https://dx.doi.org/10.4314/gjas.v58i1.5

Correlation coefficient of live weight and body measurements of extensively reared West African Dwarf goats in south west zone of Nigeria

A. TELLA*, C.A. CHINEKE & O.O. JACOB

(A.T.: Department of Animal Production and Health, Federal University Oye-Ekiti, Ekiti State, Nigeria; C.A.C.: Department of Animal Production and Health, Federal University of Technology Akure, Ondo State, Nigeria; O.O.J.: Department of Animal Science, Faculty of Agricultural Production and Management, Osun State University, Osun State, Nigeria)

**Corresponding author's email: adetunmbi.tella@fuoye.edu.ng*

ABSTRACT

The study was conducted in Ejigbo Local Government Area of Osun State, a derived savanna zone of Nigeria. Body measurements and live weight were assessed in 399 West African Dwarf (WAD) goats 194 bucks and 205 does. The data were segregated based on sex and age groups to obtain detailed information for characterisation goat in the experimental area. Body measurement values increased significantly ($p \leq 0.05$) with age in both sexes. Mean body weight ranged from 5.32±0.15 kg to 29.63±1.88 kg in bucks, and 5.75±0.13 kg to 30.29±1.22 kg in does. Live weight was positively and significantly ($p \leq 0.05$) related with most body parameters. Body length, heart girth, rump height had highest coefficient of correlation across ages. Phenotypic values were higher in male WAD goats than the female. Conclusively, body weight and linear body measurements are economically important traits in animal genetic resources especially small ruminants like goats. Selection for increase in any of the two phenotypic variables (live weight and linear measurements) will result in an equal increase in the other. Equally, live weights, in the absence of adequate records, can be utilized to predict traits that are correlated with linear measurements.

Keywords: Live weight; body measurement; extensively reared WAD goats; WAD goats

Original scientific paper. Received 22 Jun 2021; revised 26 Jun 2023

Introduction

Indigenous sheep and goat breeds constitute over 95% of small ruminant population in Africa Popoola & Adekanbi (2017). In Nigeria, they are found in every part of the country. Their geographical locations depend on their relative abilities to adapt to a particular environmental condition and stress (Banerjee, 2015). The improvement of these genetic resources depends on access to variation, as the amount of variation existing among the population is the material with which the breeder must work. A detailed knowledge of phenotypic variation is therefore a prerequisite and it is a basis for any improvement programme and this makes it necessary to study economically important traits. Variation could be either from the phenotypic or genetic standpoint.

The former included quantitative and qualitative traits, while the latter include

variation at structural loci (electrophoretic variation) and at DNA level, respectively (Halsey, 1997).The appraisal of morphological types by simply checking the relationship between body measurements and production had rightly been revalued during the last century. In that period, it was recognized that both phenotypic and genotypic evaluations of animal species were necessary for effective selection programmes, which is one of the tools a breeder must work with (Zehnder *et al*., 1997). It is the main thrust of this work to document the variations within the West African Dwarf goats from the standpoint of body measurement. Phenotypic variation among the West African Dwarf goat populations within the derived savanna zone of Nigeria is the subject of this investigation, apart from providing objective basis for targeting future development initiatives, this work will in addition enrich the Nigerian small ruminant genetic resources databank and achieve parts of the systematic evaluation of size and conformation for the populations studied.

Materials and Methods

Location of the study

The study was carried out in the rural areas of six Local Government Areas namely: Ogbomoso North, Ogbomoso South, Ogo-Oluwa, Surulere, Orire and Ejigbo in Osun State, Nigeria. Geographically, the study areas were within the derived savanna region of Nigeria on longitude 4.2436°East of Greenwich Meridian and latitude 8.1227°North of the equator. It is between 300 and 6000 m above sea level with annual temperature and rainfall of 26.1°C and 1070 mm respectively (Timothy & Ifatokun, 2019). The rainfall is usually heavy between March and October followed by a dry season between November and February when average rainfall is less than 25 mm and marked by slow cessation of vegetable growth at the peak of dry season which reduces forage supply for growth. Predominant indigenous livestock found within the areas are cattle, goats, sheep and poultry respectively.

