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Phenotype, Husbandry and Performance of the Taggar Goats in Eldaleng Area, South Kordufan State, Sudan

Tilal M. A. Mudawi [1], Mohmed E. Elimam[1],
Mohmed Khair A. Ahmed [2] and Neama A. E. Ibrahim[3]

[1] Goat Research Centre, Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan
[2] Department of Animal Genetics and Breeding, Faculty of Animal Production, University of Khartoum, Shambat, Sudan
[3] Department of Animal Production, Faculty of Agricultural Sciences, University of Daleng, Daleng, Sudan

Abstract: Tagger goats are a promising meat breed, with excellent conformation and meat quality, in Nuba Mountains, where it is raised under extensive farming conditions. The objectives of this study were to study the phenotypic characteristics, husbandry and reproductive and lactation performance of this genotype in Eldaleng area. Mean body weight was 22.5 kg. Mean body measurements (cm) were 58.75, 65.9, 78.4 and 38.55 for height at withers, heart girth, barrel circumference and back length, respectively. Body weight and measurements were generally significantly ($P \leq 0.001$) higher in males than in females and significantly ($P \leq 0.001$) increased with age. Phenotypic correlations between body weight and measurements were generally high, and different regression equations accurately predicted body weight with no significant differences at all ages. Animal colours varied greatly. Most animals were kept in all goat ages. Flock size was 21.1 and females dominated flocks and their longevity was higher than males. The animals depended on natural pastures and grazed on village outskirts. They kidded all the year round with peaks in April and October. They were weaned at 4.1 months old and most of the males were castrated. Puberty, age at first service and age at first kidding were 7.15, 8.4 and 13.1 months, respectively. Kidding rate was 87%, twining rate was 52.8% and kidding interval was 245.4 days. Mean birth weight was 1.35 kg. Mortality rate was 26.5% in kids and 10.1% in adults. Milk yield was 0.64 kg/day in 156 days.

Key words: Tagger goats; body measurements; husbandry practices; performance; Sudan

INTRODUCTION

Goats are important in Sudan due to their large population of about 44 millions producing annually about 1602 and 161 thousand tons of milk and meat, respectively (FAO 2010). Goat meat has a high nutritive value and low fat and cholesterol contents (Devendra and Owen 1987), and its international demand is increasing due to the correlation between cardiovascular diseases and saturated fatty acids; however, goat meat is the least preferred in the Sudan (Elimam 2011). Goat meat exports are small compared with the high goat population. Improving and promoting goat meat production in Sudan is vital to export more meat and improve the national income.

In the Nuba Mountains, Tagger goats are known for meat production with superior quality, compact conformation and adaptation to harsh environments. Information on the husbandry practices, phenotype and body weight and measurements of most Sudanese goat breeds in their local habitats is scarce. In addition, information on equations to predict body weight from body measurements is limited in spite of their special importance in rural areas**.** Consequently, this study was launched in Eldaleng area to furnish this important information for the exploitation of this breed for meat production.

MATERIALS AND METHODS

Study area

Eldeleng Locality lies in South Kordofan State between latitudes 11°12′ and 12°45′ North, and longitudes 29°15′ and 30°45′ East. The area is semi-arid and the temperature is 17°C–43°C with a peak in May (Bunderson 1985). It rains from April to October, and the annual rainfall is about 400-700 mm with a peak in August and may reach 1700 mm in the south (Abusin 1992). Relative humidity varies from 35% in summer to 75% in autumn. Natural pasture growth is generally confined to the autumn and feeds quantity and nutritive value decline in the dry season (Bunderson 1985).

Tagger husbandry and performance

A questionnaire was designed and distributed to flocks' owners in 10 villages around Eldaleng to collect information on herd size and structure, husbandry, milk yield and reproductive traits. In addition, interviews with herders were conducted and observations were recorded.

Tagger body weight and measurements

Three flocks that were representative of the breed were chosen from each village with a total number of 488 animals. Live body weight was determined at different ages using a spring balance (50 kg capacity). Body measurements were determined using a measuring tape; these were height at withers, heart girth, barrel circumference and back length. Coat colour was recorded for each animal.

Statistical analysis

The data were statistically analysed according to Snedecor and Cochran (1980), and the means were compared for each age, in both sexes, using Duncan's multiple range test. Phenotypic correlations between live body weight and different body measurements were estimated using SPSS software. Predicted and measured weights were compared using student's t-test.

