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Influence of age distribution on zoometric characteristics of some selected cattle breeds in Nigeria

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***Target Audience:** Animal Geneticists, Breeders, Animal conservationist, Extension agencies and Animal Scientists.*

Abstract

A study was conducted to determine the effect of age among Adamawa Gudali, Sokoto Gudali, Bunaji and Rahaji breeds of cattle. A multistage approach was used to select the breed of cattle from the States with large population of agro-pastoralists that rear Adamawa Gudali, Sokoto Gudali Bunaji and Rahaji cattle breeds. Four States were selected for the purpose of this study. Four (4) Local Government Areas (LGA) from Adamawa and Taraba States, three (3) Local Government Areas from Gombe State and two (2) Local Government Areas from Sokoto State were purposively selected. Snowball method was used to sample 1008 cattle consisting of 162 Adamawa Gudali, 306 Sokoto Gudali, 234 Bunaji and 306 Rahaji cattle from agro-pastoralist in many communities of the LGAs. Each breed sampled was grouped into three (3) age categories on the bases of sex, that is, male (168) and female (168) weaner, male (168) and female (168) young and; male (168) and female (168) adult. Age of the cattle were determined using teeth count. Data collected on biometric traits of cattle were subjected to General Linear Model procedure of the statistics software SAS statistical package to determine the effect of age, sex and breeds on some zoometric characteristics of cattle. Generally, body weight of cattle increases with increase in age across the age categories. Body weight was positively and highly correlated ($p<0.01$) with biometric traits of cattle. Most of the biometric traits of cattle increased with increase in age. High and positive relationships existed between body weight and biometric traits of cattle.

***Key words:** Age, breed, cattle, zoometric characteristics and correlation.*

Description of Problem

Phenotypic characterization is important in design and implementation of efficient breed used and conservation programmes (1). The characterization of local genetic resources depends on the knowledge of the variation of morphological traits, which have played a very fundamental role in classification of livestock based on size and shape (2). Size and conformation are important characteristics in meat animals especially ruminants. Body size and shape measured objectively could improve selection for growth by enabling the breeder to recognize early maturing and late maturing animals of different sizes. Body measurements have been used to evaluate breed performance and to characterize animals. In addition, they have been used as a means of selecting replacement animals (3). According to (4), body measurement in addition to weight measurements describes more completely an individual or population than do the conventional method of weighing

and grading. Cattle play an important role in providing meat, milk, fibre, skin, manure, hair and source of income for urban and rural dwellers. Cattle are also useful in carry out functions such as being slaughtered for funeral and marriage ceremonies and as source of income and security for the resource poor farmers (5). Measurement of various body conformations are of value in judging biometric characteristics of meat animals and are also helpful in developing suitable selection criteria. This study aimed at determining the effect of age distribution on zoometric characteristics of some selected cattle breeds in Nigeria.

Materials and Methods

Experimental site and climate

The experiment was carried out in Adamawa, Taraba, Gombe and Sokoto States of Nigeria respectively. **Adamawa State** is located at an altitude of 200 to 300 meters, between latitude $9^0 20^{'}$ and $9^0 33^{'}$N; longitude $12^0 30^{'}$ and $12^0 50^{'}$ E (6). It is bordered by Borno State to the North West, Gombe to the West and Taraba to the South West and has an Eastern border with Cameroun Republic. It has average daily minimum and maximum temperatures of 23.2^0 C and 35.2^0C, respectively. The average annual rainfall is 718.1 millimetres and relative humidity, 44.2%. It occupies an area of 39,742.12 square kilometres. The state is generally characterized by many rivers; the major one being the Benue whose source is from the highlands of the Cameroun and flows Southwards to join the River Niger. Adamawa State is characterized by different parental materials, giving rise to soils of different mineral compositions (6). **Sokoto State** is located in Sudan savannah zone in the extreme North-Western Nigeria, between longitude 4º8′E and 6º 54′ E and latitude 12º N and 13º 58′ E (7). It shares common boundaries with Niger Republic in the North; Kebbi State to the South-West and Zamfara State to the East. The humidity in January is less than 20% and between 20-40% in the Southern areas. The mean annual rainfall is 750mm and potential evapotranspiration rates have been reported to be 162cm (7). The annual mean temperature is 34.9ºC with highest temperature recorded in April (41.0ºC) and the minimum temperature (13.2ºC) occurring in January (7). **Gombe State**: Gombe town is located between latitudes 10^0N to $10^0$20'N and longitudes $11^0$1'E and $11^0$19'E. It shares common boundary with Akko Local Government Area in the South and West; Yamaltu-Deba to the East and Kwami to the North. It is the capital of Gombe State and occupied an area of about 45km^2. Gombe town is well linked by road to other regional centres like Biu/Maiduguri, Potiskum/Damaturu, Bauchi/Jos and Yola/Jalingo. For the years 1977 to 1995, the mean annual precipitation is 835 mm and the mean annual temperature is about 26°C, whereas relative humidity has same pattern being 94% in August and dropping to less than 10% during the harmattan period (8). The relief of the town ranges between 650 m in the western part to 370m in eastern parts. Subsequent dissection and stream incision in the area have carved a landscape. **Taraba State** is located in the North-East geographical zone of the country, with its head-quarters in Jalingo. It has sixteen (16) Local Government Areas (LGAs). The State has a total land mass of 51,000 kilometres square. It lies roughly between latitude $6^0 30^1$ and $9^o 36^1$N and longitude $9^0 10^1$ and $11^0 5^1$E. Itis bounded on the North-East by Adamawa State and the West and South East by Plateau and Benue States respectively. On its east border is the Republic of Cameroun. According to the 2006 Census figures released by the National Population Commission (NPC), Taraba State has a

