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Research Article

Evaluation of the relationship between body weight and linear measurements in West African Dwarf Goat as influenced by sex and agro-vegetational zone in the Southwestern Region of Nigeria

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Study on the relationship between body weight and linear measurements of West African Dwarf (WAD) goats as influenced by sex and agro-vegetational zone was carried out using 200 animals comprising 100 goats each of both sexes. Animals were measured in two different zones where they are reared extensively and kept as security against crop failure and supply of animal protein. Analyzed results indicated significant (P<0.01) phenotypic correlations between body weight and morphometric traits, and this cut across both sexes and zones. The study also revealed high positive significant (P<0.01) phenotypic correlations between morphometric traits regardless of sex and zone where the animals are found. Of all body linear measurements, heart girth was closely related to body weight, that is, recorded highest correlation coefficient value with body weight, while height-at-withers has the least relationship, that is, lowest phenotypic correlations with body weight. The study also indicated sexual dimorphism as regards the relationship between body weight and linear measurements. It was also discovered that relationship between body weight and morphometrical traits in WAD goats differed from one zone to another. Therefore, it is suggested that measurements on animals to be used for breeding or commercial purposes should be sex and zone restricted.

Keywords: WAD goats, sex, phenotypic correlations, heart girth, body weight, zone.

INTRODUCTION

Goats are multi-functional animals and play a significant role in the economy and nutrition of landless, small and marginal farmers (Khan et al., 2006). In Nigeria, goat rearing is practiced by a large section of people living in rural and semi-urban areas. Goats can survive with or without industrial by-products, and be profitably reared on less nutritious forages such as shrubs and trees in a land where most minerals and plant nutrients have been depleted due to continuous cropping. They contribute to livestock industry in terms of meat, milk, wool and skin (Matsebula et al., 2013). Khan et al. (2006) posited that when compared to other domestic animals, goats are the victims of prejudice and neglect because less attention was paid to their housing and feeding by their owners. Nevertheless, they are still performing an important role of supplying human race with meat, milk, wool, leather and other animal products.

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According to De Villiers et al. (2009), income derived from goat rearing is a major contributor to the livelihoods of rural populace. And for profitable rearing, the animals have to be properly managed and efficiently assessed when taken to market. Due to the inability of these poor rural farmers to have weighing scales of their own, they resort to visual estimation to determine market price of their animals which may not be good enough to earn them commensurate income for their efforts and sweat. Reliance on visual estimation also affects other management practices such as feeding, breeding time, medication and vaccination dosages. However, the danger of using visual estimation lies with applying the same method for more than one breed of a particular species (Matsebula et al., 2013). Otoikhian et al. (2008) documented that body structure employed in rural markets to estimate body weights of animals is very deceptive and subjective too. The net result of reliance on estimated live weights according to Matsebula et al. (2013) is inefficiencies in goat production and inconsistencies in market pricing resulting to reduced profit and loss of revenue to farmers.

Since farmers have no access to weighing scales, the use of weight band to estimate the weight of their animals becomes imperative. A weight band is a measuring tape whose graduation has a correlation between live weight (kg) and linear measurement (cm). This weight band has been successfully used in dairy cows (Dingwell et al., 2006), beef cattle (Machilaa et al., 2008; Abdelhadi and Babiker, 2009), pigs (Machebe and Ezekwe, 2010; Mutua et al., 2011), sheep (Birteebi and Ozoje, 2012) and goats (De Villiers et al. 2009; Yakubu et al., 2011). The weight band is a simple tool, less stressful, practical and can easily be understood by farmers with little education and minimum supervision.

Linear measurements such as body length, heart girth, height at withers and rump height are measured to assess the relationship between these parameters and live weight. Birteebi and Ozoje (2012) documented that optimum production and value-based trading systems will be achieved when producers and buyers of livestock are able to relate animal measurements to growth characteristics. The authors posited that correct body weight assessment will ensure that farmers are well compensated for their sweat and get value for their stock rather than the middlemen and livestock processors making a lot of profit more than the impoverished rural farmers.

Although there are many published articles on linear body measurements as predictors of live weight in goats, none dealt with the influence of gender and rearing location under Nigerian climatic conditions. It will be misleading therefore, to apply prediction formulae derived for a different breed or strain of goat under different conditions for West African Dwarf (WAD) goat which are found in Nigeria and some regions in West Africa. It is common knowledge that growth, final body weight and body conformation vary between goat breeds. Based on these assumptions, this study was designed to investigate the relationship between body weight and linear measurements of WAD goats reared in different agro-vegetation zones in the Southwestern region of Nigeria. The study was also aimed at assessing the effect of sex on the relationship between all the growth traits under investigation.

