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MORPHOLOGICAL TRAITS FOR PREDICTING LIVEWEIGHT OF WEST AFRICAN DWARF GOAT IN AFIKPO NORTH, EBONYI STATE

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ABSTRACT

Data on live body weight (LW), chest girth (CG), body length (BL), ear length (EL), rump width (RW), rump length (RL), rump height (RH), Height at withers (WH), and tail length (TL) were collected from 104 West African Goat (WAD) of both sexes before feeding them in the morning. Using a digital hanging scale for weight, a tailor measuring tape, dividers, and a measuring stick for linear body measurements, positive correlations were observed between all linear body measurements and goat weight. Significant correlation (ranging from 0.137 to 0.910; $P < 0.01$) were found between body weight and morphological traits. Height at withers was strongly correlated with live weight ($P < 0.01$). The results of regression analysis showed that, live body weight could be predicted with accuracy from linear body measurements, especially height at wither. The predictive models for body weight were established as (LW = 12.698+0.536 ±2.419WH; R^2 = 82.7%) and (LW = -8.507+0.464 ±1.937 RH; R^2 = 72.5%) for height at wither and rump height, respectively. These equations offer a practical tool for WAD goat farmers to estimate live weight when scales are unavailable, aiding in selection and breeding programs.

Keywords: Morphometrics, WAD goat, Prediction.

INTRODUCTION

Nigeria possesses several goat breeds with significant value in both meat and skin production (Adamu *et al.,* 2020). However, these breeds are often perceived to have limited genetic potential for weight gain (Ojo *et al.*, 2015). Past research on indigenous goat breeds has primarily focused on enhancing productivity, with emphasis on weight gain. To enhance genetic selection before crossbreeding or introgression may be necessary (Mrode *et al*., 2018). The initial step toward improvement or conservation involves breed characterization (Derbie and Tilahun, 2023). Live weight estimation in goat production is valuable for herd control and management throughout the rearing process. It aids in administering medications, determining nutritional rationing, and facilitating goat marketing (Tella, Chineke, and Jacob, 2021). The pricing of West African Dwarf (WAD) goats is heavily influenced by body weight. Smallholder farmers in rural communities do not have access to suitable weighing scales and often rely on non-weight-based animal marketing practices, such as visual appraisal I n fixing prices during transactions (Mathapo and Tyasi, 2021). This approach, which is commonly used by middlemen and butchers is to the disadvantage of farmers. In the absence of scales and records on farms, determining goat weight can be challenging (Ajayi, Osowe, and Babayemi, 2017).

The objective of this study was assess to the variability in body measurements and establish correlations between live weights and linear body measurements in WAD goats in Afikpo North,

Ebonyi State, Nigeria. The findings aim to contribute to body weight estimation for selection and other applications, benefiting farmers and animal scientists engaged in small ruminant research.

MATERIALS AND METHODS

Location of the Study

The research was conducted in Afikpo, in Afikpo North Local Government Area (LGA) of Ebonyi State, situated within the humid tropical rainforest zone. The geographic coordinates of the study area are Latitude 5.889455 and Longitude 7.9538378. The region experiences an average annual precipitation of 221.55mm and maintains a humidity level of 75.5%.

Experimental Animals and Management

The study involved 104 WAD goats (41 bucks and 63 does) of ages between two to four year of ages. These goats were managed under traditional extensive husbandry practices, with variations based on the owner's financial status. The primary source of feed was forage obtained from grazing along major roads, fallow plots, and backyard areas. In some instances, crop residues, grains, and kitchen wastes were offered as supplement. The animals grazed together in communal grazing grounds often without clear distinctions between the flocks of different owners. Record-keeping on the animals was minimal. The use of ethno-veterinary medicine was a common practice. There was no intentional breeding or selection aimed at improving the goats' genetic traits.

Age Determination

The ages of the animals were determined by means of dentition Based on the dentition to the animals were categorize into specific age brackets, using the method of Wilson and Durkin (1984).

Duration/ Period of Data Collection

The measurements were carried out over a period of 8 weeks (October 2023 to December 2023).