RESULTS

Tables 1 and 2 show the mean body weight and measurements of male and female Tagger goats in Eldaleng area, respectively. Generally, body weight and measurements increased with age. Male body weight was significantly ($P<0.001$) greater than female body weight except for those of less than one-year-old. All body measurements were significantly ($P<0.001$) higher in males except barrel circumference. Age significantly ($P<0.001$) affected body weight and measurements in both sexes, and the variations due to age were higher in males.

The phenotypic correlation coefficients between body weight and measurements were generally high for all measurements in all age groups (Table 3). They generally increased with age for all measurements and were highest in three years old male animals. Body measurements were

more correlated with body weight in males than in females. Highest body weight correlations were with heart girth in most ages; it had highest correlation with barrel circumference and lowest correlation in less than one year old males. The correlations of body weight with back length were comparatively low in females and to a lesser extent in males. Height at withers had high correlations with live body weight except in four years old females.

Table 4 shows the different regression equations used for predicting body weight from the most correlated body measurements. There were no significant differences between predicted and measured mean body weights of both sexes (Table 5).

Table 1. Mean body weight (kg) and measurements (cm) of Tagger males at different ages in Eldaleng area, South Kordufan State, Sudan

Body parameter	Age (years)			
	<1	1	2	3
	n=68	n=45	n=31	n=12
Live weight	15.18±0.41^{d}	22.27±0.56^{c}	25.71±0.40^{b}	29.36±0.48^{a}
Height at withers	52.11±0.72^{d}	59.48±0.57^{c}	62.38±0.40^{b}	66.46±0.41^{a}
Heart girth	56.07±0.59^{d}	65.68±0.70^{c}	70.78±0.38^{b}	76.36±0.43^{a}
Barrel circumference	67.14±0.82^{d}	76.62±0.65^{c}	82.18±0.36^{b}	87.92±0.57^{a}
Back length	33.45±0.55^{c}	39.36±0.54^{b}	40.78±0.46^{ab}	43.34±0.42^{a}
Ear length	13.38±0.23^{c}	13.99±0.22^{b}	14.39±0.16^{ab}	14.85±0.16^{a}
Horn length	7.20±0.38^{c}	9.11±0.28^{b}	11.05±0.23^{ab}	12.48±0.27^{a}
Tail length	9.67±0.24^{b}	10.19±0.17^{ab}	10.72±0.15^{a}	11.28±0.16^{a}

Means followed by the same letter(s) in each row are not significantly different at $P \leq 0.05$, according to Duncan's multiple range test.

Table 2. Mean body weight (kg) and measurements (cm) of Tagger females at different ages in Eldaleng area, South Kordufan State, Sudan

Body parameter	Age (years)				
	<1 n=103	1 n=89	2 n=67	3 n=51	4 n=22
Live weight	16.51±0.58^{c}	21.23±0.63^{b}	24.21±0.50^{ab}	25.72±0.52^{ab}	27.33±0.53^{a}
Height at withers	53.32±0.66^{c}	57.20±0.58^{b}	59.18±0.53^{ab}	59.82±0.67^{ab}	61.81±0.57^{a}
Heart girth	57.73±0.64^{c}	64.09±0.78^{b}	66.31±0.54^{b}	70.25±0.73^{a}	72.51±0.49^{a}
Barrel circumference	69.82±0.93^{d}	77.65±1.00^{c}	81.02±0.95^{bc}	84.78±1.16^{b}	89.64±1.18^{a}
Back length	34.75±0.33^{c}	37.28±0.57^{bc}	38.98±0.42^{b}	40.41±0.49^{ab}	42.31±0.44^{a}
Ear length	13.32±0.20^{c}	13.66±0.25^{bc}	13.78±0.27^{bc}	13.94±0.26^{b}	14.52±0.33^{a}
Horn length	5.35±0.32^{d}	7.86±0.36^{c}	8.69±0.40^{b}	10.18±0.37^{a}	10.58±0.34^{a}
Tail length	9.24±0.21^{b}	9.79±0.26^{b}	10.40±0.17^{a}	10.40±0.19^{a}	10.16±0.27^{a}

Means followed by the same letter(s) in each row are not significantly different at $P \leq 0.05$, according to Duncan's multiple range test.