Experimental animals and management

399 West African Dwarf goats of different age groups were sampled for the study. These goats were traditionally managed (extensive husbandry) with slight modifications from village to village depending on the financial status of the owner and availability of crop residues, grains, seasons and kitchen wastes usually used to supplement the main feed supply which is forage browsing along the major roads, fallow plots and backyard areas. Generally, they were not consciously fed and supplement usually depends on availability. Male and female animals ran together in the flocks and there were usually no demarcations between flock of many owners in the roaming range. Therefore, many flocks could be regarded as a single flock. No records were kept on the animals. Few owners took their animals for grazing in lush pastures. The practices of ethno-veterinary medicine were generally very common. There was no purposeful breeding and selection for their improvement.

Age determination

Generally, because of the nature of management and non-existence of record on animals, ages of animals were not known. Dentition was therefore used primarily to estimate age range of the animals measured. Only in a few cases did the owner know the actual ages of his animals and in such cases, dentition (Wilson, 1983) was still used to assign the animals into determined age brackets. The number of pairs of permanent incisors or their absence in the lower jaw was used as presented in Table 1.

TABLE 1

Age of animals

Age group (month)	No of animals	No. of pairs
0–14	215	None (milk teeth)
15–20	68	One (2-teeth)
21–25	39	Two (4-teeth)
26–32	18	Three (6-teeth)
33–48	29	Four (8-teeth)
Above 48	30	Worn teeth

Duration/periods of data collection

The measurements were carried out within the period of 27 months (December, 2008 to May, 2009). 66 goats were randomly sampled (33 males and 33 females) and measured in each of the five local governments except in Ejigbo, the sixth Local Government Areas where 69 goats (28 males and 41 females) were measured. Each Local Government Area was visited 15 times for accurate measurement early in the morning and around the evening time when they will be available. Tattooing method was used to differentiate previous sample.

Sample size

A total of 399 West African Dwarf goats comprising 194 bucks and 205 does were sampled for quantitative characters (body measurements). These were segregated based on sex and age of the animals. Sample sizes of milk teeth, 2-teeth, 4-teeth, 6-teeth, 8-teeth and wither teeth were as follows; 215 (106 males and 109 females), 68 (47 males and 21 females, 39 (8 males and 31 females), 18 (10 males and 8 females), 29 (12 males and 17 females), 30 (11 males and 19 females), respectively.

Body measurements

The animals were properly restrained in a standing position by an attendant employed for the sake of the research and the measurements were thoroughly taken. 10 metric traits measured on each animal include the live weight (LW), height at withers (WH), rump height (RH), shoulder width (SW), rump width (RW), heart girth (HG), body length (BL), foreleg length (FL), tail length (TL), face length (FL) and rump length (RL). Corresponding age-group and sex associated with individual animal sampled were recorded. Anatomical points of references for the linear body measurements were in accordance with the methods of Searle *et al*. (1989), Greyling *et al*. (1994), and Krausgrill (1996). Height measurement was made using a measuring stick, while the length and circumference measurements were done using a flexible tape.

Statistical analysis

Descriptive statistics such as (mean, standard deviation, standard error and coefficient of variation were computed for each parameter using SAS (2003) statistical package. Data were also subjected to an analysis of variance using a General Linear Model. The factors included in the model as sources of variation were age-group and sex. The statistical model used was:

$$Y_{ijk} = \mu = t_i + b_{ij} + \varepsilon_{ijk}$$

Where,

Y_{ijk} – Individual observation for the jth treatment

μ = General mean

t_i = Effect of i^{th} (age-group)

b_{ij} = Effect of j^{th} (sex)

ε_{ijk} = Experimental error

With the following assumptions: (i) The age group and sex effects were additive; (ii) The experimental errors were randomly, independently and normally distributed about zero mean and with a common variance, NID (0, σ^2). Tukey's test was used to test the

differences between means. Pearson coefficient of correlation (*r*) between the variance of body measurements was estimated.

Results and Discussion

Phenotypic correlation

The data on the relationships between live weight and linear body parameters at zero teeth and 2-teeth age group are presented in Tables 2 and 3. The results indicated that live weight was positively and significantly ($p \leq 0.05$) correlated with most body parameters in male and female WAD goats at zero teeth age. Highest correlation values were recorded for heart girth (0.89), foreleg length (0.87), rump height (0.79) and wither height (0.74) in males, while in females, highest value was recorded for body length (0.81); heart girth and foreleg length were (0.81) and (0.76), respectively. Phenotypic values were higher in male WAD goats than the females. Correlation between body parameters also showed that most body parameter pairs were positively and significantly correlated, some at 1% and others at 5% level, respectively. Relatively fewer pairs were unrelated in each population. At 2-teeth age, live weight was positively correlated with linear body parameters with coefficient of correlation ranged from moderate to high values (R = 0.26–0.79), with the exception of tail length and rump length that were negatively correlated with body weight, with correlation coefficient values of -0.04 and -0.9, respectively.

