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Regression Analysis of Phenotypic Traits of West African Dwarf Goats (Capra Hircus) In Derived Savanna Zone of Nigeria

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ABSTRACT

Three hundred and ninety-nine (399) West African dwarf goats from the Ejigbo Local Government Area in Osun State and the surrounding Derived Savanna Zone of Nigeria were evaluated for body measures and live weight. Analysis was done on data pertaining to 194 bucks and 205 does. These were categorized into six age groups (milk teeth, 2-teeth, 4-teeth, 6-teeth, 8-teeth, and worn teeth) and recorded by sex. The purpose of the study was to characterize the phenotype of the WAD goat and identify the best model or models for predicting liveweight based on body measures in the experimental location, which is Nigeria's derived savanna zone. For both sexes, body measurement values rose significantly (P < 0.05) with age. In bucks, the average body weight was 5.32 ±0.15 to 29.63±1.88 kg, while in does, it was 5.75±0.13 to 30.29±1.22 kg. In terms of body weight and other physical parameters, sex variations were discovered. For quantitative features including heart circumference, body length, rump height, foreleg height, and withers height, the fitted linear regression equations also show that the coefficients were positive and significant (P < 0.05). Moreover, at all ages, multiple regression considerably increased the coefficient of determination (R2) (P < 0.05). In summary, body weight and linear body measurements are economically significant characteristics in animal genetic resources, particularly for small ruminants like goats during selection, to offer precise weight determination in isolated locations without a scale.

Keywords: Regression, Phenotypic Traits, WAD, Derived Savannah Zone.

INTRODUCTION

Characterizing local genetic resources requires an understanding of the variation of morphological traits, which are essential for classifying livestock according to size and shape (Yakubu et al., 2010). Particularly for ruminants, size and conformation are crucial traits in meat animals. Animals are typically evaluated visually in the past, which is a subjective approach to evaluation (Abanikannda et al 2002). Objective measurements of body size and shape could help breeders identify animals of different sizes that mature early and late, improving selection for growth. Measurements of different body conformations are useful for determining the quantitative traits of meat animals and for creating appropriate selection criteria. Live weights and body measures obtained from live animals have been widely employed for a number of purposes in both selection procedures and experimental work (Lawrence & Fowler 2002). Animal characteristics and breed performance have been assessed using body measurements. They have also been employed to choose substitute animals (Sowande & Sobola 2008).

Goat production and management could benefit from an understanding of the morphological measurements of goat bodies. According to Afolayan et al. (2006), livestock production enterprises greatly benefit financially from the precision of functions used to forecast live weight or growth characteristics from live animal measurements. Numerous studies have demonstrated that body measures, rather than weighbridges or scales, offer a great deal of ease for predicting body weight (Birteeb & Ozoje 2012; Okpeku et al 2011).

Understanding the physical characteristics of WAD goats is crucial for effective animal management, which includes selecting replacement males and females, monitoring growth, modifying feed supplies, and comprehending medication dosages (Slippers et al., 2000). Since most farmers lack weighing instruments for determining liveweight, knowledge of weight estimate techniques will also be very helpful in the production of goats. In order to identify the best model or models for predicting liveweight based on body measures

MATERIALS AND METHODS

Study Area and Climate

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 4O - 151 East of Greenwich Meridian and latitude 87O - 71 north of the equator. It is between 300 and 6000 m above sea level with annual temperature and rainfall of 27OC and 1247 mm, respectively (Oguntoyingbo, 1978). Between March and October, there is typically a lot of rainfall. From November to February, there is a dry season with an average rainfall of less than 25 mm. During this time, vegetable growth slows down, which lowers the amount of feed available for growth. Cattle, goats, sheep, and poultry are the most common native livestock in the regions.

Experimental Animals and Management

For the study, a sample of 399 West African dwarf goats in various age categories was selected. With minor variations from village to village based on the owner's financial situation and the availability of crop residues, grains, seasons, and kitchen wastes, these goats were traditionally raised using extensive or semi-intensive husbandry. This was typically done to supplement the primary feed source, which is forage browsing along major roads, fallow plots, and backyard areas. They were typically not intentionally fed, and supplements were typically given based on availability.