population of 2, 294, 800 people (9). The temperature of Taraba State ranges between 33°C and37°C, however, in the driest month (March), it could rise to 40°C. The amount of rainfall in the State ranges between1350mm in the North and 1650mm in the South. The rainy season starts in April and ends in October, while the dry season begins in November and terminates in March.

Data collection

A multistage approach was used to select the breed of cattle from the States with large population of agro-pastoralists that rear Adamawa Gudali, Sokoto Gudali, Bunaji and Rahaji cattle breeds. Four States were selected for the purpose of this study. Four (4) Local Government Areas (LGA) from Adamawa and Taraba States, three (3) Local Government Areas from Gombe State and two (2) Local Government Areas from Sokoto State were purposively selected which include Mubi North, Song, Yola North, Lamurde, Zing, Lau, Ardokola, Yorro, Balanga, Akko, Shongom, Illela and Wurno Local Government Area respectively. Snowball method was used to sample 1008 cattle consisting of 162 Adamawa Gudali, 306 Sokoto Gudali, 234 Bunaji and 306 Rahaji cattle from agro-pastoralist in many communities of the LGAs. Each breed sampled was grouped into three (3) age categories on the bases of sex, that is, male (168) and female (168) weaner, male (168) and female (168) young and; male (168) and female (168) adult. Age of the cattle were determined using teeth count. Body weight and fourteen biometric traits such as face length, ear length, head width, horn length, neck length, neck circumference, chest girth, fore leg length, height at wither, body length, loin girth, rump height, real leg length and tail length. Each measurement was taken using a graduated measuring tailor's tape marked in centimetre (cm) while body weight was measured using a weighing band in kilogram. During body measurement, animals were made to stand upright and restrained by assistants in such a way that their necks, heads, legs, ears and tails were stretched almost in a straight line. Each measurement was taken for at least two times and recorded in centimetres for male and female weaner, male and female young and, male and female adult. Reference marks for body measurements according to the methods of (10, 11 and 12) was adapted.

Statistical analysis

The effects of age, sex, breeds and interactions on biometric traits measured were estimated using the GLM procedure of the statistics analysis system SAS (13) statistical package as shown in the model below. Statistically significant means were compared using Duncan Multiple Range Test (DMRT) Duncan, (14).

Model for the analysis was design as illustrated below

$Y_{ijkl} = \mu + A_i + S_j + B_k + (A \times S)_{ij} + (A \times B)_{ik} + E_{iikl}$

Where Y_{ijkl} is the record of observation

μ= population mean

A_i= Effect of i^{th} age categories of cattle (weaner, young and adult)

S_j= Effect of j^{th} sex of cattle (males and females).

B_k= Effect of the k^{th} breed of cattle (Adamawa Gudali, Sokoto Gudali, Bunaji and Rahaji).

$(A \times S)_{ij}$= Interaction between age categories and sex of cattle

$(A \times B)_{ik}$= Interaction between age categories and breeds of cattle

E_{ijkl}= Random error particular to the ijk^{th} observation.

