

# Linear body and reproductive organ characteristics of West African Dwarf goats fed groundnut haulms and cowpea husk with brewers dried grain supplement

## Abstract

A study was conducted to determine the effects of feeding groundnut haulms, and cowpea husk supplemented with brewers' dried grain on variability in body Morphometric measurements and the reproductive organ characteristics of West African Dwarf goats. Body parameters measured were body length (BL), heights at withers (HW), girth circumference (GC), Height at rump (HR), abdominal circumference (AC) neck length (NL), neck circumference (NC) with live weights of animals. Reproductive organ parameters determined were scrotal length (SL), scrotal circumference (SC), Scrotal and testicular weight (STW), Testicular circumference (TC), Testicular volume (TV), penile length (PL) and (PW) penile weight. The ranges for the parameters were length of animal (LA) 30.33 to 38.92cm, height at rump (HR) 28.25 to 39.71cm, abdominal circumference (AC) 18.79 to 22.29cm and neck length of 13.46 to 17.79 cm. All the results were significantly ( $P<0.05$ ) different across treatments. The reproductive organ parameters, scrotal circumference and testicular parameters were measured with caliper and tape. Results revealed that ranges were scrotal lengths (SL) varying from 27.38 to 38.92 cm, Scrotal circumference (SC) 12.67 to 17.63cm, Scrotal and testicular weights (STW) from 36.92 to 45.67g, Testicular volumes 17.88 to 21.08 mls while for penile morphometry, the results ranged from 3.06 to 4.13cm for penile length (PL) and 3.21 to 3.79g for penile weights respectively. All parameters differed ( $P<0.05$ ) significantly across treatments. It was concluded that the reproductive organ parameters especially scrotal circumference are useful indicators and important selection criteria to determine the reproductive organs development and breeding soundness in young animals. That, there is variability in body measurements and that these measurements can be exploited in predicting live body weight and hence the economic value of goats.

**Keywords:** live body weight, linear traits, reproductive organs, goats

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**Abbreviations:** BL, body length; HW, heights at withers; GC, girth circumference; HR, Height at rump; AC, abdominal circumference; NL, neck length; NC, neck circumference; SL, scrotal length; SC, scrotal circumference; STW, scrotal and testicular weight; TC, testicular circumference; TV, testicular volume; PL, penile length; PW, penile weight

## Introduction

Body dimensions in different livestock species have been studied by many scientists. Therefore the assessments of the powers of body measurements in the estimation of weights and the accuracy of body weights in the estimation of size have been reported.<sup>1</sup> The ability of the producers and buyers to relate the live animal measurements to growth characteristics is essential for optimum production and value based trading system.<sup>2</sup>

According to Akpa et al.<sup>3</sup> growth is the sum total of increase in size of different structural body components measured from gain in body weight and linear body measurements. Adewumi & Adewole<sup>4</sup> also stated that the ability of the producers and buyers of livestock to relate live animal measurements to live weights is of immense financial contribution to livestock production enterprise. Bello & Adama<sup>5</sup> reported positive significant ( $P<0.01$ ) difference between neck length

and height at withers ( $r=0.750$ ), hind leg length and foreleg length ( $r=0.560$ ) body weight and chest girth ( $r=0.677$ ).

Reproduction is one of the most important factors for the economics of livestock production. Perumal<sup>6</sup> reported that testicular measurements at early ages are very important in selection of breeding sires to collect semen for artificial insemination (A.I). The important parameters of testicular measurements are diameter, length, volume and circumference.<sup>7</sup> Kaymakci et al.<sup>8</sup> stated that male animals with bigger testes produce more sperm than males with smaller testes. Salhab et al.<sup>7</sup> further reported that testicular size is positively related to body weight and age. Scrotal circumference is reported to be highly ( $P<0.01$ ) correlated with body weight and age<sup>9</sup> and highly ( $P<0.01$ ) correlated with testes weight,<sup>10</sup> consistency and fertility.<sup>11</sup>

It is reported by Jennifer<sup>12</sup> that scrotal circumference is an indicator of a bull's fertility. The author further stated that hip height is used to measure expected progeny difference for mature weight. The larger the bull's scrotal circumference, the earlier its daughters will reach puberty.<sup>13</sup> Scrotal size correlates well with daily sperm production.<sup>14</sup> Bull with bigger testicles produce more semen, sire sons with bigger testicles and reach puberty at early age. Differences in scrotal circumference are reflected in the average size of the animal's scrotum.<sup>15</sup>

Nutrition has a dramatic effect on testicle size.<sup>9</sup> Improving nutritional intake during few months before breeding, increases testicular size and sperm production up to 100%.<sup>8</sup> The source further reported that scrotal circumference is an indication of breeding ability. That sperm production is directly correlated to testicular width. The measurable criteria for judging breeding soundness of males include scrotal circumference, libido and sperm quality tests.<sup>16</sup> That ram lambs with less than 30cm and adult with 32cm testicular circumference should not be used for breeding.

