.72 ، 58.54- 66.34، 17.94-22.31 على التوالي. وكانت كل الحيوانات بدون قرون. وجدت علاقات معنوية ($P\leq 0.05$) بين وزن الجسم وقياساته. استخدمت معادلات إنحدار خطية مختلفة لتقدير وزن الجسم من قياسات محيط البطن والارتفاع عند الكتف وطول الجسم في الأعمار المختلفة . ولم توجد اختلافات معنوية ($P\geq 0.05$) بين أوزان الجسم الحقيقية (المقاسة) والمقدرة. في الدراسة الثانية تم شراء ثمانية من ذكور أغنام الشقر من سوق الحيوانات في مدينة الفاو بعمر 6 أشهر أو عمر عام (4 في كل مجموعة) وذبحت لدراسة مكونات الجسم الثانوية وصفات الذبيحة. تناقصت النسب المئوية لمكونات الجسم الثانوية محسوبة على أساس وزن الجسم الفارغ بزيادة عمر الذبح بإستثناء الكليتين، وكان النقصان معنويا ($P < 0.05$) للأرجل والقلب. إختلفت أوزان الذبح ، وزن الجسم الفارغ ، وزن الذبيحة الساخن، العضلات والعظام والشحم الكلية في الذبيحة ونسبة العضلات إلى العظام ونسبة العضلات إلى الشحم معنويا ($P < 0.05$) بزيادة عمر الذبح. ولم تتأثر نسب التصافي على أساس وزن الجسم الحي أو الفارغ معنويا ($P\geq 0.05$) بزيادة عمر الذبح. كما لم يؤثر عمر الذبح معنويا ($P\geq 0.05$) على النسب المئوية للقطع الإجمالية للذبيحة بإستثناء الرجل والجمب.