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Linear Body Measurement Relationship in White Fulani Cattle in Derived Savannah zone of Nigeria

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Abstract
The study was conducted to evaluate genetic relationship between linear body measurements of white Fulani cattle in the derived savannah zone of Nigeria. Data was collected on 45 white Fulani cattle (19 female and 26 male). Linear body measurement (LBM) traits measured were Body length (BDL), Hip height (HPH), Heart girth (HG), Horn length (HL), Tail length (TL), Ear length (EL) and Thoracic length (THL). Data generated were analyzed using SAS procedure. The mean of BDL, HPH, HG, HL, TL, EL, and THL of both female and male were 39.65-33.07, 57.28-48.55, 8.10-7.69, 18.92-9.73, 36.73-32.15, 49.10-46.06, and 28.73-20.73 respectively. Result indicated that Body length was significantly ($p<0.05$) different in favor of female cattle. Similar result was obtained for other LBM. HG gave highest coefficient of determination in both sexes (0.92; female and 0.89; male) followed by HL (0.82; female and 0.64; male). Relationships between the variables were positive and significant, highest values were obtained between body length and hearth girth (0.823) while lowest value was obtained between ear length and tail length. Relationships between the variables were positive and significant, highest values were obtained body length and hearth girth while lowest value was obtained between ear length and tail length. Conclusively, relationship that existed between body measurement can be exploited for selection and breeding programme in white Fulani cattle.
Keywords: Genetic, Variables, coefficient and selection

INTRODUCTION

Cattle is a multi functional animal and plays a significant role in the economy and nutrition, large and marginal farmers in Nigeria. Cattle rearing are an enterprise which has been practiced by a large section of population in rural areas. Cattle can efficiently survive on available shrubs and trees in adverse harsh environment in low fertility lands where no other crop can be grown. They contribute to livestock industry in terms of milk, meat skin and hair.

Apart from providing meat, cattle also plays a vital role by providing milk, fiber, hair, manure and a major source of income especially for rural people. Additionally, cattle's are useful in carrying out functions such as being slaughtered for funeral and marriage ceremonies and as a source of income and security for the resource poor farmers (Nsoso et al., 2003). Tropical cattle yet to be improved with regard to production performance parameters for higher meat yields under stressful tropical conditions such as low quality nutrient feed, a tropical climate, diseases and parasites. Increasing meat yield from this breed of animal requires the development of a very good model for its genetic improvement. The trait of interest in this regard is the body weight. Proper measure of this trait on farm and on station is often very difficult. This is as a result of unavailability of weighing scale especially in the rural areas where most of the animals are located (Adeyinka and Mohammed, 2006). It is virtually not possible to get correct measurement of this vital trait (Adeyinka and Mohammed, 2006).

The body weight of cattle is important for a number of reasons, it related to breeding (selection), feeding and health care. However this fundamental knowledge is often unavailable to those working with cattle in the small scale-farming sector, due to unavailability of scales. Hence, farmers have to rely on questionable estimates of the body weight of their cattle, leading to inaccuracies in decision-making and husbandry. The method of weighing animals without scales is to obtain a regression formula of body weight on a certain number of body characteristics, which can be measured readily. Linear measurements are divided into two groups, which include skeletal and tissue measurements. Skeletal measurements include all the height and length measurements while tissue measurements include heart girth, chest depth, punch girth, and width of hips (Blackmore *et al.,* 1995). These body measurements can be further divided into horizontal measurements like body length (BDT) and head to shoulder (HDS) and vertical measurements like hip height (HPH) and chest depth.

According to Salako (2006), Body measurement in addition to weight measurements describes more completely an individual or population than do the conventional methods of weighing and grading. These body measurements have been used at various times for the estimation of weights when live weights are measured alongside these parameters. Body dimensions have been used to indicate breed, origin and relationship through the medium of head measurements (Itty, *et al*, 1997) or to indicate size. EAAP and FAO have used wither height for example as a prime indicator type (Wilson, 1995). More recently, alternative body measurements and indices estimated from various combinations of conventional and non – conventional body parameters not only provide

superior guide to weights but are also used as indicators of type and function in domestic animals Mason, (1996), Salako, (2006).

