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Comparative evaluation of Linear Udder and Body Conformation Traits of Bunaji and Friesian X Bunaji Cows

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ABSTRACT [ENGLISH/ANGLAIS]

Fourteen linear conformation traits couple with body weight (BW) and body condition score (BCS) of 25 Bunaji and 25(F_1) Friesian - Bunaji crossbred cows were measured. The 14 linear conformation traits comprised of 7 body conformation traits; stature (ST), chest width(CW), wither height(WH), heart girth(HG), body length(BL), body depth (BD) and rump width(RW) and 7 udder conformation traits ; rear udder height(RUW), rear udder width(RUW), udder depth(UD), udder cleft(UC), fore teat position(FTP), rear teat placements(RTP) and teat length(TL). The mean values of the traits measured showed that the crossbreds were on average taller (129.83cm ST; 126.12cm WH), broader (25.19cm CW; 174.17cm HG), longer (123.52cm BL) and heavier (391.08kg BW) than the pure Bunaji; Height (127.40cm ST; 124.20cm WH), Width (22.12cm CW, 172.34cm HG), Length (120.13cm BL) and Weight (321.08kg BW). However, the pure Bunaji were deeper (100.65cm BD) with better body condition (3.32) than the crossbred whose body depth and BCS were 97.63cm and 3.15, respectively. The crosses had larger udder size (19.18cm RUW; 24.33cm RUH) with longer teats (5.17cmTL) and teats sets that were closer at the rear (4.92cm RTP) and further at the front view (9.75cm FTP) than the pure breeds whose udder size (RUW, RUH), teat length (TL) and teat placement (RTP and FTP) were 18.83cm, 18.48cm, 4.62cm 5.18cm, and 8.64cm, respectively. The means values of crossbreds generally exceeded means of the purebreds for BW and linear body measurements indicating the genetic influence of the Friesian sire on the growth and performance of their offspring.

Keywords: Bunaji, Friesian x Bunaji, udder and body conformation, repeatability

RÉSUMÉ [FRANÇAIS/FRENCH]

Quatorze conformation linéaire quelques traits avec le poids corporel (BW) et note d'état corporel (BCS) du 25 Bunaji et 25 (F1) Frison - vaches de races croisées Bunaji ont été mesurés. Les 14 traits de conformation linéaires composées de 7 caractères de conformation du corps; stature (ST), largeur de poitrine (CW), la hauteur au garrot (WH), le périmètre thoracique (HG), la longueur du corps (BL), la profondeur du corps (BD) et la largeur croupe (RW) et 7 caractères de conformation du pis; arrière hauteur du pis (RUW), la largeur du pis arrière (RUW), la profondeur du pis (UD), la mamelle fente (UC), position du trayon avant (FTP), arrière placements tétine (RTP) et la longueur des trayons (TL). Les valeurs moyennes des caractères mesurés ont montré que les croisés étaient en moyenne plus grands (129.83cm ST; 126.12cm WH), plus large (25.19cm CW; 174.17cm HG), plus (123.52cm BL) et plus lourd (391,08 kg BW) que le pur Bunaji; Hauteur (127.40cm ST; 124.20cm WH), Largeur (22.12cm CW, 172.34cm HG), Longueur (120.13cm BL) et poids (321,08 kg BW). Toutefois, le pur Bunaji étaient plus profondes (100.65cm BD) avec un meilleur état corporel (3,32) que le croisement dont le corps profondeur et BCS étaient 97.63cm et 3,15, respectivement. Les croix avaient une taille plus grande mamelle (19.18cm RUW; 24.33cm RUH) avec de plus longues tétines (5.17cmTL) et des ensembles de tétines qui étaient plus près à l'arrière (4.92cm RTP) et encore à la vue de face (9.75cm FTP) que le pur races dont la mamelle taille (RUW, RUH), longueur des trayons (TL) et le placement des trayons (RTP et FTP) étaient 18.83cm, 18.48cm, 4.62cm 5.18cm, 8.64cm et, respectivement. Les moyens des valeurs de croisements généralement dépassé les moyens de les pur-sang pour BW et mensurations linéaires indiquant l'influence génétique du géniteur frison sur la croissance et la performance de leur progéniture.