In the roaming range, there were typically no boundaries between flocks of numerous owners, and male and female animals ran together in the flocks. As a result, numerous flocks may be considered one flock. The creatures were not documented. Few owners brought their animals to beautiful pastures to graze. In general, ethno-veterinary medicine was practiced widely. To improve them, there was no deliberate breeding or selection.

Age determination

Animal ages were generally unknown due to the nature of management and the lack of animal records. Therefore, the primary purpose of the dentition was to assess the animals' age range. Dentition (Wilson, 1983) was still employed to place the animals into predetermined age brackets in the few instances where the owner was unaware of the true ages of his animals. 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 pairs
0-14	None (milk teeth)
15 – 20	One (2-teeth)
21- 25	Two (4-teeth)
26 – 32	Three (6-teeth)
33 – 48	Four (8 -teeth)
Above 48	Worn teeth

Duration of data collection

The measurements were taken between December 2008 and May 2009, a span of twenty-seven weeks. With the exception of Ejigbo, the sixth local government area, where sixty-nine goats were measured, sixty-six goats were randomly selected and measured in each of the five local governments.

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For precise measurements, each local government area was visited fifteen times, both in the morning and in the evening when they were available. To distinguish between samples, the tattooing method was employed.

Sample Size and Body Measurements

A total of three hundred and ninety nine West African Dwarf goats comprising 194 bucks and 205 does were sampled for quantitative characters (body measurements). These were recorded according to sexes and the defined six age groups. Sample sizes of milk teeth, two teeth, four teeth, six teeth, eight 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.

The methods for measurement, as explained by Birteeb et al. (2012), are listed below. Using rope around the animal's neck and appropriately labeled inscribe cardboard, the animal was identified. Height was measured using a measuring stick, while length and circumference were measured with a flexible tape. Low friction acetal bearings on Salter hanging scales (Model: Salter 235-6S) allow for positive movement for optimal sensitivity. Live weights were measured using a method that was accurate to one part in 250 with a 15% zero adjust (Edey, 1983).

1. Weight at Withers (WH): The distance from the surface of a platform on which the animal stands to the withers.
2. Heart Girth (HG) or Chest circumference: It is a circumferential measure taken around the chest just behind the front legs and withers.
3. Body Length (BL): It is the distance from scapula (at shoulder) to the pin bone.
4. Rump Height (RH): The distance from the surface of a platform to the rump.
5. Tail Length (TL): This is a measurement taken from the base of the tail to the tip.
6. Shoulder width (SW): Measured as the horizontal distance between the two shoulders, which is also described as the widest point over the intra-spinatus muscle.
7. Rump width (RW): Measured as the width across the fusion of the sacral vertebrae and the pelvic bone of sthe animal towards the posterior end of the animal, viewed on the upper surface or from the acetabulum at the fermoral anticalation.
8. Foreleg length (FL): Distance from the proximal extremity of the olecranon process to the mid lateral point of the coronet.
9. Rump length (RL): Distance from pelvic girdle (Tuber coxa) to the pin bone (Tuber ischi).

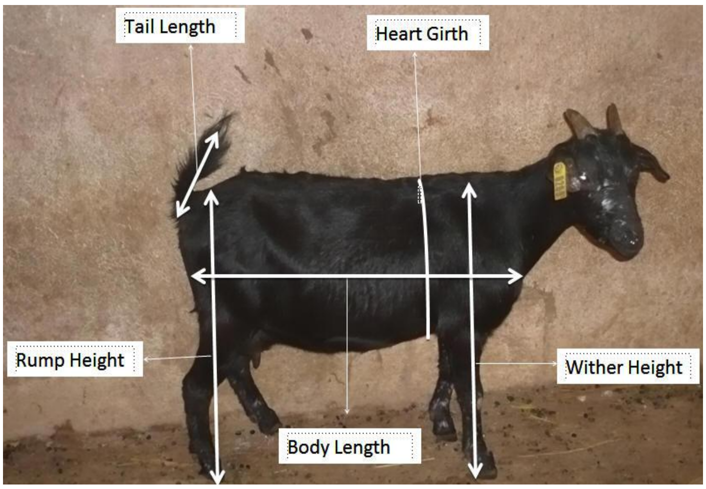

Fig. 1: Body Measurement of Goats

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:

Yijk = μ = ti + bij + εijk

Where

Yijk– Individual observation for the jth treatment

μ = General mean

ti = Effect of ith (age-group)

bij = Effect of jth (sex)

εijk = Experimental error

with the following assumptions:

a. The age group and sex effects were additive.

b. The experimental errors were randomly, independently and normally distributed about zero mean and with a common variance, NID (0, σ2). Duncan's Multiple Range test was used to test the differences between means.