MATERIALS AND METHOD

This study was carried out in two agro-vegetational zones of Southwestern region of Nigeria. The cities where the research was carried out are Ado-Ekiti and Ilesha in Ekiti and Osun states, respectively. The study was conducted between March and May, 2015. A total number of 200 West African Dwarf goats comprising 100 animals each of both sexes were included in the evaluation of morphometric traits. The animals studied were of different ages, and were reared extensively in free range and subsisted on available grasses and browse plants, cassava peels, yam peels and other domestic waste. Medical attention is provided only when the need arose, and are exposed to cold weather and other hazards in the night.

Traits Measured

Body weight and linear body characteristics evaluated included body length, heart girth, height at withers and rump height. The animals were weighed early in the morning before they were fed, and were measured by the same set of researchers throughout the period. Each of the animals selected for measurement was restrained and gently handled to prevent injury to both the animals and handlers. Calibrated hanging scale was used to measure body weight, while other linear measurements were done with the aid of a measuring tape. Pregnant does and sick ones were excluded from this study. This was to get accurate body weight of the does, since the weight of unborn kids might influence and possibly inflate the measured values. Animals that are sick will also not give correct body weight and linear body measurements. The infected organisms might have impacted negatively on their growth and bone development. Both categories were therefore, not included in this study.

Body length- It is the distance between the occipital protuberance and the base of the tail
Height at withers- It is the distance from the surface of a platform to the withers
Heart girth- It is a circumferential measure taken around the chest
Rump height- It is the distance from the surface of a platform to the rump

Data analysis

Data collected on body weight, body length, heart girth (upper abdominal-shoulder part), height at withers and

Table 1. Descriptive statistics showing Means±SD of body weight and linear measurements of West African Dwarf goat in Ekiti and Osun States

Sex	Traits	No.	Min.	Max.	Mean	SD
Male	BWT	100	5.0 (5.0)	22.0 (23.0)	12.3 (13.6)	3.8 (4.1)
	BDL	100	59.0 (64.4)	85.0 (96.6)	76.3 (79.4)	5.7 (7.9)
	HTW	100	31.0 (36.2)	50.60 (61.5)	41.6 (42.3)	3.8 (4.4)
	HTG	100	38.5 (40.2)	59.0 (62.5)	49.3 (48.6)	4.2 (8.7)
	RPH	100	29.6 (35.5)	49.1 (52.0)	40.3 (41.1)	3.8 (3.8)
Female	BWT	100	10.0 (8.0)	43.8 (43.8)	26.7 (24.2)	6.8 (8.9)
	BDL	100	36.8 (69.5)	107.4 (111.6)	88.4 (89.0)	12.4 (10.8)
	HTW	100	36.0 (32.7)	66.5 (57.2)	51.1 (47.1)	6.2 (6.1)
	HTG	100	45.5 (42.5)	72.5 (87.5)	61.8 (60.0)	6.5 (10.2)
	RPH	100	35 (31.5)	64.3 (55.5)	49.5 (46.1)	6.1 (6.1)

Values in parenthesis represent Osun state
BWT- body weight BDL- body length HTW- height at withers HTG- heart girth
RPH- rump height

Table 2. Phenotypic Correlations between body weight and linear measurements in Male WAD goats as affected by agro-vegetational zone

Traits	**BWT**	**BDL**	**HTW**	**HTG**	**RPH**
BWT	1.00	0.7169***	0.3096*	0.7586***	0.3047*
BDL	0.5662***	1.00	0.5156***	0.7210***	0.5046***
HTW	0.4353**	0.7129***	1.00	0.4482**	0.9872***
HTG	0.3808*	0.4359**	0.3077*	1.00	0.4508***
RPH	0.4519***	0.6753***	0.7707***	0.4391**	1.00

*P<0.05 **P<0.01 ***P<0.001
Above diagonal represent values for Ekiti state
Below diagonal represent values for Osun state
BWT- body weight BDL- body length HTW- height at withers HTG- heart girth
RPH- rump height

rump height were analyzed with Pearson Correlation Analysis of SAS (2001).
The appropriate statistical model is:
$Y_{ijk}= \mu+S_j+R_i+\varepsilon_{ijk}$
$Y_{ijk=}$ observation of k^{th} population, j^{th} sex and i^{th} region
μ = common mean
$S_{j=}$ fixed effect of sex (j=2) $R_{i=}$ fixed effect of region (i=2)
$\varepsilon_{ijk=}$ error term