Measure of scrotal circumference is an indirect estimate of the mass of testicular tissue which is directly related to sperm quality and quantity. Martin & Greef<sup>17</sup> reported that changes in nutrition of mature rams and bucks led to profound responses in testicular size and therefore rate of production of sperm. Duguma et al.<sup>18</sup> reported that standard nutrition can reduce scrotal circumference, testicular mass and hence sperm quality and quantity. Sperm output depends on quantity of sperm stored in the caudal epididymis in the scrotum. The higher the testicular mass, the higher the scrotal circumference and hence higher the sperm quality.<sup>19</sup>

Information on the Morphometric and reproductive organ characteristics of West African Dwarf goats fed these diets is scanty. The study was therefore carried out to determine the linear body measurements, live weights and reproductive organ characteristics of West African Dwarf goats and how they are affected by the diets.

## Methodology

### Experimental site

The research was carried out in Mubi, Adamawa State, Nigeria. Mubi region lies on Latitude 9° 11' north of the equator and Longitude 13° 45' east of the Greenwich Meridian at an altitude of 696m above sea level. It is bounded in the South and East by Republic of Cameroun. With land area of 4,728.77m<sup>2</sup> and population of 245,460,<sup>20</sup> it is situated in the Sudan Savanna zone of Nigeria. The vegetation type is best described as Combretaceous woodland savanna<sup>21</sup> which consists of grasses or weeds and shrubs collectively making 70% of the entire vegetation. Some of these grasses, weeds and shrubs are used as animal feeds.

The area has two distinct seasons. Rainy season lasts for four (4) months and dry season that lasts for eight (8) months. Annual rainfall ranges from 700-900mm with peak in August. The area has minimum temperature of 12.7°C in January and maximum of 37°C in April.<sup>22</sup>

### Sources of feeds

Groundnut haulms and Cowpea husks were obtained from local farmers' farms after harvest. Brewers' dried grains were purchased from local brewers' in and around Mubi town, Adamawa State, Nigeria. They were bagged and stored.

### Experimental animals and their management

Twelve West African Dwarf bucks of average age of 12 months and mean live weight of 12kg were sourced from the local markets in and around Mubi. Their ages were determined through their dental formulae. They were then housed individually in pens measuring 1.5m<sup>2</sup> and 1.5m high. The floor of the house was of concrete and covered with wood shavings to absorb moisture from the animals' dung and urine.

The animals were quarantined for two weeks during which they were fed the experimental diets for adaptation and dewormed with

Albendazol. At the end of the adaptation period, the animals were tagged, randomly allocated to treatments and balanced on weight basis for all the treatments. They were weighed to get the initial weights and balanced on weight basis before embarking on data collection.

### Experimental diets

In table one, are presented the experimental diets with groundnut haulms and cowpea husk combined at different levels. The experimental diets were combinations of groundnut haulms at 20, 40, 60 and 80% with cowpea husks at 80, 60, 40 and 20% designated as treatments T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub> respectively. These combinations were fed ad libitum as basal diets while the Brewers' dried grain (BDG) which served as supplement was fed at 200g to all animals across treatments (Table 1).

Table 1 Experimental diets

Feed	Treatments			
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>
GNH (%)	20	40	60	80
CPH (%)	80	60	40	20
BDG (g)	200	200	200	200

GNH, groundnut haulms; CPH, cowpea husk; BDG, brewers' dried grains

### Parameters determined

Body parameters measured were body length (BL), heights at withers (HW), girth circumference (GC), Height at rump (HR), abdominal circumference (AC) neck length (NL), neck circumference (NC) with live weights of animals. Reproductive organ parameters determined were scrotal length (SL), scrotal circumference (SC), Scrotal and testicular weight (STW), Testicular circumference (TC), Testicular volume (TV), penile length (PL) and (PW) penile weight.