Linear regression analysis between the parameters was also carried out and this also generated the coefficient of determination (R2) to indicate the efficiency of prediction.

The regression model used was of the form:

Where:

Y = Dependent variable

a = Intercept

b = Regression coefficient

x = Independent variable

RESULTS

Live weight, Wither Height and Rump Height

Live weight changes of West African Dwarf goat are presented. The results showed that mean live weight increased steadily from 5.31± 0.51 to 29.63 ± 1.88 kg in buck and from 5.75 ± 0.13 to 30.29 ± 1.22 kg in the does. The standard deviation within age-group did not follow any particular trend. Coefficient of variation ranged from 3.77 to 29.22% in buck and 4.41 to 23.55% in does within the age-group. Age-group significantly (P<0.05) influenced live weight as it increased from zero teeth to wither age. Sex did not show any significant difference (P> 0.05) within the age-group.

Mean value of wither height ranged from 29.39 ± 0.43 to 55.77 ± 2.04 cm in male and 29.60 ± 0.33 to 56.61 ± 1.3 cm in female. Wither height increased significantly (P<0.05) with age in both sexes. There were no significant differences (P>0.05) between sexes in 0 and 2 teeth ages for this parameter, significant differences (P>0.05) were not observed for 4 teeth, 6 teeth, 8 teeth and worn teeth. Standard deviation did not follow any definite pattern, coefficient of variation ranged from 4.39 to 15.05% in male and 5.36 to 11.81% in female, respectively.

Results obtained for rump height revealed the mean value ranged from 32.00 ± 0.43 to 59.09 ±1.89cm in male and 32.98 ± 0.31 to 59.74 ± 1.24cm in female, the result indicates that mean value increased significantly (P<0.05) with age in both sexes and their standard deviation did not follow any definite pattern. Coefficient of variations is within the range of 3.60 to 13.89% in male and 5.90 to 9.89 % in female. Males were generally more variable than female and they were significantly (P<0.05) longer than females in all ages except worn out teeth age where no significant difference was observed. The mean value of live weight, wither height and rump height ranges of different ages and sexes are showed with their degree of significance.

Shoulder Width, Rump Width, and Heart Girth

Trends in the growth of shoulder width with respect to sex; and the mean value showed that male WAD goats were within the range of 13.17±0.94 to 24.27±0.73cm and female were within the range of 13.56 ±0.10 to 23.26±0.39cm . Mean value increased (P<0.05) with age in

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both sexes. Coefficient of variation ranged from 7.37 to 9.94% and 3.87 to 7.28% in male and female WAD goats, respectively. The trait showed no sexual dimorphism.

Rump width was within the range of 11.42±0.11 to 21.82±0.89 cm in male WAD and 11.86±0.11 to 21.79 ± 0.63cm in female WAD goats. Males were significantly longer (P<0.05) at 0 teeth, 4 teeth and wither age than females. The mean value generally increased with age in both sexes (P<0.05) . Coefficients of variation are within the range of 3.08 to 13.57 in males and 3.97 to 12.55% in females.

Mean value of heart girth ranged from 41.83±0.61 to 86.14±2.16 cm and 42.84±0.49 to 87.13±1.97 cm in male and female WAD goats respectively. Coefficients of variations are within the range of 4.14 to 14.91% in male and 4.41 to 9.89% in female. No significant differences (P>0.05) were observed between sexes at all ages, however, the trait increased with age in both sexes while highest value was observed for wither age.

Statistics of shoulder width, rump width and heart girt of WAD goats population studied revealed mean values (shoulder width) ranged from 13.17 ± 0.94 to 24.27 ± 0.73 cm in male and 13.54 ±0.10 to 23.26 ±0.39cm in female. Mean values (Rump width) ranged from 11.42 ±0.11 to 21.82 ± 0.89cm in male and 11.86 ±0.11 to 21.79 ± 0.63 cm. Mean value (Hearth girth) ranged from 41.83 ± 0.61 to 86.14 ±2.16cm in male while 42.84 ± 0.49 to 87.13 ± 1.97 cm in female.

