Pelvic and Testicular Biometry of Sahel Goats in Maiduguri, Nigeria

1Abba, A., 2Mustapha, A. R., 1Bamanga, U. M., 2Iliyasu, D., 2Peter, I. D., 2Asuku, S. O., 2Stephen, J. and 2Waziri, M. A.

1Veterinary Teaching Hospital, University of Maiduguri
2Department of Theriogenology, Faculty of Veterinary Medicine, University of Maiduguri, P.M.B 1069, Maiduguri

* Author for Correspondence: madambe72@gmail.com

ABSTRACT

This study was carried out to document the pelvic and testicular biometric characteristics of Sahel goats. Record of body weight, body condition score, height at withers, scrotal length, scrotal circumference and external pelvic circumference were obtained from 400 male and 600 female Sahel goats. All the goats were approximately 1.5 years old and weighing 14 to 18 kg, with body condition score of 3 or 4 (scale of 1-5). The mean bodyweight of Sahel bucks was 15.12 ± 1.10 kg while that of Sahel does was 13.22 ± 1.12 kg, height at withers in bucks and does were 52.22 ± 1.20 cm, and 48.13 ± 1.23 cm respectively. The scrotal length and circumference in Sahel bucks were 11.39 ± 1.12 cm and 17.95 ± 1.21 cm respectively. The external pelvic circumference in Sahel does was 55.13 ± 1.16 cm. There was significant (P < 0.05) positive correlation between the body weight and body condition score in bucks (r=0.52) and in does (r=0.42). It was observed that there was weak but positive correlation between the body weight and height at withers (r=0.34), in bucks and in does (r=0.25; P < 0.5). A low but significant positive correlation was found between the body weight and scrotal circumference r=0.28, (P < 0.05) in bucks. There was a high and significant positive correlation between the scrotal length and scrotal circumference r=0.66, (P < 0.05). The external pelvic circumference in Sahel does was also significantly positively correlated with body weight r=0.40, (P < 0.05) and with the body condition score r= 0.33, (P < 0.05). The information obtained from this study can be used for breed -specific morphometric characterization of indigenous Sahel goats.

Keywords: Biometry; Pelvic circumference; Sahel goat; Testicular parameters

INTRODUCTION

Goats are important livestock species throughout Africa (Dehouegnon, 2017). Surveys have shown that up to 85 percent of rural households, poor farmers and small-time business people of all age groups and sexes keep goats (Salako, 2004). The world population of goats was estimated at 746 million, with 96 % of these being kept in developing countries, however, they constitute the largest group of small ruminant livestock in Nigeria (53.8 million) and also constituting 6.2 percent of the World’s goat population (FAOSTAT, 2008).

The Nigerian indigenous goats have been phenotypically classified into three distinct breeds, the Red Sokoto goat found mostly in the North Western Nigeria, the West African dwarf goats commonly found in the Middle belt and Southern part of Nigeria and the Sahel desert or West African long-legged goat found mostly in the North-Eastern Nigeria (Onakpa et al., 2010). Kwari, (2001) reported that, a pure Sahel goat are thin in appearance with narrow body, shallow chest, stiff short hair, long legs, with pendulous or semi-pendulous ears, and their colors varies from cream to red, black, pure white, gray, brown, or mixtures of colors.

In addition, Kwari (2001), stated that there were several ecotypes (brown, black, and mixed) of Sahel goats. Furthermore, the Sahel goats had higher resistance to dehydration and wide range of feeding habits that enables them to thrive in dry arid regions such as the Sahel.

In Nigeria, Sahel goats are found in the arid and semi-arid zones of Northern part of the country, mainly kept for agricultural, economic, cultural and religious purposes, and it is a resourceful and efficient ruminant producing meat, milk, skin and hair (Morand et al., 2004). The doe reach puberty between 4 to 12 months of age, and a buck can reach puberty as early as 4 months of age depending on the breed, season of birth, level of nutrition, and overall health status (Jamie and Clifford, 2014). It has been shown that Sahel does attain puberty at 5 months with presence of corpus luteum in the ovary (Bukar et al., 2006). Live body weight is often the most common and informative measure of animal reproductive performance (Adeyinka and Mohammed, 2006). Testicular biometrics has been reported
to be correlated parameters of male fertility such as semen production (Sameh et al., 2019). Raji et al. (2008) reported that live body weight in goat is often unavailable to goat’s producers under field conditions in Nigeria, however, decision making on the field is sometimes difficult and husbandry techniques like animal medication are usually based on subjective estimates of body weight, therefore, studies have indicated that scrotal circumference is one of the most heritable components of fertility in ruminants and should be included in the breeding soundness evaluation in farm animals (Mohamed et al., 2020).

Thus, there is need to determine some measurable indices (body weight, body condition score, scrotal length, scrotal circumference, height at withers and external pelvic circumference) to assist in breeding soundness and serve as guide for the selection of male and female Sahel goats for breeding in Maiduguri and its environs. This information will be useful and serve as a baseline for future genetic improvement programs.