In female WAD goat population, similar results were observed. Positive correlation values were recorded for most of the traits with body weight. Highest value (0.78) was observed for heart girth, while negative correlation coefficients were observed for tail length and rump length (-0.20 and -0.22), respectively. Phenotypic correlation values were also higher in males than in females. Correlation between body parameters showed positive relationship between their pairs.

4-teeth and 6-teeth ages

Correlation matrix of body parameters of male and female WAD goats at 4-teeth and 6-teeth age are summarized in Tables 4 and 5 respectively. The results showed that at 4-teeth age, live weight was positively and significantly correlated ($p < 0.05$) with the linear body measurement studied in both sexes. Highest correlation coefficient was observed for heart girth (R = 0.97) in male and lowest was observed for tail length (R = 0.14). Correlation between body parameters were also positive and significant with the exception of HG vs. BL, BL vs. TL, TL vs. FAL, and TL vs. RH that showed negative correlation coefficients. In female, live weight was also positively correlated with all the linear body parameters with correlation coefficients ranging from 0.14 to 0.8, highest was observed for body length (R = 0.81), while lowest was observed for tail length (R = 0.14). Correlations between body parameters were also positive and significant with relatively few pairs that were unrelated.

8-teeth age and wither

Relationships between live weight and body parameters as revealed by phenotypic correlation values at eight and wither are presented in Tables 6 and 7, respectively. The results showed that at 8-teeth age, the values were within the range of 0.13 to 0.63 for male and 0.21 to 0.97 for female, thus live weight was positively and significantly ($p \leq 0.05$) correlated with the linear body trait. However, highest correlation coefficient was recorded for body length (R = 0.63 and 0.97) in both sexes.

At wither age, the results showed that live weight was positively and significantly ($p \leq 0.05$) correlated with the linear body traits considered in both sexes, correlated values for male were within the range (R = 0.70–0.96), and highest correlation coefficient was

recorded for foreleg length (R = 0.96) followed by heart girth (R = 0.70). Strong and positive correlation coefficient was also observed among body parameters. In female population, the correlation coefficients were within the range of -0.31 and 0.98. Negative correlation coefficient was observed for face length and rump length, while highest correlation value was obtained for foreleg length (R = 0.99) followed by heart girth (R = 0.95). Correlation coefficients among body parameters were positive and significant ($p \leq 0.05$).

TABLE 2

Pearson correlation coefficient between live weight and body measurements of WAD goat at zero teeth age

	LW	WH	RH	SW	RW	HG	BL	FL	TL	FAL	RL
LW	-	0.74***	0.79***	0.38*	0.49*	0.89***	0.91***	0.87***	0.85***	0.52**	0.63***
WH	0.48*	-	0.95***	0.33*	0.25 NS	0.77***	0.74***	0.72***	0.66**	0.77***	0.58**
RH	0.67**	0.79***	-	0.37*	0.33*	0.79***	0.79***	0.77***	0.69**	0.74***	0.62**
SW	0.32*	0.83***	0.10 NS	-	0.81***	0.44*	0.40*	0.44*	0.34*	0.29 NS	0.57**
RW	0.55**	0.21 NS	0.28 NS	0.79***	-	0.46*	0.45*	0.49*	0.41*	0.22 NS	0.58**
HG	0.81***	0.60**	0.74***	0.18 NS	0.35*	-	0.89***	0.89***	0.83***	0.65**	0.71***
BL	0.81***	0.54**	0.73***	0.25 NS	0.38*	0.84***	-	0.93***	0.82***	0.55**	0.62**
FL	0.76***	0.61**	0.75***	0.26 NS	0.40*	0.83***	0.90***	-	0.79***	0.58**	0.68**
TL	0.76***	0.64**	0.71***	0.16 NS	0.31*	0.75***	0.68**	0.71***	-	0.54**	0.69**
FAL	0.02 NS	0.39*	0.25 NS	0.26 NS	0.25 NS	0.26 NS	0.18 NS	0.26 NS	0.15 NS	-	0.53**
RL	0.77***	0.55**	0.67**	0.37*	0.50**	0.77***	0.74***	0.80***	0.68**	0.32*	-