Body Measurements

The animals were securely restrained in a standing position to ensure a proper measurement procedures. Nine morphometric traits were measurements were carried out on each animal namely live body weight (LW), chest girth (CG), body length (BL), ear length (EL), rump width (RW), rump length (RL), rump height (RH), height at withers (WH), and tail length (TL). The corresponding age –which ranges from two to four years and sex of each sampled animal were carefully recorded. For accurate linear body measurements, anatomical points of reference followed the methods outlined by Searle *et al*. (1989), Greyling *et al*. (1994), and Krausgrill (1996). Digital hanging scales were used for body weight measurement, and flexible tape by fiber-glass, with capacity 60 inches and dividers for length and circumference measurements.

The following parameters were taken with measuring tape; Chest girth (CG); measured by taking the measurements of the circumference of the chest; behind the forelegs, Body length (BL); the distance from the point of shoulder to the pin bone. The following measurement was taken by dividers, Ear length (EL); measurement taken from the base to the tip of the ear, Rump width (RW); the horizontal distance between the extreme lateral points of the hook bone (*tuber coxae*) of the pelvis, Rump length (RL); measured as the distance from the hip (*tuber coxae*) to the pin (*tuber ischi*), Tail length (TL); the distance between the base and the tip of the tail. The following measurement taken by measuring stick, Rump height (RH); vertical distance between the floor and the rump region, Wither height (WH); measured as a distance from the surface of the platform to the withers of the animal.-FAO, (2012)

Statistical Analysis

Descriptive statistics such as mean, standard deviation, standard error, and coefficient of variation were computed for each parameter using the SAS (2007) version 24 statistical package. Pearson coefficient of correlation (*r*)

between the variance of body measurements was estimated.

RESULTS

Effect of sex on linear measurements and live weight of WAD goat is shown in Table 1.

Table 1: Sex variation in means of morphometric traits of WAD goats (cm)

Metrics	LW	BL	CG	EL	RW	RL	RH	WH	TL	n
Male	16.60	47.20	55.87	10.57	14.30	15.56	45.83	43.86	7.61	41
Female	17.40	48.24	56.83	10.79	14.41	15.04	45.13	43.75	7.53	63

LW: Live Weight, BL: Body Length, CG: Chest Girth, EL: Ear Length, RW: Rump Width, RL: Rump Length, RH: Rump Height, WH: Wither Height, TL: Tail Length. Means within a subclass in a column without subscript were not significantly different ($P > 0.05$)

The relationship between eight linear measurements (cm) and live weight (kg) of WAD goats as shown in table 2.

Table 2: Phenotypic correlation among traits

Metrics	LW	BL	CG	EL	RW	RL	RH	WH	TL
LW	1	0.767**	0.807**	0.213**	0.418**	0.244**	0.852**	0.910**	0.397*
BL		1	0.712**	0.137**	0.413**	0.233**	0.700**	0.776**	0.010**
CG			1	0.193**	0.464**	0.278**	0.688**	0.729**	0.341**
EL				1	0.091**	0.041**	0.188**	0.177**	0.059**
RW					1	0.500**	0.358**	0.440**	0.138**
RL						1	0.148**	0.195**	0.052**
RH							1	0.903**	0.260**
WH								1	0.389**
TL									1

LW: Live Weight, BL: Body Length, CG: Chest Girth, EL: Ear Length, RW: Rump Width, RL: Rump Length, RH: Rump Height, WH: Wither Height, TL: Tail Length. **Correlation is significant at $P < 0.01$.

The regression analysis for prediction of live body weight from linear body measurements of WAD goats is presented in Table 3. Wither height had the highest coefficient of determination value ($R^2 = 82.7\%$) and can best be used to predict the live weight of WAD goats.

Table 3: Best fitted regression models on morphometric traits

Measurement	Model	R^2 Values	S.E
Body length (cm)	LW= -4.633+ 1.17BL	58.9%	0.097
Chest Girth (cm)	LW= -4.735 + 0.92CG	65.1%	0.067
Ear length (cm)	LW= 12.942 + 0.44EL	4.6%	0.201
Rump width (cm)	LW= 9.495 + 0.73RW	17.5%	0.156
Rump length (cm)	LW= 12.853 + 0.21RL	5.7%	0.083
Rump height (cm)	LW= -8.507+0.46RH	72.5%	1.937
Wither height (cm)	LW= 12.698+0.54WH	82.7%	2.419
Tail length (cm)	LW= 11.532 + 0.75TL	15.8%	0.172

LW: live weight; BL: body length; CG: chest girth; EL: ear length; RW: rump width; RL: rump length; RH: rump height; WH: wither height; TL: tail length. R^2 = Coefficient of determination

RESULTS AND DISCUSSIONS

Sex on Morphometric Traits of WAD Goat

In the current study, sex had a negligible impact on all characteristics, as represented in Table 2. Coyne *et al*. (2008) highlighted that the genetic underpinnings of sexual dimorphism pose an intriguing evolutionary genetic challenge as such traits are restricted to one gender. These dimorphic traits may be expressed genetically either through alleles initially limited to expression in one sex or by initially expressing in both sexes but subsequently being regulated in only one sex through the evolution of modifier genes or regulatory elements.