Table 3. Phenotypic correlations between body weight and some body measurements of Tagger goats at different ages in Eldaleng area, South Kordufan State, Sudan

Body measurement	Males				Females				
	<1	1	2	3	<1	1	2	3	4
Height at withers	0.69**	0.63**	0.75**	0.77**	0.68**	0.62**	0.32**	0.57**	0.20**
Heart girth	0.84**	0.86**	078**	0.81**	0,76**	0.87**	0.83**	0.93**	0.39**
Barrel circumference	0.41**	0.73**	0.71**	0.90**	0.84**	0.71**	0.52**	0.68**	0.43**
Back length	0.33**	0.70**	0.60**	0.90**	0.38**	0.18**	0.52**	0.31**	0.13**

** Significant at P = 0.01.

Table 4. Regression equations predicting body weight of Tagger goats from some body measurements at different ages in Eldaleng area, South Kordufan State, Sudan

Age (years)	Males		Females	
	Equation	R^2	Equation	R^2
<1	$y= 0.47x_1+0.09x_2+0.03x_3-18.17$	0.89	$y= 0.43 x_1+0.29 x_2+0.17 x_3-35.39$	0.87
1	$y= 0.6 x_1+0.07 x_2+0.02 x_3-23.05$	0.86	$y= 0.43 x_1+0.38 x_2+0.16 x_3-40.02$	0.83
2	$y= 0.34 x_1+0.37 x_2+0.22 x_3-39.08$	0.91	$y= 0.66 x_1+0.16x_2+0.07 x_3-34.74$	0.94
3	$y= 0.2 x_1+0.24 x_2+0.52 x_3- 47.74$	0.87	$y= 0.61 x_1+0.09 x_2+0.01 x_3-23.13$	0.87
4			$y= 0.33 x_1+0.17 x_2+0.16 x_3-21.36$	0.84

y= body weight, x_1=heart girth, x_2=height at withers and x_3=barrel circumference

Table 5. Predicted and measured mean body weights (kg) of Tagger goats at different ages in Eldaleng area, South Kordufan State, Sudan

Age (years)	Males		Females	
	Predicted weight	Measured weight	Predicted weight	Measured weight
<1	15.45±0.61[a]	15.38±0.67[a]	17.38±0.86[b]	16.97±0.85[b]
1	22.19±0.62[a]	22.23±0.61[a]	21.08±1.00[b]	20.53±1.20[b]
2	25.12±0.48[a]	24.72±0.45[a]	23.18±0.59[b]	22.78±0.56[b]
3	28.10±0.73[a]	28.15±0.84[a]	26.24±0.55[b]	26.28±0.72[b]
4			27.00±0.55[a]	26.81±0.74[a]

Means followed by the same letter in each row are not significantly different at $P \leq 0.05$

The goat colours in both sexes varied greatly and were mostly mixed and brown, followed by black, grey and white (Fig. 1). Farmers prefer to rear goats separately or in mixed flocks with sheep where they were dominant (Table 6). Females, both adults and kids, formed most of the flocks (68.9%) with nearly equal percentages. Females were generally kept to old ages compared with males. Most animals (86.7%) were milked once daily in the morning. Animals grazed in village outskirts from morning to evening. No breeding control was practiced, although most males were castrated.

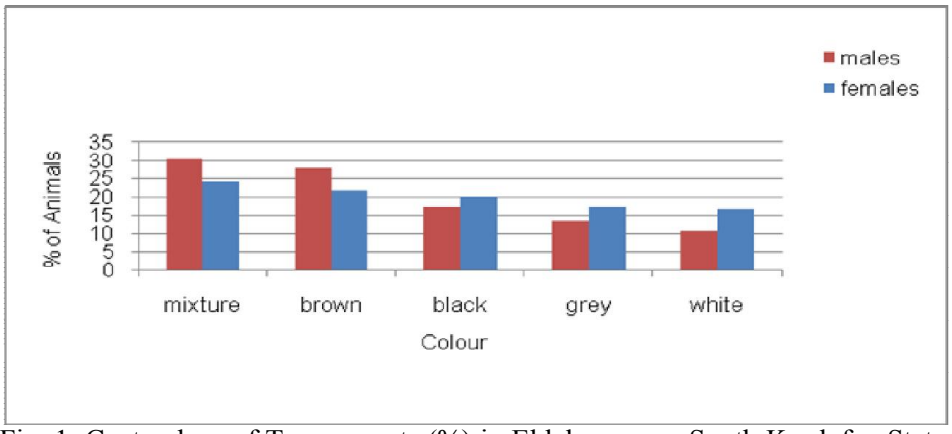

Fig. 1. Coat colour of Tagger goats (%) in Eldaleng area, South Kordufan State, Sudan