Upper diagonal represents male WAD goats; Lower Diagonal represents female WAD goats. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. LW: Live Weight; WH: Wither Height; RH: Rump Height; SW: Shoulder Width; RW: Rump Width; HG: Heart Girth; BL: Body Length; FL: Foreleg Length; TL: Tail Length; FAL: Face Length; RL: Rump length

TABLE 3

Pearson correlation coefficient between live weight and body measurements of WAD goat at 2-teeth age

	LW	WH	RH	SW	RW	HG	BL	FL	TL	FAL	RL
LW	0.00	0.76***	0.77***	0.44*	0.53**	0.79	0.67**	0.74***	-0.04 NS	0.26 NS	-0.09 NS
WH	0.86***	0.00	0.91***	0.05 NS	0.12 NS	0.76	0.77***	0.60**	-0.17 NS	0.41 *	-0.14 NS
RH	0.87***	0.96***	0.00	0.10 NS	0.22 NS	0.73	0.64**	0.55**	-0.15 NS	0.41*	-0.05 NS
SW	0.60**	0.28 NS	0.38*	0.00	0.60**	0.21	0.13 NS	0.32*	-0.43 NS	-0.14 NS	+0.19 NS
RW	0.43*	0.09 NS	0.26 NS	0.85***	0.00	0.29	0.04 NS	0.37*	-0.23 NS	-0.37 NS	-0.12 NS
HG	0.78***	0.72***	0.80***	0.35*	0.34*	0.00	0.72***	0.66**	0.15 NS	0.32*	-0.16 NS
BL	0.64**	0.45*	0.52**	0.68**	0.65**	0.39**	0.00	0.61 **	0.08 NS	0.44*	-0.07 NS
FL	0.48*	0.31*	0.22 NS	0.36*	0.09 NS	0.08 NS	0.53**	0.00	0.02 NS	0.23 NS	-0.07 NS
TL	-0.20 NS	-0.19 NS	-0.43 NS	-0.06 NS	-0.28 NS	-0.50 NS	0.13 NS	0.41*	0.00	0.32*	0.13 NS
FAL	0.25 NS	0.51 NS	0.37*	-0.16 NS	-0.26 NS	0.25 NS	-0.16 NS	0.11 NS	0.16 NS	0.00	0.46*
RL	-0.22 NS	-0.32 NS	-0.39 NS	-0.14 NS	-0.03 NS	-0.48 NS	-0.10 NS	0.12 NS	0.33*	0.06 NS	0.00

Upper diagonal represents male WAD goats; Lower Diagonal represents female WAD goats. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. LW: Live Weight; WH: Wither Height; RH: Rump Height; SW: Shoulder Width; RW: Rump Width; HG: Heart Girth; BL: Body Length; FL: Foreleg Length; TL: Tail Length; FAL: Face Length; RL: Rump length

TABLE 4

Pearson correlation coefficient between live weight and body measurements of WAD goat at 4-teeth age

	LW	WH	RH	SW	RW	HG	BL	FL	TL	FAL	RL
LW	-	0.89***	0.68**	0.73***	0.94***	0.07 NS	0.75***	0.36*	0.03 NS	0.74***	0.81***
WH	0.65**	-	0.82***	0.61**	0.73***	0.01 NS	0.50**	0.51**	0.26 NS	0.50**	0.64**
RH	0.72***	0.93***	-	0.79***	0.59**	0.16 NS	0.28 NS	0.24 NS	0.15 NS	0.40*	0.64**
SW	0.40*	0.20 NS	0.28 NS	-	0.76***	0.09 NS	0.66**	-0.03 NS	-0.26 NS	0.76***	0.91***
RW	0.58**	0.38*	0.46*	0.70***	-	0.08 NS	0.83***	0.23 NS	-0.14 NS	0.71***	0.76***
HG	0.19 NS	-0.07 NS	-0.06 NS	0.31*	0.38*	-	-0.15 NS	0.16 NS	0.68**	0.23 NS	0.18 NS
BL	0.81***	0.65**	0.72***	0.43*	0.62**	0.06 NS	-	0.28 NS	-0.31 NS	0.82***	0.73***
FL	0.19 NS	0.24 NS	0.15 NS	0.03 NS	0.08 NS	-0.07 NS	0.19 NS	-	0.49*	0.18 NS	0.07 NS
TL	0.14 NS	0.26 NS	0.24 NS	0.23 NS	0.12 NS	0.31*	0.37*	-0.05 NS	-	-0.04 NS	-0.09 NS
FAL	0.40*	0.33*	0.26 NS	0.64**	0.22 NS	0.02 NS	0.44*	0.07 NS	0.30*	-	0.94***
RL	0.17 NS	0.17 NS	0.10 NS	0.48**	0.02 NS	-0.17 NS	0.15 NS	-0.13 NS	0.03 NS	0.76***	-