Often, in countries where the marketing of beef cattle is carried out by live weight, the need for weighing equipment in the market place causes substantial difficulties for developing countries, especially where cattle production involves rural households. The marketing of animals is based on visual assessment, while drugs are administrated mostly by estimation, because the use of live weight criteria in feeding, marketing and drug administration requires sophisticated facilities such as weighing scales, which are expensive and not readily affordable by many small rural households. In addition to lacking weighing scales, most famers are not educated to understand how to use the scales properly. Numerous studies have been carried out to develop methods of estimating the live body weight of cattle using formulae derived from body measurements (Goe *et al.,* 2001; Adeyinka and Mohammed, 2006; Ojedapo *et al*., 2007; Sowande and Sobola, 2008). Linear measurements can be taken at relatively lower costs with a high relative accuracy and consistency. (Mohammed, 1990) noted that linear body measurements describe an animal more completely than conventional methods of weighing and grading. Body dimensions or linear measurements have been a recurring interest to the beef cattle industry either to supplement body weight as a measure of productivity or as predictors of some less-visible characteristic.

This study was therefore designed to evaluate body measurement relationships of White Fulani cattle in the derived savannah zone of Nigeria.

MATERIALS AND METHODS

EXPERIMENTAL ANIMAL AND LOCATION OF THE STUDY

Fifty White Fulani breed of cattle comprising 26 males and 19 females were used for the study. They were managed under semi-intensive system of Animal husbandry at Ladoke Akintola University Teaching and Research Farm Ogbomoso and quarantine station Ogbomoso, It is located in the derived savannah zone of Nigeria. The vegetation and climate of Ogbomoso has been previously described. (Ige *et al* 2012)

DATA COLLECTION

Seven metric traits (Body Length, Hip Height, Heart Girth, Horn Length, Tail Length, Tail Length, Ear Length and Thoracic Length) were taken on individual cattle with the aid of tailors's tape rule. The Animals were restrained by the handlers restrained. Sex of the cattle was also taken into consideration. Measurements were taken in centimeter (cm). Measurements were taken early in the morning prior to grazing.

Reference points for the measurements are:

Body length (BDL): The body length of the cattle was measured from the joint of the scapular to the pin bone using a measuring tape

Hip Height (HPH): This was determined using a measuring tape. It is the distance from the platform on which the animals stands to the point of its shoulder.

Heart Girth (HG): The body circumference immediately posterior of the front legs or the body circumference on the fore ribs

Horn length (HL): The distance of the horn using measuring tape rule.

Tail length (TL): The distance from the base to the end of the tail.

Ear length (EL): The distance of the ear using measuring tape.

Thoracic length (THL): The distance length of the neck region from the head to the hump using measuring tape.

STATISTICAL ANALYSIS AND MODEL

After the experiment the data was subjected to ANOVA using Statistical Analysis system (SAS 1990) and significant means were separated by using DUNCAN of the same package.

Correlation

The degrees of correlations between all pair wise metric variables were computed within each sex they were generated using the SASCORR procedure of SAS (1990).

Regression

The linear regression model adopted was:

$Y_{ij} = a + bX + e_{ij}$

where,

Where Yij represents the dependent variable (Body Weight or Linear Measurement) assumed to be random and normally distributed.

'a' represents the intercept of the regression line on the Y-axis and it is the estimate of Y (dependent variable) when X (the independent variable) is Zero. b_i = Regression Coefficients

'b' represents the regression coefficient associated with the independent variable. They represent the amount of change in Y for each unit change in X.
'eij' represents random error about the regression line.

Results

Table 1 summarizes the descriptive statistics of all the variables studied. Mean value of Body Length were longer in female (39.65cm) than in male cattle (33.07cm), similar trend was observed in heart girth and other parameters measured in favour of female subjectively. SD was within the range of 0.75-6.16, SE (0.64-1.41) and all the parameters were generally variable, with highest coefficient of variation observed on HL (58.75%) of male cattle.

Table 1 Means, Standard deviation, Standard Error, Variance, Minimum, Maximum and Coefficient of variation for linear body measurement in the White Fulani cattle.