MATERIALS AND METHODS

Experimental Animals and Management

This study was conducted in Maiduguri, Nigeria during a two weeks goat quarantine operation from 10th - 25th March, 2019. The quarantine was for a governmental program designed for livestock restocking and distribution to internally displaced persons in some local government areas of Borno State. A total of 1000 apparently healthy Sahel goats (with specified age, weight and body condition score) as specified on the contract terms were purchased from livestock markets in Borno and Yobe States. All the 1000 goats had characteristics described for the Sahel goat ecotypes as described by Kware (2001). The goats were provided shelter and fed with groundnut hay; wheat offal and water were provided ad libitum.

The goats were matured based on the appearance of their permanent teeth as described by Amin et al. (2016) and USDA (2019). Individual goats were weighed using SALTER® hanging spring balance (Nongo and Akinboade, 2013) and their weight ranges from 14-18 kg. Goats with Body Condition Score (BCS) of 3 or 4 were selected into quarantine operation (1=very thin, 2=thin, 3= average, 4=fat and 5=very fat/obese) according to the method described by Burkholder (2000) and Bukar et al. (2012).

Out of the 1000 Sahel goats studied, 600 were females and 400 were males. The animals were selected using systematic sampling technique from a pooled of 4500 Sahel goats.

External Pelvic Circumference

The external pelvic circumference of the Sahel does were measured using a flexible measuring tape as described by Samuel and Salako, (2008). It is the distance (cm) around the pelvis, over the tuber coxae and anterior part of the udder.

Testicular Morphometry

The scrotal circumference was measured using a flexible measuring tape (cm) (Ahmed et al., 2005; Memon et al., 2007). The testes are gently and firmly pushed into the scrotal sac and the circumference around the middle of the testicles was measured (Kumbhar et al., 2017). The scrotal length was measured as distance (cm) between the lower end and neck of the scrotum as described by Raji et al. (2008).

The height at withers (meters) was measured as the vertical distance from the shoulder, at the withers, to the ground (Hifzan et al., 2015), as illustrated below.

Statistical Analyses

All data were analyzed using SPSS® statistical software version 20. Data were summarized using descriptive statistics and were expressed as Mean ± Standard deviation. Correlation analyses were done for pelvic morphometric and testicular biometry in the Female and Male Sahel goats respectively. The correlations were considered significant at \( P < 0.05 \).

RESULTS

The mean values obtained for body weights of Sahel goat bucks and does recorded in this study were 15.12 ± 1.10 kg and 13.22± 1.1 kg, respectively. The mean values for height at withers was 52.22 ± 1.20 cm in bucks and 48.13±1.23 cm in does. The values documented for scrotal length in this study was 11.39 ± 1.12 cm. The values of scrotal circumference recorded in the current studies was 17.95 ± 1.21 cm, while that of external pelvic circumference in Sahel does was 55.13 ± 1.16 cm (Table 1 and 2).

The result from this study confirms that, body weight and body condition scores were significantly correlated (\( P < 0.05 \)) in both male and female Sahel goats (r=0.52; bucks and r=0.42; does). There was weak but positive correlation between the body weight and height at withers at r=0.25 in Sahel does and r= 0.34 in bucks. In this study, weak positive correlation (\( P < 0.05 \)) was found between the body weight and scrotal circumference (r= 0.28) in Sahel bucks. There was moderate positive correlation between the scrotal length and scrotal circumference (r= 0.66) (Table 3 and 4).
bucks by Ajani et al. (2015) and 17.15 ± 1.14 cm reported by Oyeyemi et al. (2011) in west African Dwarf bucks. Amare and Kefelegn, (2017) reported scrotal length of 20.8 ± 1.84 cm in indigenous breed of goats in the arid and semi-arid agro-ecological zones of Ethiopia. The slight difference could have been attributed to breed variation and management system among the two breeds.

### Table 1: Body weight, body condition score, height at withers, scrotal length and scrotal circumference of Sahel bucks in Maiduguri.

<table>
<thead>
<tr>
<th>Parameters (n=400)</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>15.12 ± 1.10</td>
</tr>
<tr>
<td>Height at withers (cm)</td>
<td>52.22 ± 1.20</td>
</tr>
<tr>
<td>Scrotal length (cm)</td>
<td>11.39 ± 1.12</td>
</tr>
<tr>
<td>Scrotal circumference (cm)</td>
<td>17.95 ± 1.21</td>
</tr>
</tbody>
</table>

### Table 2: Body weight, body condition score and external pelvic circumference of Sahel does in Maiduguri.

<table>
<thead>
<tr>
<th>Parameters (n=600)</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>13.22 ± 1.12</td>
</tr>
<tr>
<td>Height at withers (cm)</td>
<td>48.13 ± 1.23</td>
</tr>
<tr>
<td>Pelvic circumference (cm)</td>
<td>55.11 ± 1.16</td>
</tr>
</tbody>
</table>

### Table 3: Correlation between the body weights, body condition score, with testicular measurement of Sahel bucks in Maiduguri.

