Determining the Association among Body Weight and Morphostructural Traits of White Fulani Cattle

Faith, E.A[1*], Owoeye, A.O[2], Kuje, D.E.A[3], & James, J.A[4]
[1]*Department of Animal Science,
College of Agriculture Lafia,
Nasarawa State, P.M.B. 33 Lafia
[2] Department of Agricultural Education,
Federal College of Education (Technical)
Gusau, Zamfara State,
P.M.B. 1088, Nigeria
[3]Department of Animal Breeding and Physiology,
Federal University of Agriculture,
Makurdi, Benue State,
P.M.B. 2373, Nigeria
[4]Department of Animal Science,
Faculty of Agriculture,
Nasarawa State University,
Keffi, Shabu-Lafia Campus,
P.M.B. 135 Lafia, Nigeria.
[*]Corresponding author: faithelijah2013@gmail.com

ABSTRACT
Body weight and six morphostructural traits: Body length (BL) cm, Head length (HL) cm, Tail length (TL) cm, Height at withers (HW) cm, Ear length (EL) cm and Average horn length (AHL) cm were measured in 100 white Fulani cattle reared in Nasarawa State. This study aimed at determining the association among body weight and morphostructural traits of White Fulani cows. The result of the study revealed that, body weight (BW) is highly and positively correlated with average horn length (AHL) 0.63 and significant (P<0.01). Correlation between BW and BL (0.26), BW and TL (0.25), BW and HW (0.25) at P<0.05 were also significant. Correlation between BW and EL (0.17) were not significant (P<0.01 and P<0.05). This indicates that body weight and ear length does not have any direct phenotypic relationship on the White Fulani cattle investigated. Correlation between BL and HL (0.39) were positive and significant at (P<0.01), BL and HW (0.37) were also significant (P<0.05). Among the morphostructural traits measured, the highest positive correlation was seen between TL and HW (0.52) at (P<0.05) while HL and TL (0.07) at (P<0.01, 0.05) were not correlated. The high variability in the body weight might be due to great environmental factor such as temperature and nutrition on this variable. This variation therefore, could serve as a basis for the genetic improvement of body weight. They could also be used to predict live weight in the field when scales are not readily available especially in villages or smallholder farms.

Key words: *Association, body weight, morphostructural traits, White Fulani, Cattle*

INTRODUCTION

The white Fulani cattle are the most numerous (about 37 %) and wide spread of all the Nigerian cattle breeds. In Nigeria, Friesian sires are the most predominant dairy breed of cattle used in cross breeding the Bunaji cows (Alphonsus, 2010).

However, there is paucity of information on the evaluation of genetic and phenotypic relationship of linear udder and body conformation traits with body weight, body condition score and milk yield of these cattle (Alphonsus, 2010). This information is necessary in the formulation of programme for selection and improvement of dairy cattle and in predicting the direct and correlated responses due to selection.

It is desirable that farmers select their dairy replacement stock at an early age. This is to avoid costs of rearing subsequently unprofitable producers of milk. Dairy farmers are interested in knowing if heifers with higher growth rates also have higher milk yields.

Koul *et al.*, (1985) have reported significant phenotypic correlations between body weight at calving and the milk yield of cows, and on the other hand, reported genetic correlations between performance test values for growth rate and breeding values for milk to be as low as 0.06. Whether measurements are taken at calving or during performance testing, the farmer would have had to wait for a long time before making a decision about replacement stock.

The dairy farming of today placed high demands on both animals and farmers as size of dairy farms grows and the demand to keep labour costs at low levels increases, a high milk yield for each individual cow is required. The possibility to convert body fat reserves into milk is a fundamental function for lactation and in early lactation the daily energy output in milk is larger than energy intake, in this state of negative energy balance; milk production is supported by mobilized body reserves (Bewely and Schuntz, 2008). This period, close after calving is sensitive and the cow extends a higher risk of metabolic disorders that might impair the upcoming lactation as well as disturb fertility (Schroder and Staufenbiel, 2006; Bewely and Schuntz, 2008). For the farmer, impaired fertility as well as diseases contribute to the largest economical losses and cow welfare is seriously affected (von Keyserlingk *et al*., 2009). Technical development of automatic monitoring of herd performance and health is therefore of great interest and it is important to find early indicators of disease (von Keyserlingk *et al*., 2009). For instance, measuring the rate of body weight change has been suggested as a helpful indicator of dairy herd performance (Maltz *et al*., 1997; Kohirumaki *et al*., 2006) as well as estimation of energy content in the body, which can be performed by body condition scoring (BCS) (Schroder and Staufenbiel, 2006). There are potentially large benefits of measuring both body weight and BCS continuously in dairy herds, in order to detect changes of the state of the animal and enable suitable changes in management in time to avoid impaired production.