Body Length, Foreleg Length and Tail Length

The results of changes in body length of the studied WAD goats showed that mean body length measured from 26.58 ± 0.45 to 43.27 ± 0.27cm in male and 26.94 ±0.37 to 43.53 ± 0.33cm in female. Significant differences (P< 0.05) were observed between ages in both sexes. Co-efficient of variation ranged between 1.37 to 17.49% and 2.23 to 14.18% in male and female WAD goats respectively.

The results of the changes in foreleg length of the studied WAD goats showed that mean foreleg length increased from 19.20±0.27 to 32.88±0.68 cm in male and 19.51±0.23 to 33.19±0.61cm in female WAD goats. Significant differences (P<0.05) were observed between ages in both sexes. Coefficient of variation ranged between 2.36 to 14.65% and 3.82 to 12.29% in male and female WAD goats, respectively.

Descriptive statistics of tail length showed that the mean value ranged from 6.41±0.13 to 9.0±0.01cm for male and 6.61±0.12 to 9.0 ± 0.01 cm for female, the value increased significantly (P<0.05) with respect to age in both sexes. Coefficients of variation were within the range of 5.79 to 20.51% for male and 6.03 to 19.34%. Both sexes were generally variable and standard deviation did not follow any definite trend.

The results showed that mean body length measured from 26.58 to 43.27cm in male while 26.94 to 43.53cm in female. It also showed that mean for leg length increased from 19.20 to 32.88cm in male and 19.51 to 32.20cm in female. The mean tail length increased from 6.42 to 9cm in male while 6.62 to 9cm in female respectively.

Face Length and Rump Length

Mean face length of WAD goat population with respect to sex ranged from 11.45±0.21 to 20.27±0.19 cm in male and 11.19± 0.16 to 20.00±0.25 cm in female. The value increased significantly (P<0.05) with age in both sexes. Significant differences (P<0.05) were also observed between sexes in favour of female WAD goat. Coefficient of variation ranged from 1.96 to 18.40% for male and 2.98 to 16.79% for the female.

Statistics of rump length of WAD goat population studied ranged from 14.29±0.18 to 21.64±0.20 cm in male and 14.9±0.12 to 21.53±0.47 cm in female. Age significantly (P<0.05) affect the growth of the trait as it increases with the age in both sexes. Coefficients of variation are within the range of 3.12 to 15.08% in male and 4.89 to 18.15% in female populations. Sex significantly affects the growth of the trait in favour of male WAD goats.

Regression equation

The influence of body measurements on live weight determination of WAD goats shown by their R^2 values based on linear function is presented in Table 2. The equations were positive and ($P<0.01$) highly significant for most variables. At zero teeth age, the body parameters that could most accurately determine live weight was body length (0.75) followed by heart girth (0.74) and the least significant was recorded for rump width (0.28). Face length (0.09), shoulder width (0.14) were not significant ($P>0.05$). Multiple regressions showed significant improvement in R^2 value (0.82 and 0.77).

At two teeth age as shown in Table 3, rump height and shoulder width in the prediction equation showed significant ($P<0.05$) improved in R^2 (0.79) as well as combination of rump width, heart girth and body length (0.71). At 4 teeth age, body length (0.62) gave the highest predictor value followed by withers height (0.47) and rump height (0.46). Least significant value was obtained for shoulder width (0.18) and face length (0.18), respectively.

Multiple regression in combination of rump width, heart girth and body length in Table 5, showed significant improvement in R^2 (0.65). At 6 teeth age the linear body measurements that could accurately predict bodyweight was body length (0.86), followed by shoulder width (0.44) and rump height (0.44). Multiple regressions in combination of rump width, heart girth and body length also showed significant improvement in R^2 value (0.88). Table 6

At 8 teeth age, body length appeared to be the only trait that could accurately predict bodyweight ($R^2 = 0.77$) followed by heart girth and rump width 0.45 and 0.44, respectively (Table 7). Addition of rump width and heart length to body length improved R^2 significantly (0.83). Also, combination of foreleg length, tail length, face length and rump length improved R^2 value (0.70).