Upper diagonal represents male WAD goats; Lower Diagonal represents female WAD goats. *p < 0.05; **p < 0.01; ***p < 0.001. LW: Live Weight; WH: Wither Height; RH: Rump Height; SW: Shoulder Width; RW: Rump Width; HG: Heart Girth; BL: Body Length; FL: Foreleg Length; TL: Tail Length; FAL: Face Length; RL: Rump length

TABLE 5

Pearson correlation coefficient between live weight and body measurements of WAD goat at 6-teeth age

	LW	**WH**	**RH**	**SW**	**RW**	**HG**	**BL**	**FL**	**TL**	**FAL**	**RL**
LW	-	0.40*	0.66**	0.52**	0.52**	0.31*	0.97***	0.38*	0.12 NS	0.28 NS	0.15 NS
WH	0.55**	-	0.77***	0.56**	0.56*	0.62**	0.53**	0.39*	0.53**	0.88***	0.46*
RH	0.61**	0.99***	-	0.44*	0.44*	0.27 NS	0.73***	0.26 NS	0.11 NS	0.47*	0.25 NS
SW	0.60**	0.83***	0.87***	-	1.0 NS	0.50**	0.66**	0.11 NS	0.66**	0.55**	0.28 NS
RW	0.51**	0.09 NS	0.22 NS	0.55**	-	0.50**	0.66**	0.11 NS	0.66**	0.55**	0.40*
HG	0.55**	0.69**	0.77***	0.84***	0.68**	-	0.42*	0.26 NS	0.48*	0.67**	0.19 NS
BL	0.90***	0.65**	0.67**	0.71***	0.34*	0.50**	-	0.30*	0.20 NS	0.38*	0.77***
FL	0.63**	0.87***	0.87***	0.77***	0.20 NS	0.75***	0.73***	-	0.30*	0.29 NS	0.19 NS
TL	0.81***	0.69**	0.71***	0.61**	0.19 NS	0.51**	0.89***	0.80**	-	0.70***	0.61**
FAL	0.40*	0.60**	0.62**	0.66**	0.36*	0.55**	0.44*	0.63**	0.62**	-	0.29 NS
RL	0.44*	0.36*	0.42*	0.48*	0.53**	0.61**	0.37*	0.60**	0.57**	0.87***	-

Upper diagonal represents male WAD goats; Lower Diagonal represents female WAD goats. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. LW: Live Weight; WH: Wither Height; RH: Rump Height; SW: Shoulder Width; RW: Rump Width; HG: Heart Girth; BL: Body Length; FL: Foreleg Length; TL: Tail Length; FAL: Face Length; RL: Rump length

TABLE 6

Pearson correlation coefficient between live weight and body measurements of WAD goat at 8-teeth age

