# Genetic and Non Genetic Sources of Variation for Linear body Conformation Traits in Bunaji and Friesian X Bunaji cows

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## ABSTRACT

*The effects of Age of dam at calving, Sex of calf, Breed, Sire, month of calving and season of lactation on linear body conformation traits was investigated in the dairy herd of the National Animal Production Research Institute, Shika Zaria, Nigeria. Seven linear body conformation traits of 25 Bunaji and 25 crossbred (Friesian x Bunaji) cows were measured. The measurements were taken monthly by 3 evaluators for the complete lactation length of the cows, this resulted in 1275 cumulative records, (with 750 records from Friesian x Bunaji and 525 records from Bunaji). The 7 body conformation traits (stature, chest width, wither height, heart girth, body length, body depth and rump width) were measured in centimeter using flexible tape. The results showed that all the genetic and non genetic factors considered had significant effect (P<0.05) on the linear body conformation traits. However, there was no significant (P>0.05) variation amongst the evaluators in their measurements, except RW. The body size characteristics increased with age. The male bearing cows were relatively broader (CW, HG) and longer (BL) than the female bearing cows, though there was no significant difference (P>0.05) in their statures (ST) and the body depth (BD). The crossbred cows were taller (ST, HW) longer (BL), broader (CW, HG), but less deep (BD) than the pure Bunaji. The animals of season 1 were taller (ST, WH), deeper (BD) and longer (BL) than the others. However, animals of season 2 and 3 had similar body sizes (ST, CW, BD, WH, HG, BL and RW). It is therefore suggested that in selecting for body conformation these genetic and non genetic factors should be taken into consideration.*

**Key words**:  Friesian x Bunaji, linear body conformation, evaluators, breed, sire

## INTRODUCTION

Body conformation is determined by genetic and non genetic factors. The genetic make up of the individual includes additive and non additive genetic combinations that determine growth, these combination interact with both intrinsic factors such as sex, age, physiological status as well as other extrinsic factors such as maternal effect and random

environmental factors to determine the ultimate phenotypic expression of growth (Arango and Vanvleck, 2002). Linear body measurements taken on live animals have been widely used in research work as a simple means of recording certain aspect of animal growth and shape. Most of linear measurements reflect primarily the length of the long bones of the animal. They indicate when taken sequentially over a period of time, the way in which the animals' body changes in shape, and have been used as a predictor of both animal live weight and carcass composition (Lawrence and fowler, 1998). Linear measurement can be used in assessing growth rate, weight, feed utilization and carcass characteristic in farm animals (Brown,*et al.,* 1972). The importance of body size to efficiency has led to traits associated with size, mass and dimension (such as mature weight, mature height and body measurements) being included in breeding and selection objectives for crossbreeding plans (Arango and Vanvleck,2002). Information on the effects of these genetic and non genetic factors on body conformation traits would help in making appropriate breeding decision.

This study therefore, evaluates the effects of some genetic and non genetic factors on linear body conformation traits of Bunaji and Friesian X Bunaji cows.

## MATERIALS AND METHODS

### Location

The study was conducted on the dairy herd of the National Animal Production Research Institute (NAPRI) Shika, Nigeria, located between latitude $11^0$ and $12^0$N at an altitude of 640m above sea level, and lies within the northern guinea savannah zone (Oni *et al.,* 2001). The mean annual rainfall in this zone is 1,100m which commence from May and last till October, of which 90% falls during the wet rainy season (June  September). Following the wet season is a period of dry, cool weather called harmattan, which marks the onset of the dry season, this extends from mid  October to January. The dry season (February  May) is characterized by very hot weather conditions. At this period daily temperature range from $21^0$C to $36^0$C, the mean relative humidity is 21 and 72% during "harmattan" and the rainy season respectively (Malau Aduli and Abubakar, 1992).

### Animals and their Management

The animals were raised during the rainy season on paddocksown pasture. While hay or silage supplemented with concentrate of undelinted cotton seed cake, were offered during the dry season. They had access to water and salt lick *ad-libitum*. The animals were maintained on paddock according to sex and physiological status. Unrestricted grazing was allowed under the supervision of the herdsmen for about 7  9 hour per day. Routine spraying against ticks and other ecto-parasites was observed, while vaccination was carried out against endemic diseases.