<table>
<thead>
<tr>
<th>Correlation Coefficient (r)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrotal length and Scrotal Circumference</td>
<td>0.63</td>
</tr>
<tr>
<td>Body Weight and Scrotal Circumference</td>
<td>0.28</td>
</tr>
<tr>
<td>Body Weight and body condition Score</td>
<td>0.52</td>
</tr>
<tr>
<td>Body Weight and Height at withers</td>
<td>0.34</td>
</tr>
</tbody>
</table>

The correlation coefficient (r) is significant at P < 0.05.

### Table 4: Correlation between the body weights, body condition score, with external pelvic circumference of Sahel does in Maiduguri.

<table>
<thead>
<tr>
<th>Parameters (600)</th>
<th>Correlation Coefficient (r)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Weight and Pelvic Circumference</td>
<td>0.40</td>
<td>P &lt; 0.000</td>
</tr>
<tr>
<td>Body condition Score and Pelvic Circumference</td>
<td>0.33</td>
<td>P &lt; 0.000</td>
</tr>
<tr>
<td>Body Weight and body condition Score</td>
<td>0.42</td>
<td>P &lt; 0.000</td>
</tr>
<tr>
<td>Body Weight and height at withers</td>
<td>0.25</td>
<td>P &lt; 0.000</td>
</tr>
</tbody>
</table>

The correlation coefficient (r) is significant at P < 0.05.

The value documented for the external pelvic circumference in Sahel does was lower than 76 ± 1.20 cm already documented by Dereje et al. (2013) in Hararghe Highland goat in Ethiopia. The variability between the breeds could be due to breed and ecological differences.

The correlation between body weight and body condition score in both males and females Sahel goats r=0.52 (bucks) and r=0.42 (does) was similar to what was reported by Dereje et al. (2013), which stated that a correlation coefficient of r=0.47 in bucks and r=0.48 in does were documented in Hararghe Highland Goat in Ethiopia, furthermore, Turkgedli et al. (1997) reported a correlation coefficient (r=0.52) in British crossbreed goat.

The weak positive correlation between the body weight and height at withers is similar to r=0.25 reported by Babale et al. (2018) in Sheep and goats in Adamawa State, Nigeria. Muhammad et al. (2006) reported highly significant correlation (P < 0.05) between body weight and height at withers at r=0.54 in local goat in Pakistan, however, Alemayehu et al. (2010) reported r=0.50 in local sheep and goats in Ethiopia.

Similarly, a weak positive correlation between the body weight and scrotal circumference of Sahel goat buck was in contrast to the report of Adedeji and Gbadamosi, (1999), who reported a strong positive correlation (P < 0.05) between scrotal circumference and body weight at r= 0.70 in Red Sokoto goats, and suggested that, testicular length and circumference are measures of testicular size which had been found to be significantly correlated with body weight; males with larger scrotal size might possess larger body size. Raji et al. (2008) reported that, the scrotal circumference and
testes weight were significantly ($P < 0.05$) higher in the Red Sokoto breed of goat when compared with another indigenous breed of goat in Nigeria. Similarly, Shamsuddin et al. (2000) reported correlation coefficient of $r=0.95$ in the two parameters above in black Bengal goats.

A moderate positive correlation between the scrotal length and scrotal circumference was in agreement with the previous report of Raji et al. (2008), which stated that, scrotum length and scrotum circumference were found to be positively correlated with high correlation coefficients ranged from $r=0.61$ to $r=0.67$ in Red Sokoto and Borno white goats respectively. This implies the fact that selection of male goats based on scrotal circumference could be used as an indicator for breeding soundness evaluation under field condition. Result also revealed a significant ($P < 0.05$) correlation between external pelvic circumference in Sahel does with body weight ($r=0.40$) and external pelvic circumference with body condition score ($r=0.24$), which concurs with other work conducted by Theodros, (2002), which reported that, body weight and external pelvic circumference were positively correlated ($r=0.60$) in Afar does in North eastern Ethiopia. Dereje et al. (2013) reported a moderate correlation coefficient ($r=0.55$) between body weight and pelvic measurement, which provide a good predictor of live weight in Hararge Highland Goat in Ethiopia, in the fields with no access to weighing scales.

**Conclusion**

In conclusion, the body weight, body condition score, height at withers, scrotal length, scrotal circumference and external pelvic circumference of Sahel goats in Maiduguri were successfully determined, these parameters studied might serve as a bases for determining the breeding soundness of Sahel Goats in the Arid zone of Nigeria. However, further studies relating to semen evaluation is recommended.

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**Conflict of Interest**

The authors have no conflict of interest to declare.

**Authors Contributions**

AA, BUM and SOA collected the field data for the analysis, and wrote the initial draft for the manuscript. AM conceived the idea for manuscript development, MAW reviewed the manuscript, DI and IDP reviewed the literatures relating to past work. JS did the proof reading and final corrections of the manuscript. All authors approved the final draft.

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