Phenotypic correlations among body weight and body linear traits of cattle were ascertained with Pearson Product Moment

Correlation Coefficients using SAS (13) software. The model for the correlation is as shown:

$$r_{A_1A_2} = \frac{\sigma A_1 A_2}{\sqrt{\sigma^2 A_1 . \sigma^2 A_2}}$$

Where σ_{A1A2} is the covariate between traits A_1 and A_2 and ${\sigma_{A1}}^2$ and ${\sigma_{A2}}^2$ are variance for traits A_1 and A_2, respectively

Results and Discussion

Summaries of descriptive statistics and coefficient of variation among biometric traits of cattle

The coefficient of variation among biometric traits of cattle are presented in table 1. The table defined 15 measures of growth traits in cattle encompassing body weight, face length, head width, horn length, ear length, neck length, neck circumference, fore leg length, height at wither, chest girth, body length, loin girth, rump height, rear leg length and tail length. Generally, there were inconsistencies in the variations within the measures of growth traits. Body weight was highly variable (42.07%). The variations in some of the measures were generally high, increasing among the body linear traits. Face length (17.24%), head width (26.07%), horn length (105.46%), ear length (15.94%), neck length (38.83%), neck circumference (19.19%), fore leg length (13.70%), height at wither (10.00%), chest girth (15.78%), body length (12.27%), loin girth (14.84%), rear leg length (14.15%) and tail length (20.34%) had high level of variability whereas rump height (9.67%) showed low level of variability among the body linear traits measured. Head width (26.07%), horn length (105.46%), neck length (38.83%) and tail length (20.34%) were the body linear traits, which showed the highest level of variability among the biometric traits of weaner cattle studied. The differences in body dimensions observed might be because of the differences in age, breed, sex, body sizes, nature of growth of body linear traits and the genetic constitution of the animals. The results of this study is similar to the findings of John *et al.* (15) who reported high coefficient of variation in body weight and other body linear measurements of weaner donkeys. John and Iyiola-Tunji (16) also reported high coefficient of variation in body weight and other morphometric traits of adult donkeys in North West Nigeria. The results of this study is similar to the findings of Ige *et al.* (17) who reported high coefficient of variation for horn length in males (32.68%) and (37.95%) in females, chest girth (35.76%) in males and (19.17%) in thoracic length of male cattle among White Fulani cattle breed.

Effect of age distribution on biometric traits of cattle

The Effect of age on biometric traits of cattle are presented on table 2. All the biometric traits showed significant ($P<0.01$) difference with change in age across the age categories. The biometric traits change with increase in age from 8months-1year to above 3years. The results showed that animals above 3years of age (adult cattle) had superior body weight and other biometric traits measured, followed by those that falls within the age range of above 1 to 3years (young cattle) while the least body weight and sizes were recorded in animals within the age limit of 8months to 1year (weaner cattle). Body weight of cattle increases with increase in age across the age categories ranging from 146.98±2.56kg in 8month-1year, 240.72±2.56kg in >1-3years and 385.66±2.55kg in >3years of age. All the body weights and biometric traits of cattle across the age categories also increases significantly ($p<0.01$) as their age increases. This might be due to increase in body weight and sizes of the animals as their age increases. This study agreed with the findings of Adejoro and Salako (18) who

reported that the general positive influence of age of the animals on body sizes and weight is not surprising since the size and shape of the animals is expected to increase with increasing age of the animals. The author further stated that increase in age leads to increase in body traits; this could be termed as growth. Measurement of various body conformations are value in judging quantitative characteristics of meat animals and are also helpful in developing suitable selection criteria (19 and 20). The 140.60±0.58cm obtained in this study is in range with the findings of Namikawa *et al*. (21) who reported heart girth of Bangladeshi native cattle of >2 years old as (151cm). Rashid *et al*. (22) reported body weight (97.5±3.35kg), hip height (97.2±1.24cm), height at withers (94.1±1.43cm), body length (91.8±1.30cm), heart girth (106.4±2.14cm), ear length (19.9±0.71cm) and tail length (61.6±3.22cm) for cattle >9-12months, which is similar to the results obtained for cattle within the age range of 8-12months (weaner cattle). Rashid *et al*. (22) also reported body weight (241.2±18.6kg), hip height (120.7±2.25cm), height at withers (115.9±2.23cm), body length (118.2±3.04cm), heart girth (144.2±3.80cm), ear length (19.9±0.71cm) and tail length (85.6±3.48cm) for cattle >27-30 months. This is in conformity with the results obtained for cattle within the age range of >1-3 years (young cattle).