### Measurements of the Body Conformation Traits

Seven linear body conformation traits of 25 Bunaji and 25 crossbred (Friesian x Bunaji) cows were measured between year 2007 and 2008. The 7 body conformation traits

(stature, chest width, wither height, heart girth, body length, body depth and rump width) were measured in centimeter using flexible tape. The measurements were taken by 3 evaluators for the complete lactation length of the cows. Each evaluator was able to take 10 repeated measurements on each of the Friesian x Bunaji, and 8 repeated measurements on each of the Bunaji cows due to there relatively short lactation length,(average 250 days). The data collected by the three evaluators from the 50 cows resulted in 1275 cumulative records (with 525 records from the Bunaji and 750 records from the Friesian x Bunaji). The cows were artificially mated using artificial insemination techniques (A.I) and were checked 30 days later for non return (Conception). Following parturition, the body conformation traits were measured monthly for the complete lactation length of the cows, commencing 3 4 days post-partum. All measurements were taken immediately before the morning milking while locked in the milking parlour. The Bunaji calves were allowed to run with their dams until weaning at the age of 12weeks while the cross-bred calves were weaned and bucket fed 3 4 days post partum, after calves must have taken the colostrums.

## Methods of Measurements of Body Conformation Traits
**Stature(ST):** Measured from top of the spine in between hips to ground
**Height-at-Withers (HW):** Highest point over the scapulae vertically to the ground or measured from the highest point on the dorsum of the animal to the ground surface at the level of front legs.
**Heart Girth (HG):** Measured as a circumference of the body at a point immediately behind the fore legs, perpendicular to the body axis
**Chest Width (CW):** Measured from the inside surface between the top of the front legs.
**Body Depth (BD):** Distance between the top of spine and bottom of barrel at last rib, the deepest point independent of stature.
**Body Length (DL):** Measured from the point of shoulder to the ischium.
**Rump Width (RW):** The distance between the most posterior points of pin bones

## Fixed Factors
The fixed factors that were considered are: age of dam at calving, evaluators, sex of calf, sire, breed, month of calving, and season of lactation. The seasons were grouped into four (4) according to the weather pattern as follows: Season 1: January March (late dry); Season 2: April June (Early wet); Season 3: July September (Late wet); Season 4: October December (early dry)

## Statistical Analysis
The fixed effects for each body conformation traits were analyzed by least squares techniques using the general linear model procedure of SAS (SAS, 1999). The statistical analysis was based on the general linear model:

$$Y_{ijklmno} = \mu + A_i + B_j + E_k + M_l + S_n + X_o + Z_p + e_{ijklnop}$$

Where $\mu$ = OveRall Mean

$A_i$ = fixed effect of $i^{th}$ age (i : 4, 5--, 11)

$\quad\quad$ $B_j$ = fixed effect of $j^{th}$ Breed (j : Bunaji and Friesian x Bunaji)

$\quad\quad$ $E_k$ = fixed effect of $k^{th}$ evaluators (k: 1, - 3)

$\quad\quad$ $M_l$ = fixed effect of $l^{th}$ month of calving (l: January - June)

$\quad\quad$ $S_n$ = fixed effect of $n^{th}$ Season of lactation (n : 1--- 4)

$\quad\quad$ $X_o$ = fixed effect of $o^{th}$ Sex of calf (o = male or female)

$\quad\quad$ $Z_p$ = fixed effect of $p^{th}$ sire (p = 1, 2, - - - 6)

$\quad\quad$ $e_{ijklnop}$ = random residual error effect.

## RESULTS AND DISCUSSION

$\quad\quad$ The Mean, Coefficient of Variation (CV), Standard Deviation (SD), Minimum and Maximum Values for Body Measurement is shown in Table 1. The body conformation traits measured were less variable, the CVs ranged from 2.74 % (BL) to

**Table 1: Summary Statistic of Linear Body Measurements**

| Traits* (cm) | Mean ±SE | SD | CV | Minimum | Maximum |
|---|---|---|---|---|---|
| Stature | 128.04±0.17 | 4.26 | 3.32 | 118.00 | 140.00 |
| Chest width | 23.49±0.08 | 2.10 | 8.94 | 18.00 | 27.00 |
| Body depth | 99.30±0.25 | 4.29 | 4.32 | 92.00 | 112.00 |
| Height at withers | | 7.16 | 5.73 | 125.00 | 137.00 |
| Heart girth | 173.15±0.21 | 8.28 | 4.78 | 154.00 | 199.00 |
| Body length | 121.65±0.23 | 3.33 | 2.74 | 114.00 | 128.00 |
| Rump width | 17.52±0.06 | 1.04 | 5.94 | 16.00 | 21.00 |

**Effects of Evaluator**

The least square means of the effects of evaluators and number of lactations is shown in Table 2. The effect of the evaluators on the body measurements was not significant (P>0.05) except RW. This indicates that the evaluators had uniform technique in the measurements of the body conformation traits, except RW, probably due to the difficulty in identifying the pin bones in the fat cows.