Trait	Sex	N	Mean (cm)	S D	S E	Var	Min	Max	C V (%)
BDL	F	19	39.65	2.79	0.64	7.83	31.00	44.00	7.05
	M	26	33.07	4.26	0.83	18.15	28.00	43.00	12.88
HG	F	19	57.28	3.71	0.85	13.81	48.50	65.00	6.48
	M	26	48.55	5.98	1.17	35.76	40.00	63.00	12.31
EL	F	19	8.10	0.75	1.17	0.57	7.00	9.00	9.32
	M	26	7.69	0.78	1.15	0.62	6.00	9.00	10.24
HL	F	19	18.92	6.16	1.41	37.95	6.00	29.00	32.55
	M	26	9.73	5.71	1.12	32.68	4.00	25.00	58.75
TL	F	19	36.73	2.80	0.64	7.87	27.00	40.00	7.63
	M	26	32.15	5.08	0.99	25.81	20.00	42.00	15.80
HPH	F	19	49.10	2.80	0.64	7.87	41.00	56.00	5.71
	M	26	46.06	4.52	0.88	20.46	38.00	56.00	9.82
THL	F	19	28.73	3.14	0.72	9.87	18.00	32.00	10.93
	M	26	20.73	3.97	0.77	15.80	16.00	31.00	19.17

N = Number of observation, EL = Ear Length, S D = Standard deviation, HL = Horn Length, S E = Standard Error, TL = Tail length, C V (%) = Coefficient of Variation, HPH = Hip Height, BDL = Body Length, THL = Thoracic Length, HG = Heart Girth, Var = Variance, F = Female , M = Male

Table 2 Shows the T – Test analysis between means of the female and male White Fulani cattle. Significant differences ($p < 0.05$) were in all the means of linear body parameters measured except ear length which showed no significant differences ($P > 0.05$). Female cattle were generally favoured having higher significant values than male counterpart.

Table 2: Summary of T – Test of Mean Difference between Sexes

Trait	Sex	Mean	Significant
Body Length	F	39.66^a	
	M	33.08^b	**
Heart girth	F	57.29^a	
	M	48.56^b	**
Ear Length	F	8.10^a	
	M	7.69^a	**
Horn Length	F	18.92^a	
	M	9.73^b	**
Tail Length	F	36.74^a	
	M	32.15^b	**
Hip Height	F	49.12^a	
	M	46.06^b	**
Thoracic Length	F	28.74^a	
	M	20.73^b	**

NOTE: *Means with the same letter are not significantly different (p>0.05), F = Female, M = Male*

Phenotypic correlation coefficient that described the degree of association within the body measurements were presented in Table 3. The values were generally positive and significant. Values for female are above diagonal while values for male are below. Highest coefficient of correlation in female were observed between BDL and HG (0.7015), BDL and HPH (0.7049), BDL and THL (0.7598), HG and HL (0.7532), HG and HPH (0.8250) while low but positive coefficient of correlation were observed between HG and TL (0.3167), EL and TL (0.2233), HL and HPH (0.0203).

In male, high coefficient of correlation were observed between HG and HL (0.8866), HG and HPH (0.7820), HPH and HL (0.7209), THL and HL (0.8308) while low but positive coefficient of correlation were observed between TL and EL (0.2419), HPH and EL (0.3016). Generally correlation coefficient did not follow any definite pattern within the population.

Table **3 Coefficient of correlation matrix within body measurements in female white Fulani cattle (*Values for female are above the diagonal and those for males below*)**

Variable	BDL	HG	EL	HL	TL	HPH	THL
BDL	1.0000	0.7015***	0.6348***	0.3479^{ns}	0.6564**	0.7049***	0.7598***
HG	0.6261***	1.0000	0.5618**	0.7532***	0.3167^{ns}	0.8250***	0.6134**
EL	0.5494**	0.5087**	1.0000	0.4852*	0.2233^{ns}	0.3610^{ns}	0.4683*
HL	0.6692***	0.8866***	0.5488**	1.0000	0.4567*	0.0203^{ns}	0.4868*
TL	0.6479***	0.6440***	0.2419^{ns}	0.6734***	1.0000	0.4975*	0.6786
HPH	0.6090***	0.7820***	0.3016^{ns}	0.7209***	0.6652***	1.0000	0.6144***
THL	0.6247***	0.5794**	0.5723**	0.8308***	0.5110***	0.5757**	1.0000

NOTE: *EL = Ear Length, HL = Horn Length, TL = Tail length, HPH = Hip Height, BDL = Body Length, THL = Thoracic Length, HG = Heart Girth*

Summary of the linear regression equations and their respective coefficient of determination are as shown in table 4. Various values showed the strength with respect to each body measurement in Body weight determination and it is also presented according to sex.