At wither age, fore length gave the highest R^2 value (0.96) followed by heart girth (0.94), rump height (0.86), wither height (0.78) shoulder width (059), rump width (076). Face and rump lengths are poor predictor of body weight with R^2 value of 0.03 and 0.02, respectively (Table 7). Addition of tail length, face length and rump length to foreleg length in the multiple regression equation gave no significant improvement in R^2 value (0.96). However, there was an improvement in R^2 value (0.95) when rump width and body length was added to heart girth in the multiple regression equations.

Table 2: Estimate of Parameters in Simple Linear and Multiple Function Fitted for Weight linear Measurement at Zero Teeth Age

No.	Regression Equation	R^2	Sign
1.	Y = -1.28 + 0.23WH	0.39	**
2.	Y = -3.51 + 0.28RH	0.55	***
3.	Y = -1.65 + 0.54SW	0.14	ns
4.	Y = -2.17 + 0.66RW	0.28	ns
5.	Y = -3.80 + 0.22HG	0.74	***
6.	Y = -2.49 + 0.30BL	0.75	***
7.	Y = -3.41 + 0.46 FL	0.67	***
8.	Y = -0.41 + 0.911 TL	0.65	***
9.	Y = 2.95 + 0.23FAL	0.09	ns
10.	Y = -3.55 + 0.62RL	0.46	**
11.	Y = -6.68 - 0.06WH + 0.32RH + 0.28SW	0.59	**
12	Y = -5.56 + 0.23RW + 0.10HG + 0.16BL	0.82	***
13.	Y = -3.30 + 0.27FL + 0.46 TL - 0.09FAL + 0.11RL	0.77	***

R^2 : coefficient of determination
NS= not significant
** Significant at p< 0.01
*** Significant at p< 0.001

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Table 3: Estimate of Parameters in Simple Linear and Multiple Function Fitted for Weight linear Measurement at Two teeth Age

No.	Regression Equation	R^2	Sign
1.	Y = -1.16 +0.32WH	0.62	***
2.	Y = -2.67 +0.33RH	0.64	***
3.	Y = 1.51 0.611SW	0.24	ns
4.	Y = 3.13 + 0.55RW	0.23	ns
5.	Y = -0.12 + 0.19HG	0.61	***
6.	Y = -0.83 +0.33BL	0.37	**
7.	Y = -1.67 + 0.49 FL	0.43	**
8.	Y = 11.84 – 0.19 TL	0.00	ns
9.	Y = 8.57 + 0.13 FAL	0.07	ns
10.	Y = 11.30 – 0.06RL	0.02	ns
11.	Y = -8.09 + 0.18WH + 0.14RH + 0.46SW	0.79	***
12	Y = -5.47 + 0.34RW + 0.14HG + 0.12BL	0.71	***
13.	Y = 1.87 + 0.47FL - 0.46 TL + 0.12FAL - 0.08	0.53	**

R^2 : coefficient of determination
NS= not significant
** Significant at p< 0.01
*** Significant at p< 0.001

Table 4: Estimate of Parameters in Simple Linear and Multiple Function Fitted for Weight linear Measurement at Four teeth Age

No.	Regression Equation	R^2	R^2 Adjusted
1.	Y = 2.83+0.27WH	0.47	**
2.	Y = 3.56 + 0.23RH	0.46	**
3.	Y = 8.21 +0.33SW	0.18	ns
4.	Y = 4.24 + 0.65RW	0.38	**
5.	Y = 10.78 +0.05HG	0.03	ns
6.	Y = -3.95 + 0.49BL	0.62	***
7.	Y = 10.08 + 0.13FL	0.05	ns
8.	Y = 11.95 + 0.20TL	0.02	ns
9.	Y = 11.32 +0.15FAL	0.18	ns
10.	Y = 12.59 + 0.06RL	0.05	ns
11.	Y = 0.31 + 0.19WH + 0.05RH +0.21SW	0.55	***
12	Y = -5.64 + 0.16RW + 0.03HG + 0.43BL	0.65	***
13.	Y = 9.33 + 0.08FL +0.02 TL + 0.22FAL- 0.07RL	0.23	ns