Live weight of each animal was determined by suspending the animal on a spring balance and weight of each animal taken and recorded. In determining body measurements, body length (BL) was measured using tape rule as the distance from the occipital protuberance to the base of the tail.

Height at wither was obtained by using platform upon which each animal was placed. It was measured as the distance from the surface of the platform to the withers using a meter rule. Girth circumference was determined by taking the measurement of the circumference of the chest with a tape. Height at rump was measured as the distance from the surface of the platform to the rump using a measuring rule.

Neck length was the distance from the lower jaw to the point of the shoulder using tape rule. Neck circumference was gotten by measuring the distance round the neck below the lower jaw using the tape rule.

Scrotal circumference was measured by holding the testicles to the bottom of the scrotal sack and placing the tape around the widest point. Testicular length was measured with a tape by manipulating the testes to obtain the distance between the distal and proximal poles of the testes avoiding the capus and cauda of the epididymis. Testes width was measured using veneer caliper at the same point of the scrotal circumference. Paired testes volume was determined by water displacement using a 500mls glass beaker. Scrotal and testicular weight was determined by weighing intact testis in the scrotum. Penile

length and weights were determined by slaughtering two animals from each treatment, having each penis measured with tape rule to obtain penile length, and weighing scale to obtain penile weight.

### Data analysis

Data obtained were subjected to Analysis of Variance (ANOVA), using SAS<sup>23</sup> package. Where significant differences occurred among means, Duncan Multiple Range Test<sup>24</sup> was used to separate them.

## Results and discussion

The results of the research are presented in Tables 2–4. Table 1 shows the composition of the experimental diets while Table 2 is the chemical compositions of the individual feeds. Brewers' dried grain being the supplement had a high dry matter, highest crude protein with low crude fiber. Groundnut haulms had the highest crude fibre, dry matter and Ash. However, all the feed ingredients had crude protein above the 12% minimum requirement of ruminants.<sup>25</sup> Table 3 shows the effects of the diets on Morphometric parameters. The result shows that the heights at withers had a range of 35.79 to 46.08cm with significant ( $P<0.05$ ) difference between treatment means. This value was similar to 38.95cm obtained by Bello et al.<sup>5</sup> when they fed Savanna brown goats. Girth circumference (GC) was in the range of 22.17 to 25.96cm with significant difference ( $P<0.05$ ) among treatment means. This was lower than the range of 55.10 to 65.65 cm obtained by Babale et al.<sup>26</sup> when they fed Red Sokoto male goats on replacement levels of corn cobs for maize bran with cowpea husk basal diet. The ranges for other parameters were length of animal (LA) 30.33 to 38.92cm, height at rump (HR) 28.25 to 39.71cm, abdominal circumference (AC) 18.79 to 22.29cm and neck length of 13.46 to 17.79cm all the results were significantly ( $P<0.05$ ) different across treatments.

**Table 2** Chemical composition of experimental feeds

Parameters	BDG	Groundnut haulms	Cowpea husk
Dry matter (DM) %	90.00	90.89	85.79
Crude protein (CP) %	19.61	13.58	16.10
Crude fiber (CF) %	15.82	35.88	11.04
Ether extract (EE) %	6.5	1.56	4.40
Ash %	9.2	45.68	9.2

BDG, brewers' dried grains

**Table 3** Effects of diets on linear body measurements

Parameters	Treatments				SEM	Sig. lev
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>		
HW (cm)	35.79 <sup>d</sup>	46.08 <sup>a</sup>	45.46 <sup>b</sup>	42.96 <sup>c</sup>	0.15	**
GC (cm)	24.92 <sup>b</sup>	25.96 <sup>a</sup>	22.46 <sup>c</sup>	22.17 <sup>c</sup>	0.09	**
LA (cm)	30.83 <sup>c</sup>	38.92 <sup>a</sup>	30.33 <sup>c</sup>	34.63 <sup>b</sup>	0.12	**
HR (cm)	28.25 <sup>c</sup>	39.71 <sup>a</sup>	31.63 <sup>b</sup>	30.33 <sup>b</sup>	0.11	**
AC (cm)	18.79 <sup>b</sup>	22.29 <sup>a</sup>	21.75 <sup>a</sup>	20.38 <sup>a</sup>	0.08	**
NL (cm)	13.46 <sup>b</sup>	14.72 <sup>b</sup>	16.33 <sup>a</sup>	17.79 <sup>a</sup>	0.07	**

abc, means in the row with different superscripts differed significantly ( $P<0.05$ ). HW, height at withers; GC, girth circumference; LA, length of animal; HR, height at rump; AC, abdominal circumference; NL, neck length; SEM, standard error of the mean