	LW	WH	RH	SW	RW	HG	BL	FL	TL	FAL	RL
LW	-	0.19*	0.42*	0.13 NS	-0.10 NS	0.48*	0.63**	0.25 NS	0.26 NS	0.48*	0.12 NS
WH	0.33*	-	0.95***	-0.80 NS	-0.75 NS	0.24 NS	0.59**	0.77***	0.41*	0.60**	-0.66 NS
RH	0.21 NS	0.84***	-	-0.70 NS	-0.71 NS	0.30*	0.68**	0.76***	0.41*	0.64**	-0.58 NS
SW	0.66**	-0.12 NS	-0.18 NS	-	0.85***	-0.07 NS	-0.21 NS	-0.55 NS	0.14 NS	-0.30 NS	0.67**
RW	0.81***	-0.10 NS	-0.11 NS	0.92***	-	-0.02 NS	-0.16 NS	-0.60 NS	0.37 NS	-0.22 NS	0.77***
HG	0.79***	0.32*	0.13 NS	0.38*	0.47*	-	0.44*	0.22 NS	0.32*	0.30*	-0.04 NS
BL	0.97***	0.33*	0.23 NS	0.66**	0.80***	0.79***	-	0.61**	0.44*	0.76***	-0.19 NS
FL	0.76***	0.28 NS	0.28 NS	0.73**	0.68**	0.76***	0.79***	-	0.23 NS	0.84***	-0.79 NS
TL	0.23 NS	0.44*	0.44*	0.67***	0.44*	0.33*	0.67**	0.45*	-	0.56**	0.12 NS
FAL	0.23 NS	-0.05 NS	-0.05 NS	0.36*	0.30*	0.34*	0.24 NS	0.62**	0.45*	-	-0.41 NS
RL	0.69***	-0.19 NS	-0.19 NS	0.45*	0.69**	0.49*	0.66**	0.22 NS	0.06 NS	-0.07 NS	-

LW: Live Weight; WH: Wither Height; RH: Rump Height; SW: Shoulder Width; RW: Rump Width; HG: Heart Girth; BL: Body Length; FL: Foreleg Length; TL: Tail Length; FAL: Face Length; RL: Rump length

TABLE 7

Pearson correlation coefficient between live weight and body measurements of WAD goat at wither age

	LW	WH	RH	SW	RW	HG	BL	FL	TL	FAL	RC
LW	-	0.86***	0.96***	0.81***	0.84***	0.94***	0.70***	0.96***	0.25 NS	0.87**	0.88***
WH	0.91***	-	0.96***	0.80***	0.97***	0.82***	0.66**	0.75***	0.77***	0.63**	0.79***
RH	0.93***	0.98***	-	0.84***	0.93***	0.89***	0.68**	0.89***	0.76***	0.78***	0.84***
SW	0.85***	0.80***	0.80***	-	0.76***	0.72***	0.65**	0.71***	-0.55 NS	0.65***	0.87***
RW	0.90***	0.77***	0.82***	0.87***	-	0.81***	0.77***	0.71***	-0.60 NS	0.55**	0.82***
HG	0.98***	0.93***	0.92***	0.85***	0.87***	-	0.76***	0.88***	0.22 NS	0.77***	0.86***
BL	0.69**	0.50**	0.58**	0.40*	0.60**	0.61***	-	0.57**	0.61**	0.37*	0.84***
FL	0.99***	0.87***	0.89***	0.82***	0.87***	0.97***	0.71***	-	0.45*	0.96***	0.78***
TL	0.25 NS	0.32*	0.65**	0.23 NS	0.43*	0.23 NS	0.55**	0.34*	-	0.67**	0.54**
FAL	-0.31 NS	-0.03 NS	0.00 NS	-0.14 NS	-0.28 NS	-0.31 NS	-0.19 NS	-0.39 NS	0.62**	-	0.71***
RL	-0.31 NS	-0.09 NS	-0.04 NS	-0.15 NS	-0.29 NS	-0.31 NS	-0.16 NS	-0.31 NS	0.22 NS	0.94***	-

Upper diagonal represents Male WAD goats; Lower Diagonal represents Female WAD goats. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. LW: Live Weight; WH: Wither Height; RH: Rump Height; SW: Shoulder Width; RW: Rump Width; HG: Heart Girth; BL: Body Length; FL: Foreleg Length; TL: Tail Length; FAL: Face Length; RL: Rump Length

Correlations between live weight and other body measurements with respect to sex are presented in Tables 2, 3, 4, 5, 6 and 7, for zero teeth, 2-teeth, 4-teeth, 6-teeth, 8-teeth and wither teeth, respectively (Hamayun Khan *et al*., 2006; Fajemilehin & Salako, 2008). The positive and significant phenotypic correlation ($p < 0.05$, $p < 0.01$) between most body parameters and live weight at all ages agreed with the reports of other researchers carried out with goats in similar climatic conditions (Hanyun Khan *et al*., 2008; Shuaibu *et al*., 2020) who reported that the correlation coefficients observed between body weight and linear body measurements were generally moderate to high and significant. This also agreed with the work of Bedada *et al.* (2019) who reported coefficient of 0.91, 0.96, 0.93, 0.79 and 0.45 between the body weight and length, chest girth, wither height, pelvis width and ear length in males, and with corresponding values of 0.84, 0.87, 0.71, 0.83 and 0.41 in females, respectively.