R^2 : coefficient of determination
NS= not significant
** Significant at p< 0.01
*** Significant at p< 0.001

Table 5: Estimate of Parameters in Simple Linear and Multiple Function Fitted for Weight linear Measurement at Sixth Teeth Age

No.	Regression Equation	R^2	Sign
1.	Y = 10.04 + 0.15WH	0.33	**
2.	Y = 7.49 +0.19RH	0.43	**
3.	Y = 0.45 +0.91SW	0.44	**
4.	Y = 2.58 + 0.90RW	0.36	**
5.	Y = 7.28 + 0.14HG	0.23	ns
6.	Y = -17.92 + 0.90BL	0.86	***
7.	Y = 9.41 + 0.27FL	0.28	ns
8.	Y = 11.68 + 0.61TL	0.18	ns
9.	Y = 14.27 + 0.14FAL	0.09	ns

10.	Y = 12.87 + 0.21RL	0.11	ns
11.	Y = -0.24 + 0.16WH + 0.26RH +0.67SW	0.54	**
12	Y = -18.66 + 0.27RW + 0.01HG + 0.83BL	0.88	***
13.	Y = 8.77 + 0.23FL +0.27 TL + 0.01FAL+0.04RL	0.30	ns

R^2 : coefficient of determination
NS= not significant
** Significant at p< 0.01
*** Significant at p< 0.001

Table 6: Estimate of Parameters in Simple Linear and Multiple Function Fitted for Weight linear Measurement at Eight Teeth Age

No.	Regression Equation	R2	Sign
1.	Y = 17.39+0.08WH	0.03	Ns
2.	Y = 15.00+0.11RH	0.04	ns
3.	Y = 5.49+0.76SW	0.35	**
4.	Y = 6.89+0.78RW	0.44	**
5.	Y = -1.83+0.30HG	0.45	**
6.	Y = -42.95 + 1.53BL	0.77	***
7.	Y = 0.32 + 0.69FL	0.23	ns
8.	Y = 21.08 + 0.00TL	0.00	ns
9.	Y = 8.83 + 0.62FAL	0.05	ns
10.	Y = 0.96 + 0.97RL	0.39	**
11.	Y = -14.80 + 0.15WH + 0.13RH +1.06SW	0.60	***
12	Y = -34.30 + 0.35RW + 0.09HG + 1.01BL	0.83	***
13.	Y = - 22.99 + 0.85FL +0.00 TL - 0.17FAL+1.05RL	0.70	***

R^2 : coefficient of determination
NS= not significant
** Significant at p< 0.01
*** Significant at p< 0.001

Table 7: Estimate of Parameters in Simple Linear and Multiple Function Fitted for Weight linear Measurement at Wither Teeth Age

No.	Regression Equation	R^2	Sign
1.	Y = 24.77 +0.97WH	0.78	***
2.	Y = - 35.50 + 1.10RH	0.86	***
3.	Y = - 30.75 + 2.57SW	0.59	***
4.	Y = -15.96 + 2.11RW	0.76	***
5.	Y = -40.48 + 0.81HG	0.94	***
6.	Y = -129.26 + 3.67BL	0.47	**
7.	Y = -57.88 + 2.66FL	0.96	***
8.	Y = 30.05 + 0.57TL	0.00	ns
9.	Y = 41.58 – 0.58FAL	0.03	ns
10.	Y = 42.13 – 0.56RL	0.02	ns
11.	Y = -41.59 =0.49Wh + 1.49RH +1.00SW	0.88	***
12	Y = -54.40 + 0.41RW + 0.65HG + 0.44BL	0.95	***
13.	Y = - 59.28 + 2.67FL +0.00 TL +0.04FAL+0.02RL	0.96	***

R^2 : coefficient of determination
NS= not significant
** Significant at p< 0.01
*** Significant at p< 0.001

DISCUSSION

Body length had the highest R^2 value (0.75) at zero teeth age, followed by heart girth (0.75), according to a linear regression model comparing live weight and body measures. The

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highest R^2 values at two teeth were 0.64 and 0.62 for rump height and wither height, respectively. Additionally, body length provided the highest R^2 value at the age of 4 teeth (0.62), as well as at the ages of 6 and 8, respectively. The greatest R^2 values at worn teeth age were 0.96 and 0.94 for foreleg length and heart circumference, respectively. The regression equations show how well one trait explains the generalised variation of body shape when combined with other traits. Both simple and complex linear regressions were used to regress body weight on each of the body dimensions. With the exception of the regression models that employed rump length, face length, and tail length as predictors, all of them were highly significant ($p<0.001$ &0.01).