**Table 2: Least Squares Means of Effect of Evaluators on Linear Bbody Conformation Traits**

| Measurements (cm) | Evaluators | | | P-value |
|---|---|---|---|---|
| | $E_1$ | $E_2$ | $E_3$ | |
| | Mean± SE | Mean ± SE | Mean ± SE | |
| Stature | 133.83±0.16 | 133.85±0.16 | 133.83±0.15 | NS |
| Chest width | 25.19±0.08 | 25.20±0.09 | 25.20±0.09 | NS |
| Body depth | 103.78±0.62 | 103.78±0.61 | 103.77±0.62 | NS |
| Height at withers | 130.09±0.16 | 130.10±0.16 | 130.09±0.16 | NS |
| Heart girth | 177.17±0.21 | 178.15±0.20 | 177.18±0.19 | NS |
| Body length | 125.87±0.60 | 125.88±0.60 | 125.85±0.61 | NS |
| Rump width | 18.72±0.21 | 19.01±0.22 | 18.80±0.22 | * |

E1, E2 and E3 = Evaluator one, two and three, respectively; 1,2,3 = first, second and third lactation; * P<0.05,

**Effects of Age**

Generally, the effect of age on body conformation traits, was significant (P<0.05) as shown in Table 3.Although there was no definite trend of relationship but the older cows (10 to 11 years old) were bigger in size (ST, WH, BD, HG) than the younger. However, the 10 year old cows were relatively taller (ST, WH) with broader CW and HG, and longer body (BL), but less deeper (BD) than the 11 year old cows. The increase in body size characteristics with age observed in this study is supportive of the previous reports on dairy cows (Kadarmideen, 2004), Yankasa sheep (Akpa *et al.,* 2006) and Goats (Akpa *et al.,* 1998). However, the present results seem to define a limit to such increasing relationship in cows, since the increasing relationship peaked at the 10th year and started declining. This observation needs further investigation. Other authors like Wenzhong *et al.,* (2005); Maiwashe *et al,*(2002) and Sebhatu *et al,* (1994) also reported significant influence of age of dam on the body size characteristics. The significant effect of age on the body size characteristics shows that age is a major determinant of growth and physiological development of the animals. It also indicates that the physiological and morphological growth of the animals go concurrently with age. However, such growth usually decreases with advanced age of the animal.

**Table 3: Least Square Means and Standard Error for Effect of Age on Body Conformation**

| Age (Years) | N | ST(cm) | CW(cm) | BD(cm) | HW(cm) | HG(cm) | BL(cm) | RW(cm) |
|---|---|---|---|---|---|---|---|---|
| 3 | 172 | $122.83\pm0.16^e$ | $21.19\pm0.08^{cd}$ | $97.77\pm0.25^{cd}$ | $121.12\pm0.16^d$ $\pm$ | $166.57\pm0.21^d$ | $118.32\pm0.23^d$ | $17.41\pm0.06^{cd}$ |
| 5 | 196 | $124.00\pm0.20^{de}$ | $21.69\pm0.24^{cd}$ | $98.00\pm0.18^c$ | $120.46\pm0.81^e$ | $164.13\pm0.20^d$ | $119.00\pm0.20^d$ | $17.25\pm0.14^{de}$ |
| 6 | 155 | $125.07\pm0.38^d$ | $22.68\pm0.21^b$ | $98.36\pm0.34^c$ | $122.03\pm0.38^{cd}$ | $172.69\pm0.93^{bc}$ | $119.64\pm-.30^{cd}$ | $17.11\pm0.08^{de}$ |
| 7 | 147 | $125.75\pm0.25^d$ | $22.38\pm0.26^{bc}$ | $97.81\pm0.25^c$ | $122.67\pm0.28^{cd}$ | $174.17\pm0.15^{bc}$ | $120.25\pm0.48^{bc}$ | $16.75\pm0.17^e$ |
| 8 | 150 | $128.77\pm0.39^c$ | $22.46\pm0.22^{bc}$ | $99.63\pm0.20^{bc}$ | $126.12\pm0.35^b$ | $177.00\pm0.54^b$ | $120.08\pm0.60^{bc}$ | $18.61\pm0.21^b$ |
| 9 | 165 | $130.03\pm0.78^{bc}$ | $23.13\pm0.25^b$ | $103.78\pm0.61^b$ | $127.45\pm0.77^b$ | $177.05\pm1.63^b$ | $121.87\pm0.42^b$ | $17.97\pm0.19^c$ |
| 10 | 150 | $135.77\pm0.34^a$ | $24.15\pm0.60^a$ | $103.23\pm0.36^b$ | $133.46\pm0.33^a$ | $189.76\pm2.30^a$ | $123.50\pm0.24^a$ | $19.54\pm0.22^a$ |
| 11 | 140 | $132.00\pm0.17^b$ | $24.12\pm0.24^a$ | $106.88\pm0.43^a$ | $129.12\pm0.17^a$ | $179.00\pm0.72^{ab}$ | $118.76\pm0.29^{cd}$ | $17.53\pm0.05^{cd}$ |