Similarly, Ijomanta (2012) found a low, positive, and significant relationship between Red Sokoto goat morphometric traits. At zero teeth age, body length and live weight had the highest correlation coefficient (0.81, male; 0.91, female); followed by heart girth and live weight (0.89, male; 0.81, female); shoulder width and body weight had the lowest but positive and significant correlation (0.38, male; 0.32, female). At 2-teeth age, the highest correlation coefficient (0.99, male; 0.73, female) was obtained, while the lowest and non-significant value was obtained between body weight and tail length.

At 4-teeth age, heart girth was highly correlated with body weight (0.97, male; 0.89, female). Body length was highly correlated with body weight at 6-teeth age (0.97 for male, and 0.90 for female), respectively. Furthermore, at 8-teeth age, body length was highly correlated with body weight (0.63 for male and 0.97 for female). In both sexes, foreleg length,

rump height, and heart girth were highly correlated with body weight at wither teeth age, while other body parameters were positively and significantly correlated. The correlations found in this study were generally higher than those found in previous studies by Okpeku *et al*. (2011), Pesmen & Yardimci (2008), and Khan *et al*. (2006). Pesmen & Yardimci (2008) found the strongest correlation between live weight and heart girth.

In general, the correlation results between linear measurements and body weights in this study agreed with those reported in the literature by Shresthra *et al*. (1984), Brown *et al*. (1973), and Jeffery & Berg (1972). The positive and highly significant correlation found between body weight and other parameters suggests that any of these variables or their combinations would provide a good estimate for predicting live weight in WAD goats in Nigeria's derived savannah zone. The lack of correlation and non-significance confirms the traits' unsuitability for body weight prediction. Positive correlation indicates that both body measurements in pairs can be considered for live weight improvement at the same time, as previously asserted by Buvanendran *et al*. (1980), Raymond *et al*. (1982), Hassan & Ciroma (1992), Hanyun Khan *et al*. (2006), and Fajemilehin & Salako (2008).

Conclusion and Recommendation

Body weight and linear measurements are critical characteristics in meat animals. The analysis of data on body measurements provides quantitative measures of desirable body size and shape, allowing genetic parameters for these traits to be estimated and inclusion in breeding programs. Both sex and age had significant influences on body measurements, and these findings should be taken into account in any improvement program to increase goat meat yield. According to the findings of this study, live weight of WAD goats can be predicted using some body measurements with high correlation coefficients of linear body measurements. Body measurements had a strong and positive correlation with body weight and could be used as a selection criterion. Increases in either of the two phenotypic variables (live weight or linear measurements) will result in a reciprocal increase in the other. In the absence of adequate records, live weights can also be used to predict traits that are correlated with linear measurements.

It is recommended that linear body measurements must be refined to account for differences in body weight. There is a need to create similar database information for other livestock species because different species have different parameter relationships in order to avoid past mistakes. More research is needed to investigate the relationships between body weights and linear body measurements in all breeds of goats in various parts of West Africa and at various ages.

REFERENCES

Banerjee, S. (2015) Morphometrical and production traits of Bengal sheep in West Bengal, India. *Animal Genetic Resources*, **57**, 57–71.

Bedada, A., Abdullah, A. & Ibrahim, S. (2019) Biochemical and molecular responses to thermal stress in goats. *Int. J. Livest. Res*., **3**, 27–38.

Brown, J.E., Brown, J.C. & Butts, W.I. (1973) Evaluating relationships among immature measures of size, shape and performance of beef bulls, II; The relationships between immature measures of size shape and feedlot traits in young beef bulls. *Journal of Animal Science*, **36**, 1021–1031.

Buvanendran, V., Umoh J.E. & Abubakar B.V. (1980) An evaluation of body size as related to weight of three West African breeds of cattle in Nigeria. *J. Agric. Sci. Camb.*, **95**, 219–224.