However, sufficient frequency of body weight measurements and body condition scoring are not easy to accomplish; body weight is often measured using a scale that the cows walk through which can be stressful for the animals as well as labour intensive for the farmer. Furthermore, the use of the output data from body weight measurements is often poor and not integrated into herd management software. Also body weight data does not tell anything about the composition of the body, which BCS might do. BCS also involves high labour costs and it may even be hard to score the cows as often as necessary to obtain sufficient information that can be used in herd management. This study therefore aimed at determining the association among body weight and morphostructural traits of White Fulani dairy cattle.

Statement of problem

The dairy farming of today placed high demands on both animals and farmers as size of dairy farms grows and the demand to keep labour costs at low levels increases, a high milk yield for each individual cow is required. The possibility to convert body fat reserves into milk is a fundamental function for lactation and in early lactation, the daily energy output in milk is larger than energy intake, in this state of negative energy balance milk production is supported by mobilized body reserves and therefore associating body weight and other morphostructural traits to dairy production in cattle could be very stressful and difficult to local farmers.

MATERIALS AND METHODS

Study Location

This experiment was carried out at the Livestock Complex Unit of College of Agriculture, Lafia Modern Abattoir and Shinge market Lafia, Nasarawa State, Nigeria and lies between latitude 8.4917^{o}N and longitude 8.5167^{o}E (Wikipedia, 2015). It falls within the guinea savannah zone with the total population of 330, 712 (National Population Census, 2006). It has a total land area of 27,117km^{2} (10,470 square miles).

Data Collection

Data were obtained from 100 cattle of the indigenous white Fulani breed in College of Agriculture Livestock Complex Unit, Lafia Modern Abattoir and Shinge market Lafia, Nasarawa State, Nigeria. The animals used were within the age range of 2 to 4 years. The cows were reared under semi-intensive system. They were released early in the morning for grazing and returned late noon in which supplemental feed (concentrates/hay and forages) were provided. The age of the dairy cattle were determined from the available records provided by the livestock keepers and where information was missing, the age was estimated using dentition, by counting the number of permanent incisors that had erupted on the lower jaw of the mouth as described by Matika *et al.*, (1992). Body weight (BW) and six morphostructural traits as defined by Brown *et al*., (1973) were taken on restrained animals on a plane ground; Body length (BL) cm, Head length (HL) cm, Tail length (TL) cm, Height at withers (HW) cm, Ear length (EL) cm and Average horn length (AHL) cm respectively.

Body weight (BW) :- The animal body weight were taken by allowing them to pass through the weighing bridge.

Body length (BL):- Is measured as the distance between the points of shoulder to the pin bone.

Head length (HL):- Is measured as the distance between the muzzle base and the fore head.

Tail length (TL):- Is taken as the distance from the base of the tail (point of attachment to the body) to the tip of the tail.

Height at withers (HW):- Is taken as the vertical distance from the ground while the animal is standing on a fixed position to the highest point of the mane or withers.

Ear length (EL):- Is measured as the distance from the base of the ear to the tip of the ear.

Average horn length (AHL):- Is taken as the distance from the tip of the horn to the point of curvature where it joined the skin on the head.

The BL, HL, TL, EL and the AHL were measured by the use of flexible tape rule while the HW was measured using graduated measuring stick.

Statistical analysis

Statistical packages for social sciences (SPSS 17.0) were used for this analysis. Descriptive

statistics were computed such as mean, standard deviation, standard error and coefficient of variability (CV) for Body Weight (BW), Body length (BL), Head Length (HL), Tail Length (TL), Height at withers (HW), Ear length (EL) and Average horn length (AHL) respectively.
The Pearson's correlation coefficients were used to assess the association between BW, BL, HL, TL, HW, EL and AHL.

RESULTS AND DISCUSSIONS

Results

Table:1. Descriptive statistics of the body weight and morphostructural traits of White Fulani Cattle

Traits	Mean	SD	SEM	MIN	MAX	CV%
BW (kg)	324.11	62.54	7.47	38.00	410.00	19.30
BL (cm)	86.03	9.01	1.08	44.00	98.00	10.47
HL (cm)	48.61	3.18	0.38	42.00	55.00	6.54
TL (cm)	93.57	9.98	1.19	68.00	120.00	10.67
HW (cm)	124.43	5.26	0.63	110.00	138.00	4.24
EL (cm)	20.99	1.30	1.16	17.00	24.00	6.19
AHL(cm)	39.27	12.24	1.46	14.00	58.00	31.17

SD= Standard deviation; SEM= Standard error of mean, CV= Coefficient of variability, BW=body weight, BL= body length, HL= head length, TL= tail length, HW= height at withers, EL= ear length and AHL= average horn length.