Table 1. Descriptive statistics among biometric traits of some selected cattle breeds in Nigeria

Traits	N	Mean±SE	CV	Minimum	Maximum
BWT (kg)	1008	259.28±3.44	42.07	98.00	610.00
FLT (cm)	1008	42.66±0.23	17.24	26.00	110.00
HWD (cm)	1008	18.27±0.15	26.07	11.00	128.00
HLT (cm)	1008	21.75±0.72	105.46	0.00	99.00
ELT (cm)	1008	20.55±0.10	15.94	9.00	74.00
NLT (cm)	1008	32.06±0.39	38.83	18.00	388.00
NCR (cm)	1008	74.85±0.45	19.19	29.00	135.00
FLL (cm)	1008	74.58±0.32	13.70	20.00	127.00
HTW (cm)	1008	119.76±0.38	10.00	90.00	161.00
CGT (cm)	1008	142.47±0.71	15.78	35.00	201.00
BLT (cm)	1008	117.96±0.46	12.27	50.00	177.00
LGT (cm)	1008	150.09±0.70	14.84	89.00	220.00
RHT (cm)	1008	123.31±0.38	9.67	92.00	176.00
RLL (cm)	1008	81.73±0.36	14.15	55.00	180.00
TLT (cm)	1008	94.56±0.61	20.34	25.00	143.00

BWT: Body weight, FLT: Face length, HWD: Head width, HLT: Horn length, ELT: Ear length, NLT: Neck length, NCR: Neck circumference, FLL: Fore leg length, HTW: Height at withers, CGT: Chest girth, BLT: Body length, LGT: Loin girth, RHT: Rump height, RLL: Rear leg length, TLT: Tail length, N: Number, CV: Coefficient of variation.

Influence of sex and age categories on biometric traits of cattle

Effect of age and sex on biometric traits of cattle are shown on table 3. The Effect of age on biometric traits of cattle revealed significant (P<0.01) difference with change in age across the age categories of males and females. The biometric traits changes with an increase in age of both males and female cattle from 8months-1year, above 1-3years and above 3years. The results showed that animals above 3years of age (adult cattle) had higher body weight and other biometric traits measured, followed by those that falls

within the age range of above 1 to 3years (young cattle) while the least body weight and sizes were recorded in animals within the age limit of 8months to 1year (weaner cattle) in both male and female age groups. Body weight of cattle increases with increase in age across the age groups, ranging from 150.13±3.71kg in 8month-1year, 249.61±3.71kg in above 1-3years and 408.93±3.71kg above 3years of age in male cattle. In female cattle, body weight and body linear traits also increases across the age groups as the animals matures. Body weight ranges from 144.31±2.94kg in 8months-1year, 234.50±2.94kg in above 1-3years and 368.17±2.94kg in those above 3years of age. Generally, male cattle had higher body weight and body linear traits across the age groups. All the body weights and biometric traits of cattle across the age categories increases significantly ($p<0.01$) as their age advances. An increase in body weight and body linear measurements observed in this study might be attributed to increase in age as the animals matures. The significant differences observed between males and females across the age categories could be as a result of sexual dimorphism. Rashid *et al*. (22) reported significant increase in body weight and body linear measurements of Brahman crossbred cattle as age increases. The mean value of body weight, chest girth, height at wither and rump height measurements of above 1-3years age groups of male cattle in this study were in range with those reported by Abdelhadi and Babiker (23) for Sudanese indigenous Baggara bulls (266k), (150.6cm), (120cm) and (126cm) respectively. Alsiddiq *et al*. (24) observed similar height at withers (116 and 119cm), heart girth (140 and 149cm) and body length (121 and 129cm) for Baggara Zebu bulls. Bag *et al*. (25) obtained heart girth for adult female of 54 months as (137cm), which is lower than the value obtained for chest girth (164.65±0.72cm) in adult females of the same age range. The differences observed in chest girth measurements might be attributed genetic constitution, age, environment, differences in management practices and geographical locations.