Mots-clés: Bunaji, Frisonne x Bunaji, la mamelle et la conformation du corps, la répétabilité

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INTRODUCTION

There are few distinct dairy breeds of cattle in the tropics. Although no tropical breed can be seen as a specialized dairy type, they are only considered as such because they produce more milk than others; hence some breeds are preferred for milk production. Many breeds are dual purpose or multi-purpose and fulfill a variety of roles as producers of milk, draught power, meat, dung and hides.

No breed is suited to all circumstances, where there is a choice; farmers must find the breed most suitable to the environmental conditions and husbandry favourable to their animals. The white Fulani (Bunaji) is the most numerous and wide spread of all the Nigerian cattle breeds. It represents about 37% of the National cattle population. The white Fulani as a breed of cattle has been comprehensively reviewed by Tawah and Rege [1]. The main limiting factors of these tropical breed of cattle as it relates to milk yield include: late sexual maturity, long interval between calving and short lactation length. The white Fulani cattle are however, important for their genetic predisposition of disease resistance, hardiness, heat tolerance and adaptation to local conditions.

The main strategies for increasing milk production in the tropical cattle have been dominated by the superiority in additive genetic merit for milk yield of temperate breeds over tropical breeds, hence cross breeding as a tool for blending the adaptability of indigenous breeds of cattle in the tropics with high yield of Temperate breeds of dairy cattle is well documented [2,3]. First generation cross bred generally have been reported [2]to yield twice that of the indigenous pure breeds, as a result, temperate breeds have been introduced to many parts of the tropics and cross breeding has produced a number of stabilized cross bred. At the same time, there is an increasing interest in the preservation of indigenous breeds and their improvement by selection, but such work can go parallel with the improvement by the introduction of temperate sires. In Nigeria, Friesian sires are the most predominant dairy breed of cattle used in cross breeding the Bunaji cows. Evaluation of the conformation and production traits of these indigenous genotypes and their crosses will provide a valuable information that will help the dairy breeders to formulate breeding and management programme.

Therefore, the objective of this study was to comparatively evaluate the linear udder and body conformation traits of pure Bunaji and Friesian- Bunaji crosses

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 12^0N at an altitude of 640m above sea level, and lies within the northern guinea savannah zone [4]. 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 21^0C to 36^0C, the mean relative humidity are 21 and 72% during "harmattan" and the rainy season respectively [5].

Animals and their Management

The animals were raised during the rainy season on both natural and paddock–sown pasture. While hay or silage supplemented with concentrate mixture 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

Fourteen linear conformation traits couple with body weight (BW) and body condition score (BCS) of 25 Bunaji and 25(F_1) Friesian - Bunaji crossbred cows were measured between year 2007 and 2008. The 14 linear conformation traits comprised of seven body conformation traits; stature (ST), chest width (CW), wither height (WH), heart girth(HG), body length (BL), body depth (BD) and rump width (RW) and seven udder conformation traits ;rear udder height (RUW), rear udder width (RUW), udder depth (UD), udder cleft (UC), fore teat position (FTP), rear teat placements (RTP) and teat length (TL). The linear conformation traits were measurements in centimeter (cm) using graduated measuring stick and flexible tape while BW was measured in Kilogram using Weigh Bridge. The BCS was determined on a scale 1 to 5 based on the methods described by David Allen [6]. All measurements were taken immediately before the morning milking while locked in the milking parlour. The details of the measurements and definition of the traits is presented in Table 1.

The cows were artificially mated using artificial insemination techniques (A.I) and were checked 60 days later for non return (Conception). Following parturition, the conformation traits were measured monthly for the

complete lactation length of the cows, commencing 3 – 4 days post-partum. Body weight measurements were taken in the morning prior to feed intake. Cows were housed in tie stalls, and standard position of the cow was defined to collect measurements; as a precautionary measure, before data collection those points which are difficult to define (eg pins, hips) were marked with color chalk to make sure that the same points would be used in the subsequent measurements. 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, cows and 8 repeated measurements on each of the pure 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 evaluators had no experience in judging or measuring cows, but were able to recognized body parts after one-month brief training session. The training manual was given to each of the evaluators to study the specifications of the measurements. Then after the one month training a preliminary trial was conducted to ascertain the level of the accuracy of the evaluators.