Pearson's Correlation among Quantitative Variables (Body Weight and Linear Body Traits)

Morphometric traits are important in expanding the understanding of unidentified populations and are vital in the identification and classification of breeds (Adamu *et al*., 2020). In the current study, the phenotypic correlations among quantitative variables, including body weight and linear body traits, were generally significant ($p < 0.01$), ranging from RW 0.091, TL 0.059 to WH 0.91,).195. and were consistently positive (Table 3). These findings are comparable to those of Birteeb and Lomo (2015) and Chacón *et al*. (2011). There were low correlations between body weight and certain linear body traits such as ear length, rump length, and tail length. This suggests that these traits may have a limited influence on total body weight and may not serve as strong predictors. However, a moderate correlation (0.418) was observed between body weight and rump width, indicating a connection between body weight and carcass yield. Improvement in rump width may consequently enhance body weight and carcass yield (Morales-delaNuez *et al*., 2012). High correlations (0.767 - 0.910) were noted between body weight and body length, chest girth, rump height, and wither height, making them strong indicators of body weight. Enhancing these linear traits could significantly improve body weight and carcass yield. Tehe correlations (0.903) between wither height and rump height suggests that selecting for one trait could positively impact the other if the high correlation is genetically influenced. Rump length and width displayed a moderate correlation (0.500), defining the pelvic region size and its relation to ease of parturition

in female animals. Frandson *et al*. (2009) observed that improving rump length and width may enhance the ease of parturition, particularly when selecting for increased birth weight. While some correlations align with previous studies: Birteeb and Lomo (2015), they generally appear higher than reported by Mathapo and Tyasi, (2021) andDorantes-Coronado *et al*., (2015). However, these results support studies by Sam *et al*. (2016) and Idrissou *et al*. (2017), emphasising medium to high correlation coefficients between body weight and linear body measurements in West African Dwarf goats.

Regression Equations to Predict the Body Weight of WAD Goats from Linear Body Traits

The regression analysis for predicting live body weight from linear body measurements of WAD goats is summarized in Table 4. Body length (BL), chest girth (CG), rump height (RH), and wither height (WH) emerged as crucial linear body dimensions for predicting WAD goat body weight. The R-squared values, representing the percentage of variability explained by the fitted model, highlighted the efficacy of these linear dimensions in predicting body weight. The regression analysis for prediction of live body weight from linear body measurements of WAD goats is presented in Table 4. Wither height had the highest coefficient of determination value (R^2 = 82.7%) and can best be used to predict the live weight of WAD goats.

For WAD goats, wither height (WH) stood out as the most influential single trait for body weight prediction, followed by rump height (RH). This suggests the feasibility of developing a single-variable weight estimator using measuring tape, based on wither height or rump height prediction equations. These findings align with the report of Birteeb and Lomo (2015), which emphasized the high significance ($p < 0.001$) of regression models in predicting WAD goat body weight in the transitional zone of Ghana. However, they differ from Sam *et al*. (2016), who proposed chest/heart girth as a predictor for Nigerian WAD goat body weight. The present study supports the findings of Fajemilehin and Salako (2008), suggesting accurate body weight prediction from wither height in WAD goats in Southwestern Nigeria.

CONCLUSION

The study underscores the effectiveness of using a measuring tape as a non-conventional method for estimating the live weight of goats. This practical approach offers a feasible alternative for goat keepers, especially in areas where access to weighing scales is limited.

REFERENCES

Adamu, H., Ma'aruf, B. S., Shuaibu, A., Umar, H. A. and Maigado, A. I. (2020). Morphometric characteristics of Red Sokoto and Sahel goats in Maigatari Local Government Area of Jigawa State. *Nigerian Journal of Animal Production,* 47(4), 15-23.

Ajayi, M. O., Osowe, C. O. and Babayemi, O. J. (2017). Assessment of conventional and non-conventional estimation of live weight, carcass characteristics and dressing percentage of Nigerian breeds of goats as panacea for livestock entrepreneurship. *Nigerian Journal of Animal Production*, 44(2), 173-178.