Table 2. Effect of age on biometric traits of cattle

Traits	N	8M-1year	>1-3years	>3years	P value
BWT (kg)	1008	146.98±2.56^{c}	240.72±2.56^{b}	385.66±2.55^{a}	0.0001
FLT (cm)	1008	34.88±0.21^{c}	41.95±0.21^{b}	49.96±0.21^{a}	0.0001
HWD (cm)	1008	15.45±0.24^{c}	18.41±0.24^{b}	20.82±0.24^{a}	0.0001
HLT (cm)	1008	7.72±0.50^{c}	18.16±0.50^{b}	37.34±0.50^{a}	0.0001
ELT (cm)	1008	17.89±0.13^{c}	19.65±0.13^{b}	23.53±0.12^{a}	0.0001
NLT (cm)	1008	27.07±0.66^{c}	31.88±0.66^{b}	37.33±0.66^{a}	0.0001
NCR (cm)	1008	62.07±0.51^{c}	72.85±0.51^{b}	88.88±0.51^{a}	0.0001
FLL (cm)	1008	65.49±0.31^{c}	71.89±0.31^{b}	84.23±0.32^{a}	0.0001
HTW (cm)	1008	106.12±0.27^{c}	119.38±0.27^{b}	132.61±0.27^{a}	0.0001
CGT (cm)	1008	118.87±0.58^{c}	140.60±0.58^{b}	167.24±0.58^{a}	0.0001
BLT (cm)	1008	102.48±0.36^{c}	118.74±0.36^{b}	133.93±0.36^{a}	0.0001
LGT (cm)	1008	127.65±0.67^{c}	148.74±0.67^{b}	172.15±0.67^{a}	0.0001
RHT (cm)	1008	109.86±0.23^{c}	123.12±0.23^{b}	135.62±0.23^{a}	0.0001
RLL (cm)	1008	71.42±0.34^{c}	78.55±0.34^{b}	92.33±0.34^{a}	0.0001
TLT (cm)	1008	76.63±0.65^{c}	92.12±0.65^{b}	109.89±0.65^{a}	0.0001

BWT: Body weight, FLT: Face length, HWD: Head width, HLT: Horn length, ELT: Ear length, NLT: Neck length, NCR: Neck circumference, FLL: Fore leg length, HTW: Height at withers, CGT: Chest girth, BLT: Body length, LGT: Loin girth, RHT: Rump height, RLL: Rear leg length, TLT: Tail length, N: Number, abc: Means with different superscripts along same row shows significant differences ($P<0.01$).