Milk Yield

Cows were milked after measurements were taken in the morning. The frequency of milking was twice daily (morning and evening) commencing 3 – 4 day post-partum.

Statistical Analysis

The means and standard errors were determined as well as the coefficient of variations (CV) for each parameter measured using a summary statistical analyses procedure of SAS, [7].

Repeatability

The repeatability was estimated from the variance components using intra-class correlations and repeated records of the same animal [8].

$$r = \frac{\delta_A^2}{\delta_A^2 + \delta_E^2}$$

Where: r = repeatability estimates; δ_A^2 = Animal variance; δ_E^2 = Environmental variance

The SE of each estimate was calculated using the formula:

$$SE\sqrt{\frac{2(1-R)^2[1+(K-1)n]^2}{K(K-1)(N-1)}}$$

Where: R = Repeatability; K = number of measurement per cow; n = number of cows

RESULTS

The phenotypic means, standard deviation (SD) and coefficient of variation (CV) for each measurement recorded on the 25 Bunaji and 25 Friesian x Bunaji cows are presented in Table 2. Means of crossbreds generally exceeded means of purebreds for milk yield, body weight and linear body measurements. Amongst all the linear conformation traits analysed, the largest variation existed for the udder conformation traits; the CV for the udder conformation traits ranged from 9.71% to 25.41% (Bunaji) and 8.08% to 24.21% (Friesian x Bunaji). While the CV for the body conformation traits ranged from 2.31% to 7.88% (Bunaji) and 1.58% to 4.42% (Friesian x Bunaji). Teat placement (FTP and RTP) had the largest variability among the conformation traits in both Bunaji (19.44 – 15.41%) and Friesian x Bunaji (18.50 – 24.21%). However milk yield presented the highest variability (32.34% for Bunaji and 23.61% for Friesian x Bunaji) amongst all the traits measured.

Comparatively, the crossbreds were on average slightly taller (129.83cm ST; 126.12cm WH), Wider (25.19cm CW; 174.17cm HG), longer (123.52cm BL) and heavier (391.08kg BW) than the pure Bunaji: Height (127.40cm ST; 124.20cm WH), Width (22.12cm CW, 172.34cm HG), Length (120.13cm BL) and Weight (321.08kg BW). However, the pure Bunaji were deeper (100.65cm BD) with better body condition (3.32) than the crossbred whose body depth and BCS were 97.63cm and 3.15, respectively. The crosses had larger udder size (19.18cm RUW; 24.33cm RUH) with longer teats (5.17cmTL) and teats sets that were closer at the rear (4.92cm RTP) and further at the front view (9.75cm FTP) than the pure breeds whose udder size (RUW, RUH), teat length(TL) and teat placement (RTP and FTP) were 18.83cm, 18.48cm, 4.62cm 5.18cm, and 8.64cm, respectively. Also the average daily milk yield of the crosses (7.85 Liters) was higher than that of the pure Bunaji (3.31 liters).

Repeatability Estimates

The repeatability estimates are presented in Table 3. The repeatability of the linear conformation traits measured in Bunaji varied between 0.456 (TL) and 0.965 (BW) while those of the Friesian x Bunaji varied between 0.674 (UD)

and 0.960 (BW). On an average, the repeatability of body conformation traits for both Bunaji (0.854) and Friesian x Bunaji (0.922) were higher than the udder conformation traits 0.676 (Bunaji), 0.855 (Friesian x Bunaji). However, the average repeatability estimates of the udder and body conformation traits were relatively higher in the crosses than the pure breeds. The repeatability of milk yield in the crosses was relatively higher (0.967) than that of the pure breed (0.844). However, the repeatability of the BCS of the pure breed (0.699) was slightly higher than that of the crosses (0.659). Further, both breeds had high level of stability in BW (0.965 versus 0.960) within the lactation period.