Table 6. Husbandry practices of Tagger goats in Eldaleng area, South Kordufan State, Sudan

Parameter	Mean± S.E.	Range
Rearing system (%)		
Pure flocks	53.33	
Mixed flocks	46.67	
Flock size (heads)	21.10±2.37	8-55
Flock structure (%)		
Adult males	9.92±1.53	2-27
Male kids	21.17±1.80	9-42
Adult females	34.70±2.25	15-79
Female kids	34.21±1.75	21-55
Female: male	2.45	
Doe: buck	7.29	
Longevity (years)		
Males	5.96±0.56	3-9
Females	10.33±0.42	5-12
Weaning age (mon.)	4.10±0.22	1-6
Milking frequency per day (%)		
Once	86.66	
Twice	13.34	
Breeding control	Non.	
Castration(%)	93.33	

Females reached puberty earlier than males, and age at first service was about a month after puberty in both sexes (Table 7). Age at first kidding was 13.1 months, and kidding rate was 87%. Twinning rate was 52.83% and kidding interval was 245.4 days. Kidding was throughout the year with peaks in April and October. Males were heavier at birth (1.49 kg) than females (1.19 kg). Mean milk yield was 0.64 kg/day in a lactation length of 156.3 days. Mortality rate was higher (26.45%) before weaning than after weaning (10.12%).

Table 7. Performance of Tagger goats in Eldaleng area, South Kordufan State, Sudan

Parameter	Mean± S.E.	Range
Puberty age (mon.)		
Males	7.43±0.39	4-9
Females	6.87±0.34	4-9
Age at first service (mon.)		
Males	8.04±0.39	4-12
Females	7.78±0.37	4-11
Age at first kidding (mon.)	13.10±0.41	9-16
Kidding rate (%)	87.00±3.23	50-100
Twining rate (%)	52.82±2.24	25-75
Kidding interval (days)	245.40±13.20	180-390
Birth weight (kg)		
Males	1.49±0.04	1-2
Females	1.19±0.04	0.75-1.5
Mortality rate (%)		
Pre-weaning	26.45±1.42	1.-50
Post-weaning	10.12±0.82	5-20
Milk yield (kg /day)	0.64±0.03	0.5- 1.0
Lactation period (days)	156.30±7.80	90-180

DISCUSSION

Tagger body weights and measurements were higher at all ages than those reported in Rashad area in Nuba Mountains (Elbukhary 1998) and this could be due to different strains, crossing with other breeds or nutrition. The increased body weight and measurements with age and males having greater body weight than females are similar to those reported for Tagger in Rashad area (Elbukhary 1998) and Nubian goats in Shukaba area (Elimam and Ayderous 2002) and Kenana area (Khalifa 2002). The high correlations between body weight and measurements and prediction method of body weight, using linear regression equations were reported for Nubian goats in Shukaba (Elimam and Ayderous 2002) and Kenana areas (Khalifa 2002) and Grey and Brown Bengal in India (Mukherjee *et al.* 1982) and were due to coordinated growth in animals (Pant 1974). Equations are beneficial where instrument is not available or difficult to operate and maintain. The great variation in Tagger colours are similar to that in Rashad area (Elbukhary 1998) and suggests that Tagger is not a homogeneous breed and that there is extensive haphazard crossing.

Tagger goats in Eldaleng area are well adapted to the local environment and easy to acquire, maintain and market, and their meat is preferred. The existence of goats in mixed flocks improves pasture utilization due to different grazing habits (Devendra and Burns 1983). Flock size was less than that of Tagger in Rashad (Elbukhary1998) and Nubian goats in Shukaba (Elimam and Ayderous 2002). The higher percentages of young animals and females in flocks indicated a high rate of offtake. Similarly, females formed most of the flocks in Shukaba (Elimam and Ayderous 2002). In addition, the higher female's longevity in flocks substantiated maintaining high producing flocks. However, weaning at 4.1 months old indicated a traditional system as mentioned by Devendra and McLeroy (1982) and should be improved by early weaning as possible. The animals were milked once a day due to low yields and studies in Malawi concluded to milk the animals at suitable times with no effects on milk yield and kid performance (Wilson 1982). Grazing on village outskirts is a typical semi extensive system with animals kept together and kidding all the year. Males were mainly castrated to control breeding and to produce highly demanded fat carcasses.