[a, b, c, d, e] Means in the same column with different supper scripts differs significantly (P<0.05) N Number of records

## Effects of Sex, Breed and Sire

The LSMs for the effect of sex, breed and sire on body conformation is presented in Tables 4. Sex of calf had significant effect (P<0.05) on the body conformation traits except ST, BD and HW. The male bearing cows were relatively broader (CW, HG) and longer (BL) than the female bearing cows, though there was no significant difference (P>0.05) in their height (ST; WH) and the body depth (BD). Sex differences has also been reported in cattle ( Alade,1990; Essien and Adesope, 2003)  Breed had significant effect (P<0.05) on body conformation traits. The crosses (Friesian x Bunaji) were taller (ST, HW) longer (BL), broader (CW, HG), but less deeper (BD) than the pure Bunaji. The significant effect of breed on the body conformation traits is an indication that the percentage of Friesian genes in the cross bred cows (Friesian x Bunaji) had significant effects on the conformation traits. There was significant effect (P<0.05) of sire on the body conformation traits, although no definite trend could be established. However, cows of sire 2 were taller (ST, WH) deeper (BD) and broader (HG), while cows from sire 6 were broader (CW) and longer (BL). The significant effect of sire on the body conformation traits indicates that appropriate breeding plan that will ensure the use of proven sire in the dairy herd combined with good mating system will yield good results.

**Table 4: Least Squares Means and Standard Errors for Body Conformation Traits by Sex, Breed and Sire**

| Sex of Calf | N | ST(cm) | CW(cm) | BD(cm) | HW(cm) | HG(cm) | BL(cm) | RW(cm) |
|---|---|---|---|---|---|---|---|---|
| Male | 679 | 127.92±0.25 | 23.82±0.13[a] | 98.99±0.25 | 124.58±0.57 | 173.99±0.43[a] | 122.05±0.24[a] | 17.39±0.06[b] |
| Female | 616 | 128.92±0.39 | 23 | 99.70±0.39 | 125.71±0.38 | 172.05±0.79[b] | 121.13±0.23[b] | 17.69±0.09[a] |
| **Breed** | | | | | | | | |
| Bunaji | 525 | 127.40±0.43[b] | 22.12±0.25[b] | 100.66±0.91[a] | 124.20±0.09[b] | 172.34±0.21[b] | 120.13±0.33[b] | 17.61±0.32[a] |
| F x B | 750 | 128.83±0.08[a] | 25.19±0.31[a] | 97.63±0.12[b] | 126.12±0.19[a] | 174.17±0.12[a] | 123.52±0.21[a] | 17.41±0.12[a] |
| **Sire** | | | | | | | | |
| 1 | 222 | 124.88±0.41[e] | 22.51±0.13[c] | 98.29±0.54[c] | 120.65±0.20[e] | 166.14±0.46[d] | 119.35±0.41[d] | 17.13±0.16[d] |
| 2 | 197 | 132.90±0.38[a] | 22.55±0.34[c] | 102.05±0.74[a] | 130.12±0.69[a] | 183.98±0.54[a] | 121.57±0.21[c] | 18.38±0.25[a] |
| 3 | 186 | 127.57±0.74[d] | 22.31±0.22[c] | 102.77±0.56[a] | 125.31±0.48[d] | 182.92±0.14[a] | 121.58±0.58[c] | 19.07±0.39[a] |
| 4 | 206 | 127.33±0.53[d] | 20.96±0.18[d] | 103.71±0.36[a] | 125.65±0.96[a] | 168.53±0.09[d] | 119.61±0.45[d] | 17.09±0.43[d] |
| 5 | 219 | 128.07±0.26[c] | 24.95±0.30[b] | 96.36±0.44[d] | 126.55±0.36[c] | 173.19±0.19[c] | 122.34±0.34[b] | 17.29±0.34[c] |
| 6 | 245 | 130.18±0.34[n] | 25.63±0.56[n] | 99.87±0.18[d] | 127.11±0.22[b] | 175.90±0.30[b] | 125.61±0.51[a] | 17.79±0.25[c] |