Table 4 Linear regression equation predicting body weight from linear body measurement in White Fulani cattle

Variable	Sex	N	Equation	R^2	R^2 Adj
HL	F	19	Y = 36.66 + 0.15HL	0.82	0.76
	M	26	Y = 28.22 + 0.49HL	0.64	0.52
EL	F	19	Y = 20.60 + 2.35EL	0.70	0.67
	M	26	Y = 30.79 + 0.29EL	0.70	0.63
HG	F	19	Y = 9.38 + 0.52HG	0.92	0.46
	M	26	Y = 11.41 + 0.44HG	0.89	0.56
TL	F	19	Y = 15.59 + 0.65TL	0.53	0.49
	M	26	Y = 15.60 + 0.54TL	0.41	0.39
HPH	F	19	Y = 5.13 + 0.70HPH	0.69	0.56
	M	26	Y = 6.65 + 0.57HPH	0.67	0.64
THL	F	19	Y = 20.20 + 0.67THL	0.57	0.55
BDL	F	19	Y = 25.59 + 0.65TL	0.83	0.79
	M	26	Y = 18.60 + 0.54TL	0.81	0.70

NOTE: *N = Number of observation, EL = Ear Length, HL = Horn Length, TL = Tail length, HPH = Hip Height, BDL = Body Length, THL = Thoracic Length, F = Female, HG = Heart Girth, M = Male*

DISCUSSION

Mean values of Body measurement studied exhibited sexual dimorphism in favour of Female cattle, this may be due to physiological condition of the Animals as it was not taken into consideration during the conduct of this research work, Females were significantly ($P<0.05$) superior to males in all the body measurement taken, this observation is in line with submission of various workers, Seifemichael *et al* 2014 submitted that the influence of sex on the body weight and some morphometric traits indicate the usual difference between sexes due to hormonal actions leading to differential growth rates. However, values reported for linear body measurement in this study agreed with work of Udeh *et al* 2011 and further established genetic differences as a source of variation in linear body measurement work.

On the contrary, values got by Serkan and Yalcin 2008 in Holstein, Brown swiss and their crossbred were higher than values reported in this study, the differences may be due to genetic composition of the animals as earlier noted by Udeh *et al* 2011.

The correlation is one of the most common and most useful statistical tools that describe the degree of relationship between two variables. Coefficients of correlation observed in this study were positive, strong and

significant; this thus indicates that certain level of positive genetic response to selection can be made in white Fulani cattle in relation to trait studied. Highest coefficient of correlation obtained between BDL and HG, BDL and HPH in this study was in line with reported values in literature, Gunawan and Jakaria reported closed value of coefficient of correlation in Bali cattle. Maiwashe *et al*., 2002 opined that moderate to high correlations coefficients between growth traits suggest that the two pairs of growth traits are influenced by a similar set of genes and selection of one is likely to increase the other which will result in high genetic gain. Alsiddig *et al* 2010 equally reported high coefficient of correlation for hearth girth in Sudan zebu cattle. Dim *et al* 2012 documented a similar high coefficient of correlation for chest girth and body length in their work, this further confirms that these traits have direct relationship with body weight could be easily improved upon by direct selection.

Coefficients of determination obtained for regression equations were also positive and high for most of the parameters studied, HB, BDL, El and HL gave highest coefficient of determination which thus advance the result obtained in literature coefficient of determination in estimation of bodyweight in cattle. Dim *et al* 2012 reported high coefficient of determination for BL , HW and CG. They however reiterated that CG is more reliable which thus conform to the result of this work. It therefore suggests that tissue measurements are better predictor than skeletal measurement. Ladan *et al* 2009 reported similar observation in small ruminant animals, so also Gunawan and Jakaria in Bali cattle. (Rahman, 2007) equally noted that the existence of positive significant correlation of live weight with body measurements justified the use of linear regression for prediction of live weight. Conclusively, result obtained from this can used breeding programmed for improvement of white Fulani cattle in the derived savannah zone of Nigeria.

Conclusion

- Fixed effect of sex is a source of variation for most of the linear body measurement traits studied in white Fulani cattle
- Relationships between linear body measurements are generally positive, strong and significant
- Body weight of white Fulani cattle can be predicted from linear body measurements such as Hip height, Body girth,
- The present findings could be useful in designing scheme and aid selection strategy for improvement of white Fulani cattle in the derived savannah zone of Nigeria.

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