RESULTS AND DISCUSSION

Body weight measurement is essential for any breeding and selection programme, feeding, vaccination and drug dosage in livestock industry.
Table 1 represented the descriptive statistics for the body weight and linear measurements evaluated on the WAD goats as influenced by sex and agro-vegetational zones. Males in both zones recorded lower standard variation values when compared to females. This might be due to inherent variability in both sexes.
The results in Table 2 showed the phenotypic correlation coefficients between body weight and morphometric traits in WAD male goats as affected by agro-vegetational zone. There was a significant (P<0.01) high positive correlation coefficient between body weight and body length in the two zones, with males in Ekiti zone recording higher values than those measured in Osun zone. Between body weight and height at withers and rump height, WAD males from Osun zone recorded higher positive values than those measured in Ekiti zone. However, pertaining to relationship between body weight and heart girth, WAD males from Ekiti zone had higher positive correlation coefficient than those from Osun zone. Bello and Adama (2012) asserted that the presence of muscle and bone around the heart region was responsible for the relatively higher and positive relationship between body weight and heart girth when compared to other linear traits. Cam et al. (2010) and Lavvaf et al. (2012) reported comparable findings in Turkish hair goats and Afshari and Zandi rams,

Table 3. Phenotypic Correlations between body weight and linear measurements in Female WAD goats as affected by agro-vegetational zone

Traits	BWT	BDL	HTW	HTG	RPH
BWT	1.00	0.4754***	0.4747***	0.7619***	0.4882***
BDL	0.8025***	1.00	0.5002***	0.5144***	0.5131***
HTW	0.8397***	0.8603***	1.00	0.6316***	0.9588***
HTG	0.8980***	0.8296***	0.8482	1.00	0.6199***
RPH	0.8447***	0.8692***	0.9861***	0.8608***	1.00

*P<0.05 **P<0.01 ***P<0.001
Above diagonal represent values for Ekiti state
Below diagonal represent values for Osun state
BWT- body weight BDL- body length HTW- height at withers HTG- heart girth
RPH- rump height

respectively. The authors found high phenotypic correlations between body weight and chest girth in the afore-mentioned animals.

The obtained results suggested that any one among morphometric traits or their combinations could be used to predict live weight in WAD male goats, though variations existed in values obtained between zones. In addition, higher positive correlations were recorded between and among all morphometric traits in WAD male goats reared in the two zones. Of particular interest was the very high values recorded between rump height and height at withers. This indicates epistatic effect of the genes controlling important economic traits in farm animals, and an improvement in one trait will result to corresponding increase in the value of the other.

The results obtained in different zones for body weight and morphometric traits showed that there are differences in body conformation of these animals being reared in different zones though they belong to the same breeding group. Therefore, it is suggested that for any successful breeding programme, data obtained on body weight and linear measurements be analyzed and applied for the animals in that particular zone and avoid using values obtained from different zones from where the breeding project is being carried out.

In Table 3, high and positive significant (P<0.01) phenotypic correlations were reported for WAD female goats in both Ekiti and Osun zones. Similar to what was reported for WAD male goats, high correlations were recorded between body weight and morphometric traits. However, values between body weight and heart girth appeared to be the highest when compared to other linear traits. In agreement with this study are the observations of De Villiers et al. (2009) and Yakubu et al. (2011) who reported that heart girth was a better predictor of live weight. Also, variations in correlations existed for each trait between the two zones with WAD females reared in Osun zone having higher correlations between body weight and linear traits than those from Ekiti zone. It also confirmed earlier assertion that correlation values obtained between body weight and morphometric traits in a particular region cannot be applied for animals in another region since they differ in body conformation due probably to differences in genetic make-up, health status, feeds and feeding and management practices. Musa et al. (2012) reported results similar to what was obtained in this study. The authors observed high correlations between body weight and linear traits in Sudanese Kenana cattle. The high and positive association obtained between body weight and morphometric traits in this study suggest that anyone of them or combinations will provide a good estimate for body weight in WAD female goats, though differences exist in values from one zone to another.

It was equally seen from analyzed data that high and positive correlations existed between and among linear traits in the two zones covered (Table 3). The highest correlations were reported between height at withers and rump height, and this means that once the value of one is given the value of the other could be predicted. The obtained results show a very strong relationship between the various traits that are connected with animal growth. According to El-Labban (1999), positive correlation among traits could be as a result of pleiotropic effects of genes and linkage effects which operate on these traits. Therefore, any attempt to perform phenotypic selection for one trait will consequently result in improvement of the other.

CONCLUSIONS

The findings of this work revealed that heart girth has very strong association with body weight regardless of sex and zone where the animals are reared. The trait with least correlation value was height-at withers. Among the linear traits, rump height and height-at-withers had strong

relationship than with other traits. In addition, the study established positive influence of sex and zone on body weight and morphometric traits.

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