Table 3. Effect of sex and age groups on biometric traits of cattle

Sex		Males				Females				
Traits	N	8M-1year	>1-3years	>3years	P value	N	8M-1year	>1-3years	>3years	P value
BWT (kg)	504	150.13±3.71^{c}	249.61±3.71^{b}	408.93±3.71^{a}	0.0001	504	144.31±2.94^{c}	234.50±2.94^{b}	368.17±2.94^{a}	0.0001
FLT (cm)	504	35.21±0.35^{c}	43.20±0.35^{b}	50.85±0.35^{a}	0.0001	504	35.09±0.24^{c}	41.71±0.24^{b}	49.88±0.24^{a}	0.0001
HWD (cm)	504	11.59±0.16^{c}	18.32±0.16^{b}	21.33±0.16^{a}	0.0001	504	15.39±0.43^{c}	18.68±0.43^{b}	20.29±0.43^{a}	0.0001
HLT (cm)	504	7.81±1.54^{c}	19.04±0.54^{b}	38.07±0.54^{a}	0.0001	504	7.68±1.38^{c}	17.86±1.38^{b}	40.04±1.38^{a}	0.0001
ELT (cm)	504	18.15±0.21^{c}	20.05±0.21^{b}	23.79±0.21^{a}	0.0001	504	18.07±0.14^{c}	19.79±0.14^{b}	23.47±0.14^{a}	0.0001
NLT (cm)	504	27.46±0.26^{c}	31.85±0.29^{b}	36.85±0.26^{a}	0.0001	504	26.50±1.25^{c}	31.63±1.25^{b}	38.09±1.25^{a}	0.0001
NCR (cm)	504	62.97±0.63^{c}	75.21±0.63^{b}	96.77±0.63^{a}	0.0001	504	61.79±0.59^{c}	70.59±0.59^{b}	81.77±0.59^{a}	0.0001
FLL (cm)	504	66.09±0.45^{c}	73.45±0.45^{b}	87.51±0.45^{a}	0.0001	504	65.57±0.49^{c}	71.59±0.49^{b}	83.25±0.49^{a}	0.0001
HTW (cm)	504	106.26±0.35^{c}	120.81±0.35^{b}	134.95±0.35^{a}	0.0001	504	106.51±0.37^{c}	118.56±0.37^{b}	131.49±0.37^{a}	0.0001
CGT (cm)	504	119.73±0.82^{c}	143.09±0.82^{b}	170.89±0.82^{a}	0.0001	504	118.01±0.72^{c}	138.48±0.72^{b}	164.65±0.72^{a}	0.0001
BLT (cm)	504	102.42±0.52^{c}	119.85±0.52^{b}	135.38±0.52^{a}	0.0001	504	101.99±0.49^{c}	116.17±0.49^{b}	131.96±0.49^{a}	0.0001
LGT (cm)	504	128.85±0.99^{c}	151.82±0.99^{b}	175.13±0.99^{a}	0.0001	504	126.41±0.86^{c}	146.95±0.86^{b}	171.38±0.86^{a}	0.0001
RHT (cm)	504	110.07±0.38^{c}	123.96±0.38^{b}	138.09±0.38^{a}	0.0001	504	110.39±0.44^{c}	123.03±0.44^{b}	134.33±0.44^{a}	0.0001
RLL (cm)	504	71.89±0.61^{c}	80.33±0.61^{b}	96.17±0.61^{a}	0.0001	504	71.90±0.47^{c}	78.61±0.47^{b}	91.48±0.47^{a}	0.0001
TLT (cm)	504	77.73±0.97^{c}	96.17±0.97^{b}	113.29±0.97^{a}	0.0001	504	77.96±1.06^{c}	91.44±1.06^{b}	110.76±1.06^{a}	0.0001

BWT: Body weight, FLT: Face length, HWD: Head width, HLT: Horn length, ELT: Ear length, NLT: Neck length, NCR: Neck circumfer ence, FLL: Fore leg length, HTW: Height at withers, CGT: Chest girth, BLT: Body length, LGT: Loin girth, RHT: Rump height, RLL: Rear leg length, TLT: Tail length, N: Number, abc: Means with different superscripts along same row shows significant differences (P<0.01).

Effect of age and breed on biometric traits of cattle

Effect of age and breed on biometric traits of cattle are presented on table 4. Significant ($p<0.01$) differences were observed among biometric traits of cattle based on age categories and breeds. Adult Sokoto Gudali cattle breed above 3 years of age were superior for body weight (403.49±4.48kg), followed by Rahaji adult cattle breed (388.96±4.46kg). The body weight for weaner cattle breeds; Adamawa Gudali (146.76±6.16kg), Sokoto Gudali (149.23±4.48kg), Bunaji (143.00±5.13kg) and Rahaji (148.92±4.51kg) cattle breeds were similar. In young cattle within the age range of >1-3 years of age, Adamawa Gudali (234.74±6.16kg), Bunaji (233.97±5.13) and Rahaji (239.62±4.48kg) cattle showed similar body weight, with the exception of Sokoto Gudali (254.54±4.48kg), which were higher. However, adult Sokoto Gudali cattle breed recorded the longest face length (51.62±0.36cm) and wider head width (21.60±0.42cm), which were similar to adult Adamawa Gudali (21.22±0.57cm). Adult Rahaji cattle were superior for horn length (68.79±0.88cm), ear length (24.09±0.22cm) and neck length (39.86±1.15cm) whereas the shortest horn length (0.10±0.88cm) and neck length (26.42±1.16cm) in Sokoto Gudali weaner cattle which were similar to neck length (26.47±1.32cm) in Bunaji weaner cattle breed while the shortest ear length (16.26±0.30cm) was in Adamawa Gudali weaner cattle breed. Adult Sokoto Gudali cattle showed superiority in terms of wider neck circumference (92.74±0.89cm), longer fore leg length (88.94±0.55cm) and taller height at wither (134.21±0.47cm), which was similar to height at wither (134.51±0.47cm) Rahaji adult cattle. The wider chest girth (170.83±1.02cm), wider loin girth (180.63±1.18cm) and taller rump height (136.96±0.53cm) obtained in Sokoto Gudali adult cattle was also similar to rump height (137.50±0.52cm) obtained in adult Rahaji cattle. Longer rear leg length (97.73±0.60cm) and longer tail length (119.72±1.14cm) were higher in adult Sokoto Gudali compared to other breeds across the age categories. The height at wither (107.24±0.47cm), chest girth (118.85±1.02cm), body length (102.70±0.63cm) and tail length (80.73±1.14cm) obtained in Sokoto Gudali weaner cattle were similar to height at wither (107.15±0.47cm), chest girth (119.36±1.02cm), body length (102.05±0.64cm) and tail length (79.99±1.15cm) observed in Rahaji weaner cattle. The chest girth (140.04±1.40cm) recorded in Adamawa Gudali young cattle is comparable to those of Bunaji (139.11±1.16cm) and Rahaji (140.36±1.02cm). Body length (117.67±0.67cm) and rump height (124.58±0.53cm) obtained in Sokoto Gudali young cattle were also similar to body length (117.31±0.72cm) and rump height (123.08±0.60cm) in Bunaji and Rahaji (124.27±0.53cm) cattle breeds respectively. The differences observed among body linear traits of cattle breeds mighty attributed to differences in age, management practices and breeds. The differences observed among body linear traits of cattle breeds mighty attributed to differences in age, management practices and breeds. The significant effect of age groups on biometric traits of cattle breeds observed in this study is similar to the findings of John and Iyiola-Tunji (16) who reported significant differences among biometric traits of donkeys in North West Nigeria.