Table.2: Pearson correlation coefficient of body weight and morphostructural traits of white Fulani Cattle

TRAITS	BL	HL	TL	HW	EL	AHL
BW	0.26^{*}	0.54^{**}	0.25^{*}	0.25^{*}	0.17^{NS}	0.63^{**}
BL		0.39^{**}	0.30^{*}	0.37^{**}	0.30^{*}	0.24^{*}
HL			0.07^{NS}	0.35^{**}	0.01	0.38^{**}
TL				0.52^{**}	0.36^{**}	0.51^{**}
HW					0.38^{**}	0.40^{**}
EL						0.32^{**}

** Significant at 0.01 (P<0.01) * Significant at 0.05 (P<0.05)
NS= not significant at (P<0.01 and P<0.05) , BW=body weight, BL= body length, HL= head length, TL= tail length, HW= height at withers, EL= ear length and AHL= average horn length.

The descriptive statistics for the body weight and morphostructural traits were presented in Table 1.
The mean value scores for the morphostructural traits were body weight (324.11kg), body length (86.03cm), head length (48.61cm), tail length (93.57cm), height at withers (124.43cm), ear length (20.99cm) and average horn length (39.27); the standard deviation of the body weight,

body length, head length, tail length, height at withers, ear length and average horn length measurements were 62.54, 9.01, 3.18, 9.98, 5.26, 1.30, 12.24; standard error of the mean were 7.47, 1.08, 0.38, 1.19, 0.63, 1.16 1.14 while the coefficient of variability (CV) were 19.30%, 10.47%, 6.54%, 10.67 %, 4.23%, 6.19% and 31.17% respectively. The minimum and the maximum mean were also presented in table 1. The result of the Pearson correlation coefficient which estimates the relationship among body weight (BW), BL, HL, TL, HW, EL and AHL is presented in table 2.

Discussions

In early lactation, the energy needed for milk production exceeds the daily energy intake. Body fat reserves are mobilized to compensate the lack of sufficient nutritional intake needed to maintain the high milk production (Bewely and Schuntz, 2008).

The composition of the dairy cow body is in constant change because of the adaptations to lactation and pregnancy. Variation in body water content is positively correlated to lactation stage as well as milk yield, and their relationship is linear (Yan *et al*., 2009). The variation in water content in the body is greater for pre partum and early lactation cows than for late lactation cows (Andrew *et al*., 1994; Yan *et al*., 2009). Yan *et al*. (2009) suggests that more water is stored in the body of high yielding cows due to higher dry matter intake, compared with cows with a lower milk yield. For very thin cows, changes in amount of water in tissue, e.g. dehydration, could be mistaken for change of body protein or fat (Otto *et al.*, 1991).

The present values on withers height, body length and tail length are consistent with the report of *Kawu et al*., *(2006)*, and also confirm the large body size nature of bunaji dairy cattle Kunene *et al*., (2007).

The result indicated that body weight (BW) is highly positively correlated with average horn length (AHL)0.63 and significant($P<0.01$). Correlation between BW and BL (0.26), BW and TL (0.25), BW and HW (0.25) at $P<0.05$ were significant and conformed with the report of Ojedapo *et al., (2000.)*

Correlation between BW and EL (0.17) was not significant ($P<0.01$ and $P<0.05$) and very low. This indicates that body weight and ear length does not have any direct relationship on the White Fulani cattle investigated. Correlation between BL and HL (0.39) was positive and significant at ($P<0.01$), BL and HW (0.37) was also significant ($P<0.05$). Among the morphostructural traits observed, the highest positive correlation were seen between TL and HW (0.52) at ($P<0.05$) while from the other traits, HL and TL (0.07) at ($P<0.01, 0.05$) were not correlated as reported by Ojedapo *et al., (2000.)*

According to Woods *et al*. (2005) the feeding regime only affects the weight of the gastrointestinal tract. Wood *et al*. (1980) suggested that body weight is affected by output e.g. changes in body weight are substantially reflected by increasing milk yield. Contrary, Korver *et al*. (1985) did not find any effect on body weight change with regard to the genetic potential for milk production capacity. Overall, the body weight at calving has a positive correlation with weight loss during lactation but there is however a large individual variation (Touchberry and Batra, 1975; Koenen *et al*., 1999).

The high variability in the body weight might not be unconnected with great environmental influence such as temperature and nutrition on this variable. This variation therefore, could serve as a basis for the genetic improvement of body weight.

They could also be used to predict live weight in the field when scales are not readily available especially in villages or smallholder farms.

Conclusion

Simple phenotypic correlations revealed that body weight was positively and highly correlated with average horn length (AHL) and head length (HL) compared to withers height, body length and tail length where as Ear length has no significant direct effect on the body weight.

Based on the information obtained from this study it could be inferred that body weight and other morphostructural traits such as BL, HL, TL, HW and AHL could jointly be used to assessed the performance of the white Fulani cattle in terms of conformation and stature during selection and breeding programmes.

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