Birteeb, P. T., Danquah, B. A. and Abdul-Rahaman, S. S. (2015). Growth performance of West African Dwarf Goats Reared in the Transitional Zone of Ghana. *Asian Journal of Animal Science*, 9(6), 370-378.

Chacón, E., Macedo, F. Velázquez, F., Paiva, S. R., Pineda, E. and McManus, C. (2011). Morphological measurements and body indices for Cuban Creole goats and their crossbreds. *Revista Brasileira de Zootecnia*, 40(8), 1691-1679.

Coyne, J. A., Kay, E. H. and Pruett-Jones, S. (2008). The genetic basis of sexual dimorphism in birds. *Evolution*, 62(1), 214-219.

Derbie, Y. and Tilahun, H. (2023). Phenotypic characterization of indigenous sheep breeds in the Jimma Zone, Oromia, Ethiopia. *Journal of Applied Animal Research*, 51(1), 644-652.

Dorantes-Coronado, E. J., Torres-Hernández, G. O., Hernández-Mendo, O. and Rojo-Rubio, R. (2015). Zoometric measures and their utilization in prediction of live weight of local goats in southern México. *Springer Plus*, 4, 695.

Fajemilehin, O. and Salako, A. (2008). Body measurement characteristics of the West African Dwarf goat in deciduous forest zone of southwestern Nigeria. *African Journal of Biotechnology*, 7(14), 2521-2526.

FAO, (2012). Phenotypic characterization of Animal Genetic Resources. FAO Animal Production and Health Guidelines, No.11. FAO, Rome.

Frandson, R. D., Wilke, W. L. and Fails, A. D. (2009). Anatomy and Physiology of Farm Animals (7th edition). Wiley-Blackwell, Hoboken.

Greyling, J. P. C., Koteze, W. F., Taylor, G. J. and 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.

Idrissou, N. D., Ahounou, S. G., Tougan, U., Tamimou, M. I., Hounmanou, Y. M. G., Mensah, G. A. and Karim, I. Y. A. (2017). Morphometric and zootechnical characterization of dwarf goats in Northeastern Benin. *International Journal of Agronomy and Agricultural Research*, 11(3), 26-42.

Krausgrill, S. (1996). Regulation of cell wall invertase by a protein aqeous inhibitor. *Journal of Experimental Botany*, 47, 1193–1198.

Mathapo, M. C. and Tyasi, T. L. (2021). Prediction of body weight of yearling boer goats from morphometric traits using classification and regression tree. *American Journal of Animal and Veterinary Sciences*, 16(2), 130-135.

Morales-delaNuez, A., Rodríguez, C., Santana, M., Hernandez-Castellano, L. E., Niño, T., Reyes-Chacon, R. J., Moreno-Indias, I., Castro, N. and Capote, J. (2012). Morphological measurements and indexes as a tool to support molecular genetic studies: an example in Canary Islands. *Journal of Applied Animal Research*, 40(3), 215-221.

Mrode, R., Tarekegn, G. M., Mwacharo, J. M. and Djikeng, A. (2018). Invited review: Genomic selection in developed countries: how applicable for the rest of the world? *Animal*, 12(7), 1333-1340.

Ojo, A., Akpa, G. N., Orunmuyi, M. and Adeyinka, I. A. (2015). Genetic differentiation among Nigerian indigenous goat population. *Journal of Agricultural Science*, 7(11), 39-47.

Sam, I., Ekpo, J., Ukpanah, U., Eyoh, G. and Warrie, M. (2016). Relationship between linear body measurement and live body weight in West African Dwarf Goats in Obio Akpa. *Journal of Biology, Agriculture and Healthcare*, 6(16), 118-124.

Searle, D., Atkins, H. and Allen, K. (1989). Structure and function of Hsp90". *Current Opinion in Structural Biology*, 2(1), 16–21.

Tella, A., Chineke, C. A. and Jacob, O. O. (2021). Correlation coefficient of live weight and body measurements of extensively reared West African Dwarf goats in south west zone of Nigeria. *Ghana Journal of Agricultural Science*, 58(1), 49-59.

Wilson, R. T. and Durkin, J. W. (1984). Age at permanent incisor eruption in indigenous goats and sheep in semi-arid Africa. *Livestock Production Science*, 11(4), 451-455.