According to Okpeku et al. (2011), the phenotypic measurements are correlated with body length, height at wither, and height at rump. This may imply that tall animals will typically be huge since they will have both lengthy body lengths and wide heart girths. An animal that was large for one feature was typically large for all attributes in Ghanaian sheep, according to the first PC (Birteeb et al 2012).

Other body predictors yielded the highest accuracy, therefore the resulting coefficients of determination (Adj. R2) were typically low. The moderate correlations between BW and each of the attributes may have contributed to the low prediction accuracies. The study's prediction accuracy was nearly identical to the higher 89% value that Okpeku et al. (2011) reported for the native goats of southern Nigeria. For two goat populations in Ethiopia, HG produced 80.7% and 9.46% yields, while BL produced 53.2% and 29.0% yields, respectively (Hassen et al 2012). The prediction accuracies of the multiple models in this study were comparable to the range of 71% to 95% obtained in Saanen goats (Pesmen and Yardimci 2008), while the prediction accuracies of the simple linear regressions in this study were below the majority of values obtained for WALL sheep (Birteeb and Ozoje 2012). R^2 values at all ages are improved by multiple regressions, which include adding more than one body parameter to the regression equation. These findings match those of earlier research by Fajemilehin and Salako (2008), who found that body length and heart circumference were useful indicators of WAD goat bodyweight. Similar outcomes were also noted in West African dwarf sheep by Salako and Ngere (2002) and Salako (2004).

Linear equations are widely used in genetics, bioinformatics, and animal breeding to predict phenotypic traits based on genetic and environmental factors. They are favored for their simplicity, ease of interpretation, and computational efficiency. By providing a straightforward mathematical relationship between variables, linear models allow researchers and breeders to estimate traits such as growth rate, milk production, and disease resistance with relative ease. Since many quantitative traits follow an additive genetic model, where individual gene effects contribute independently to the phenotype, linear equations serve as an effective tool for modeling these relationships. Additionally, they play a crucial role in selective breeding programs by helping to estimate breeding values, which guide the selection of superior animals or plants for reproduction. Furthermore, linear models provide a foundational basis for more advanced predictive techniques, ensuring that if a simpler model yields accurate predictions, more complex and computationally demanding approaches may not be necessary.

Adeyinka and Mohammed (2006) suggested that using additional linear measurements in addition to heart girth could increase the predictability of the resulting equations, and the reasonable R^2 values of the multiple regression models shown corroborate this idea. Animals could be chosen using the phenotypic data based on a collection of factors rather than just one characteristic. According to Yakubu (2010), factor analysis could be used in breeding and selection programs to obtain well-coordinated animal bodies with a limited number of body parts. However, given the slight increase in prediction accuracy, any trait additions to a model must be assessed. Previous studies also showed that meat production was enhanced by selection depending on the measures.

CONCLUSION

Using the linear body measurement, it is simple and accurate to predict the body weight of West African dwarf goats. Linear measures and body weight are significant characteristics of meat animals. The evaluation of body measuring data yields quantitative measurements of ideal body size and form, which are useful for estimating genetic parameters for these characteristics and for allowing their inclusion in breeding programs.

Age and sex both significantly impacted body measurements at various ages, and development programs aimed at boosting goat meat yield should take these findings into account. Given the excellent regression coefficients of the West African dwarf goats' linear body measurements, the study's findings suggest that live weight can be predicted using a few body measurements. Since this method uses both single and multiple regression techniques, weight estimation might also be done using the retrieved factors.

It is necessary to adjust linear body measures to account for any variations in body weight. To avoid past mistakes, identical database information for additional livestock species must be developed, as each species has a different parameter relationship. The correlations between the body weights and linear body measurements of all goat breeds in various regions of West Africa and at various ages require more investigation.

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