DISCUSSION

The coefficient of variation (calculated as the standard deviation divided by the mean multiplied by 100) gives an indication of the variation present for a trait. It allows comparisons in terms of variations between traits that were measured on different scales. The high CV observed for the udder conformation traits may be due to high individual variability present in the udder morphological traits of the animals used and is reflected in the measurements. However, teat placement (FTP and RTP) is the trait that presented the largest variability amongst the udder conformation traits considered in both breeds. This is important because this trait is linked to machine milking adaptation [9]. Also, there was a high variability in milk yield amongst the individual animals used. The high variability of the udder conformation traits and milk yield indicate the possibility of improving these traits through selection [10].

Repeatability Estimates

In this study, the interest was in the changes that may occur in the conformation, body weight and body condition of the animals within the lactation period. Therefore, the relatively low repeatability estimates for the udder conformation traits suggested that the udder conformation traits had high variability within the lactation length than the body conformation traits. This may be partly attributed to the physiological changes that may have occurred in the milk secreting organs (udder) and was reflected in the high variation observed on the level of milk yield within the lactation length. The difficulty in taking accurate measuremenst on the soft tissue of the udder may have also contributed to the high variability. This is in line with the report of Lawrence and Fowler, [11] that the accuracy of measurements of linear conformation traits decreased from skeletal measurement to skeletal plus flesh measurements and to soft tissue measurements. However, the body conformation traits had high repeatability indicating low variability of the traits within the lactation period, probably due to the fact that, all the measurements taken on the body conformation traits were closely related to bone structure of the cows, and since most of the cows used in this study were adults, it is reasonable to assume that the bone structure of an adult cow may not change significantly within one lactation length.

The variability observed in the conformation traits may also be due to error that might have occurred in taken repeated measurements, although effort was made to have consistency and use the same point when taking the measurements. For example, before the data collection thurl, pin and hips which are the most difficult points to define were marked with a colour chalk to make sure that the same point would be used to take subsequent measurements. Also precaution was taken to minimize variation in the measurement of live weight that may be due to stomach fill, by standardizing the weighing time to as near as possible to the start of the day. This was done in line with the report of Lawrence and Fowler [11] that in grazing animals the digesta present in the gastro intestinal tract in likely to be minimal in quantity and least variable at the beginning of the day and highest and most variable at the end of the day. The high repeatability of BW observed in both Bunaji and Friesian x Bunaji cows indicates that, there was high level of stability in the BW of the animals within the lactation period.

Willis [12] reported that a high repeatability means that one record is a good guide to future one and hence waiting is hardly needed. In contrast, low repeatability characters benefit from additional records. Therefore, the high repeatability observed in this study for the body conformation trait, suggested that a single measurement per lactation would be sufficient for each trait. The repeatability of the milk yield in the crosses was relatively higher than the pure breed, indicating that the crosses were more consistent in milk yield than the pure breed within the lactation period. However, the repeatability of the BCS of the pure breed was slightly higher than that of the crosses, implying that the pure breed had more stable body condition within the lactation period than the crosses, perhaps due to the relative higher milk yield of the crosses, since milk yield is reported to have strong negative correlation with body condition score [13], probably due to the apparent relationship of BCS with energy balance and tissue mobilization

Table 1: This table shows details of udder and body measurements as adopted from IHFA [14].

No	Measurements	Abbreviation	Description	Instruments
1	Stature	ST	Measured from top of the spine in between hips to ground	Measuring stick
2	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.	Measuring stick
3	Heart Girth	HG	Measured as a circumference of the body at a point immediately behind the fore legs, perpendicular to the body axis or simply as the smallest circumference.	Flexible tape
4	Chest width	CW	Measured from the inside surface between the top of the front legs.	Flexible tape
5	Body depth	BD	Distance between the top of spine and bottom of barrel at last rib, the deepest point independent of stature.	Flexible tape
6	Body length	BL	Measured from the point of shoulder to the ischium.	Flexible
7.	Rump width	RW	The distance between the most posterior point of pin bones	Flexible tape
8	Rear udder height	RUH	The distance between the bottom of the vulva and the milk secreting tissue, in relation to the height of the animals.	Flexible tape
9	Rear udder width	RUW	Determined by the width of the udder from the maximum dimension	Flexible tape
10.	Udder depth (udder-hocks distance)	UD	The distance from the lowest part of the udder floor to the hock or distance between rear attachment	Flexible tape
11	Udder cleft (central ligament)	UC	The depth of cleft, measured at the base of the rear udder	Flexible tape
12	Rear Teat Position	RTP	The position of the rear teat from centre of quarter	Flexible tape
13	For teat placement	FTP	The position of the front teat from central of quarters	Flexible tape
14	Teat length	TL	The length of the front teat	Flexible tape