Ages at puberty and first service were reasonable and less than in other developing countries (Elimam 2011) and could be reduced by improving nutrition and management of kids (Devendra and Burns 1983). Early puberty and mating increase production life and profits. Age at first kidding was close to that for Tagger in Rashad area (Elbukhary 1998) and higher than for Baggara goat (Ageeb 1992) and less than for Desert and Nilotic goats (Tleimat 1986). Kidding rate was better than Black Bengal and British Saanen in India (Elimam 2011). Twining rate was less than in Rashad (Elbukhary 1998) and close to that in Desert goats (Wilson 1991). It was generally lower than in Desert (Tleimat 1986) and Baggara goats (Ageeb 1992).

Kidding interval was higher than in Tagger of Rashad area (Elbukhary 1998), Nubian, Desert, Nilotic (Tleimat 1986) and Baggara goats (Ageeb 1992). Kidding all the year round was similar to that reported by Devendra and McLeroy (1982) for tropical breeds. The two kidding peaks were associated with availability of feeds at mating and kidding improving reproductive performance and kid's survival. Birth weight was less than Tagger in Rashad area (Elbukhary 1998) and other Sudanese breeds (Tleimat 1986). This reflected genetic and non-genetic differences among breeds. Males' heavy birth weight than females is substantiated by many reports as mentioned above. Mortality rate was higher than for Tagger in Rashad area (Elbukhary 1998). Variations in mortality rates with age were similar to those reported by Devendra and McLeroy (1982), Wilson (1991) and Elbukhary (1998). Better nutrition and management are essential to reduce pre-weaning mortality. Mean daily milk yield and lactation period were less than Nubian goats (Devendra and McLeroy 1982).

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الطراز المظهرى ونظام الرعاية والأداء الإنتاجي للماعز الجبلي (التقر) بمنطقة الدلنج، ولاية جنوب كردفان ، السودان

طلال مصطفي علي مضوي[1] و محمد الأمين الإمام[1]
و محمد خير عبد الله أحمد[2] ونعمة آدم إسحق إبراهيم[3]

[1] مركز أبحاث الماعز، كلية العلوم الزراعية ، جامعة الجزيرة ، ودمدنى – السودان
[2] قسم الوراثة وتربية الحيوان ، كلية الإنتاج الحيوانى ، جامعة الخرطوم ، شمبات – السودان
[3] قسم الإنتاج الحيواني، كلية العلوم الزراعية ، جامعة الدلنج، الدلنج– السودان

المستخلص: يعتبر الماعز الجبلي (التقر) من الحيوانات الواعدة لإنتاج اللحوم لتميزه بالقوام الجيد مع جودة خواص اللحم ورغماً عن ذلك تقل الدراسات عنه . هدفت هذه الدراسة لتحديد الصفات المظهرية ونظام الرعاية والأداء الإنتاجي والتناسلى لهذا الطراز الوراثي في منطقة الدلنج . بلغ متوسط وزن الجسم 22.5 كجم ومتوسط مقاييس الجسم (سم) 58.75 و 65.9 و 78.4 و 38.55 لإرتفاع الجسم ومحيط الصدر ومحيط البطن وطول الظهر على التوالي . كانت أوزان ومقاييس الجسم عامة أعلى معنوياً في الذكور وتزيد معنوياً ($P\leq0.01$) بزيادة العمر . كان الإرتباط المظهرى بين وزن ومقاييس الجسم المختلفة عامة عالياً ، وتنبأت معادلات الإنحدار المختلفة بأوزان الجسم بدون إختلافات معنوية فى كل الأعمار . وتباينت ألوان الحيوانات بدرجة كبيرة . ‘حفظت معظم الحيوانات في كل قطعان الماعز وكان حجم القطيع 21.1 مع سيادة للإناث وفترة بقاء في القطيع أطول من الذكور . إعتمدت الحيوانات على المرعى الطبيعي وكانت ترعى حول القرية . كانت الولادات طوال العام بقمتين فى أبريل وأكتوبر . بلغ عمر الفطام 4.1 شهراً ومعظم الذكور كانت مخصية . كان عمر البلوغ والعمر عند أول تلقيح وعند أول ولادة 7.15 و 8.4 و 13.1 شهراً على التوالى . بلغ معدل الولادة 87%،

والتوائم 52.8%، والفترة بين الولادتين 245.4 يوماً. بلغ متوسط وزن الميلاد 1.35 كجم ، ونسبة النفوق 26.5 للصغار و 10.1 للبالغين، وإنتاجية اللبن 0.64 كجم/يوم كمتوسط لـ 156 يوم إدرار.