[a, b, c, d] Means in the same column with different supper scripts differs significantly (P<0.05) N Number of records

**Effects of Month and Season of Lactation**

The LSM for the effect of month of calving and season of lactation on the body conformation traits is shown in Table 5. Month of calving had significant effect (P<0.05) on all the body conformation traits measured. The effect of month of calving on the body conformation is usually related to the stages in the wet and dry weather cycle at which an animal reaches a given age; and relative rankings of month of calving groups might be expected to change from stage to stage. (FAO,2008). Also the season of lactation had significant effect (P<0.05) on the body conformation traits with the animals of season 1 being taller (ST, WH), deeper (BD) with longer body (BL) than the others. However, animals of season 2 and 3 had similar body sizes (ST, CW, BD, WH, HG, BL and RW). The significant effect of season on the conformation traits is in agreement with the earlier observations of Akpa *et al*; (2006) and Gebeyehu *et al.* (2007). However, this result is contrary to the observation of Nsoso *et al.* (2003) that BW and HG were not apparently sensitive to effect of season. The significant effect of month of calving and season of lactation showed that there is a high contribution of the environment to the growth and development of the body conformation traits. Thus, poor management and other environmental stress may affect the efficient growth of the cows.

**Table 5: Least Squares Means and Standard Error for Body Conformation Traits by Month of Calving and Season of Lactation**

| Month Of calving | N | ST(cm) | CW(cm) | BD(cm) | HW(cm) | HG(cm) | BL(cm) | RW(cm) |
|---|---|---|---|---|---|---|---|---|
| January | 250 | 130.35±0.58[a] | 24.00±0.58[a] | 100.77±0.52[ab] | 128.03±0.53[a] | 181.68±0.81[a] | 123.85±0.29[a] | 18.10±0.15[a] |
| February | 269 | 125.47±0.21[b] | 21.35±0.43[b] | 99.36±0.38[bc] | 122.76±0.24[ab] | 165.18±1.60[d] | 122.76±0.44[a] | 16.76±0.20[d] |
| April | 272 | 126.86±0.22[b] | 24.52±0.09[a] | 96.23±0.19[d] | 124.24±0.25[bc] | 170.10±0.29[c] | 119.22±0.14[b] | 17.31±0.07[b] |
| May | 226 | 129.50±0.33[a] | 23.91±0.25[a] | 101.47±0.45[a] | 126.57±0.32[cd] | 173.89±0.34[b] | 122.93±0.39[a] | 17.60±0.08[b] |
| June | 258 | 125.29±0.39[b] | 21.40±0.13[b] | 98.67±0.33[c] | 120.78±1.56[d] | 166.93±1.02[d] | 120.15±0.29[b] | 17.10±0.09[c] |
| **Season Of Lactation** | | | | | | | | |
| 1 | 381 | 132.31±0.81[a] | 23.61±0.26[b] | 102.73±0.75[a] | 130.17±0.72[a] | 184.93±1.15[a] | 122.98±0.37[a] | 18.69±0.19[a] |
| 2 | 311 | 127.29±0.32[b] | 23.45±0.22[b] | 98.51±0.37[bc] | 124.56±0.30[b] | 171.34±0.05[b] | 121.32±032[b] | 17.19±0.09[c] |
| 3 | 280 | 127.12±0.24[b] | 23.18±0.16[b] | 99.09±0.28[b] | 123.66±0.74[b] | 170.79±0.48[b] | 121.36±0.25[b] | 17.24±0.05[c] |
| 4 | 303 | 127.67±0.50[b] | 24.45±0.24[a] | 97.74±0.40[c] | 124.64±0.51[b] | 171.00±0.91[b] | 121.75±0.53[b] | 17.75±0.09[b] |

[a, b, c, d] Means in the same column with different supper scripts differs significantly (P<0.05) N Number of records

## CONCLUSION

Findings of this study revealed that linear body conformation traits of Bunaji and Bunaji crossbred were predominantly influenced by age, sex of calf, breed and sire, month of calving and season of lactation. It is therefore suggested that in selecting for body conformation traits these factors should be taken into consideration.

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