Fajemilehin, O.K.S. & Salako, A.E. (2008) Body measurement characteristics of the West African Dwarf (WAD) goat in deciduous forest zone of Southwestern Nigeria. *African Journal of Biotechnology*, **7**(14), 2521–2526.

Greyling, J.P.C, Koteze, W.F., Taylor, G.J. &Hagendijk, W.J. (1994) Synchronization of oestrus in sheep: Use of different doses of progestagen outside the normal breeding season. *South Africa Journal of Animal Science*, **24**, 33–37.

Hassan, A. & Ciroma, A. (1992) Biochemical and molecular responses to thermal stress in Sahel goat breeds. *Int. J. Livest. Res*., **1**, 27–38.

Hamayun, K.B., Olio, S.D., Beretti, F., Portolano, B. & Russo, V. (2008) Genomic scan of selective sweeps in Sahel and WAD goat breeds for identifying of candidate regions associated with fat deposition. *Journal of Tropical Animal Health*, **4**(1), 23–34.

Hamayun, K., Fida, M., Riaz, A., Gul, N., Rahimullah, N. & Muhammad, Z. (2006) Relationship of body weight with linear body measurements in goats. *Journal of Animal and Veterinary Advances*, **5**(6), 452–455.

Halsey, L. (1997) Nitrates in forage cause cattle deaths: A common weed and uncommon circumstances. Florida Beef Cattle Short Course.https://animal.ifas.ufl.edu/beef_extension/bcsc/1998/pdf/halsey.pdf (Accessed on 5th, November 2022).

Ijomanta, S. (2012) Sheep and Goat Production handbook for Ethiopia; Addis Ababa. Pp. 1–4.

Jeffery, H.R. & Berg, R.I. (1972) An evaluation of several measurements of beef cow size as realted to progeny performance. *Can. J. Anim. Sci.*, **52**, 23–37.

Krausgrill S, (1996) Regulation of cell wall invertase by a protein aqeous inhibitor. *Journal of Experimental Botany*, **47**, 1193–1198. https://doi.org/10:1093/jxb/47.

Peşmen, G. & Yardımcı, M.E. (2008) Estimating the live weight using some body measurements in Saanen goats. *Journal of Animal Science*, **35**, 45–59.

Popoola, M.A. & Adekanbi, A.O. (2017) Zoometrical index analysis of Nigerian indigenous goat populations. *Nig. J. Anim. Prod. 2017*, **44**(2), 18–24.

Okpeku, M., Oladeji, P. & Emmanuel, A. (2011) Heat tolerance in Brazilian sheep: Physiological and blood parameters. *Trop. Anim. Health Prod*. **41**, 95–101.

Oguntoyinbo, J.S. (1987) The climatology of West Africa. New Jersey: Barnes and Noble Books. Pp. 199–215.

Raymond, G., Nancy, R., Ronald, H., Matthew, G. & Henry, R. (1982) Function, and mechanism of the Hsp90 molecular chaperone. *The Blackwell Science*, **2**(1), 56–68.

Searle, D., Atkins, H. & Allen, K. (1989) Structure and function of Hsp90". *Curr. Opin. Struct. Biol*., **2**(1), 16–21.

Shuaibu, M., Ismaila, Y.S., Malachi, A.T. & Augustine, C. (2020) Alpha SI-Casein gene polymorphism in Yankassa sheep breed of Mubi, Adamawa State, Nigeria. *International Journal of Life Sciences and Biotechnology*, **3**(3), 275–290. DOI:38001/ijlsb.740103.

Shrestra, J.N.B., Heaway, D.P., Fiser, P.C. & Langford, G.A. (1984) Influence of breed, birth date, age and body weight on linear body measurements of growing rams maintained in a controlled environment. *Can. J. Anim. Sci*., **64**, 279–291.

Timothy, O.O. & Ifatokun, P.I. (2019) Rainfall trends and its implications on water resources management: A case study of Ogbomoso city in Nigeria. *International Journal of Hydrology*, 3(3).

Wilson, R.T. (1991) Small ruminant production and the small ruminant genetic resource in tropical

Africa. Food and Agriculture Organization (FAO). Pp. 106–114. ISBN 978-92-5-102998-5.

Zehnder, A.J., Liu, J., You, L., Amini, M. & Herrero, M. (1997) Some keys to successful promotion of goat production among the poor. *Small Ruminant Research*, **77**(2-3), 221–224.