Table 2: This table shows means, standard deviation (SD) and coefficients of variation (CV) of udder and body conformation traits of Bunaji and Friesian X Bunaji cows

	Bunaji			Friesian x Bunaji		
Traits* (cm)	Mean ± SE	SD	CV	Mean ± SE	SD	CV
Stature	127.40 ± ±0.37	5.33	4.18	129.83 ± 0.17	2.16	1.67
Chest width	22.12 ± 0.12	1.74	7.88	25.19 ± 0.08	0.98	3.90
Body depth	100.65 ± 0.31	4.56	4.53	97.63 ± 0.25	3.23	3.31
Height at withers	124.20 ± 0.65	9.39	7.56	126.12±0.16	2.06	1.64
Heart girth	172.34 ± 0.75	10.82	6.28	174.17 ± 0.21	2.76	1.58
Body length	120.13 ± 0.19	2.77	2.31	123.52 ± 0.23	2.99	2.42
Rump width	17.61 ± 0.84	1.22	6.89	17.41 ± 0.06	0.77	4.42
Rear udder height	18.48 ± 0.17	2.48	13.41	24.33 ± 0.23	2.99	12.29
Rear udder width	18.83 ± 0.13	1.82	9.71	19.18 ± 0.12	1.55	8.08
Udder depth	15.09 ± 0.15	2.22	14.69	10.35 ± 0.09	1.18	11.40
Udder cleft	2.22 ± 0.02	0.32	14.55	2.63 ± 0.02	0.31	11.79
Rear Teat Placement	5.18 ± 0.09	1.32	25.41	4.92 ± 0.07	0.91	18.50
Fore Teat Position	8.64 ± 0.12	1.68	19.44	9.75 ± 0.18	2.36	24.21
Teat Length	4.62 ± 0.61	0.89	19.26	5.17 ± 0.04	0.50	9.67
Body weight	321.08 ± 835	64.53	20.09	391.30 ± 6.40	40.00	10.22
Body condition score	3.32 ± 0.07	0.23	8.78	3.15 ± 0.07	0.46	17.76
ADM	3.31 ± 0.36	0.75	32.34	7.85 ± 0.73	1.38	23.60

** - Body condition score, body weight and milk yield were recorded on scale 1 to 5, Kilogram (kg) and liter (L), respectively. ADM-average daily milk*

Table 3: This table shows repeatability (r) estimates for udder and body conformation traits of Bunaji and Friesian x Bunaji Cow

Trait	Bunaji		Friesian x Bunaji	
	r	SE	r	SE
Stature	0.910	0.08	0.940	0.03
Chest width	0.778	0.18	0.873	0.04
Body depth	0.854	0.13	0.954	0.02
Height at wither	0.787	0.18	0.892	0.05
Heart-girth	0.961	0.04	0.941	0.03
Body length	0.957	0.18	0.955	0.02
Rump width	0.930	0.07	0.899	0.05
Rear udder height	0.841	0.16	0.938	0.03
Rear udder width	0.675	0.22	0.935	0.03
Udder depth	0.835	0.14	0.674	0.13
Udder cleft	0.535	0.26	0.829	0.04
Rear teat placement	0.905	0.09	0.938	0.03
Fore teat position	0.484	0.26	0.847	0.04
Teat length	0.456	0.16	0.827	0.04
Body weight	0.965	0.07	0.960	0.02
Body condition score	0.699	0.22	0.659	0.13
Milk yield	0.844	0.13	0.967	0.02

CONCLUSION

T It is concluded that the means of crossbreds generally exceeded means of pure breeds for milk yield, body weight and linear body measurements indicating the genetic contribution of the Friesian sire to the performance of their offspring. Therefore to improve the performance of dairy herd, proven sires should be used.

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CONFLICT OF INTEREST

No conflict of interests was declared by authors

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