**Table 4** Effects of diets on reproductive organ parameters

Parameters	Treatment				SEM	Sig. lev
	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>	T <sub>4</sub>		
SL (cm)	33.04 <sup>c</sup>	27.38 <sup>d</sup>	35.88 <sup>b</sup>	38.92 <sup>a</sup>	0.16	**
SC (cm)	17.63 <sup>a</sup>	15.25 <sup>b</sup>	13.17 <sup>c</sup>	12.67 <sup>c</sup>	0.08	**
STW (g)	45.67 <sup>a</sup>	38.46 <sup>b</sup>	43.63 <sup>a</sup>	36.92 <sup>b</sup>	0.13	**
TC (cm)	10.00 <sup>a</sup>	9.88 <sup>a</sup>	8.67 <sup>b</sup>	8.57 <sup>b</sup>	0.04	**
TV (mls)	21.08 <sup>a</sup>	18.42 <sup>a</sup>	20.46 <sup>a</sup>	17.88 <sup>b</sup>	0.02	**
PL (cm)	3.42 <sup>b</sup>	3.06 <sup>c</sup>	3.33 <sup>b</sup>	4.13 <sup>a</sup>	0.02	**
PW (g)	3.79 <sup>a</sup>	3.29 <sup>b</sup>	3.46 <sup>a</sup>	3.21 <sup>b</sup>	0.02	**

abc, means in a row with different superscripts differ significantly ( $P<0.05$ ). SEM, standard error of the mean; SL, scrotal length; SC, scrotal circumference; STW, scrotal and testicular weight; TC, testicular circumference; TV, testicular volume; PL, penile length, PW, penile weight

Effects of the diets on reproductive organ parameters are presented in Table 4. Results revealed that scrotal lengths (SL) varied from 27.38 to 38.92cm with significant difference ( $P<0.05$ ) across treatments. Rekik et al.<sup>27</sup> reported that in males, reproductive function in young animals appears to be more susceptible to dietary restrictions of energy and protein than in adult and may lead to permanent histological changes at the level of the testis. Scrotal circumference (SC) ranging from 12.67 to 17.63cm is reported in this experiment which differed ( $P<0.05$ ) significantly across treatments. These values are similar to 17.82 to 19.91cm reported by Abba & Igbokwe<sup>19</sup>

Scrotal and testicular weights (STW) result ranged from 36.92 to 45.67g with significant ( $P<0.05$ ) difference among treatment means. For the testicular circumference (TC), values ranged from 8.57 to 10.00cm which were significantly ( $P<0.05$ ) different across treatments. These values are similar to 8.39 to 9.89 cm reported Abba & Igbokwe<sup>19</sup> for Nigerian Sahel goats. The result could be due to the fact that the animals are immature and so the scrotal circumference has not yet developed. According to Schoenian<sup>28</sup> and Neary<sup>29</sup> scrotal circumference (SC) measurement can be taken along with the palpation of the testicle area as part of breeding soundness evaluation. Testicular volumes obtained ranged from 17.88 to 21.08 mls which also differed significantly ( $P<0.05$ ) across treatments.

These results are in agreement with Nasir et al.<sup>30</sup> who reported that testicular morphometry showed significant effect ( $p<0.05$ ) in all the parameters observed when they offered Red Sokoto Bucks Cotton Seed Cake. For penile morphometry, the results ranged from 3.06 to 4.13cm for penile length (PL) and 3.21 to 3.79g for penile weights respectively. All parameters differed ( $P<0.05$ ) significantly across treatments.

## Conclusion and recommendations

It was clear from this study that diets showed some positive effects on reproductive organ morphometry of West African Dwarf goats. This study therefore leads us to recommend that the suitability of testicular and scrotal measurements as criteria for early selection of male goats should be emphasized and therefore the animals be fed adequately.

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None.

## Conflict of interest

The authors declare there is no conflict of interest.

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