Table 4. Effect of age and breed on biometric traits of cattle

Age group	8M-1year				>1-3years				
Traits	Adamawa Gudali	Sokoto Gudali	Bunaji	Rahaji	Adamawa Gudali	Sokoto Gudali	Bunaji	Rahaji	SEM
BWT (kg)	146.76±6.16^{g}	149.23±4.48^{g}	143.00±5.13^{g}	148.92±4.51^{g}	234.74±6.16^{f}	254.54±4.48^{e}	233.97±5.13^{f}	239.62±4.48^{f}	3.44
FLT (cm)	32.54±0.50^{j}	35.75±0.36^{i}	35.69±0.42^{i}	35.54±0.37^{i}	38.94±0.50^{h}	44.34±0.36^{e}	40.87±0.42^{g}	43.65±0.36^{f}	0.23
HWD (cm)	15.37±0.57^{h}	15.89±0.42^{g}	15.05±0.48^{i}	15.50±0.42^{h}	18.26±0.57^{e}	18.60±0.42^{d}	17.41±0.48^{f}	19.37±0.42^{c}	0.15
HLT (cm)	5.67±1.22^{l}	0.10±0.88^{k}	11.46±1.01^{g}	13.64±0.89^{f}	13.54±1.22^{f}	2.13±0.88^{j}	23.28±1.01^{d}	33.69±0.88^{c}	0.72
ELT (cm)	16.26±0.30^{h}	18.65±0.22^{f}	17.88±0.25^{g}	18.77±0.22^{f}	17.94±0.30^{g}	20.66±0.22^{d}	19.28±0.25^{e}	20.72±0.22^{d}	0.10
NLT (cm)	27.91±1.59^{h}	26.42±1.16^{i}	26.47±1.32^{i}	27.49±1.64^{h}	33.07±1.59^{e}	32.18±1.16^{f}	31.55±1.32^{f}	30.74±1.56^{g}	0.39
NCR (cm)	60.39±1.22^{j}	64.60±0.89^{h}	60.73±1.02^{j}	62.54±0.89^{i}	73.94±1.22^{e}	76.25±0.89^{d}	69.95±1.02^{g}	71.25±0.89^{f}	0.45
FLL (cm)	63.06±0.75^{k}	66.86±0.55^{i}	65.56±0.63^{j}	66.48±0.55^{i}	67.83±0.75^{h}	74.91±0.55^{e}	71.14±0.63^{g}	73.67±0.55^{f}	0.32
HTW (cm)	104.12±0.65^{l}	107.24±0.47^{g}	105.93±0.55^{h}	107.15±0.47^{g}	116.94±0.65^{f}	120.88±0.47^{d}	119.93±0.54^{e}	119.74±0.47^{e}	0.38
CGT (cm)	119.28±1.40^{g}	118.85±1.02^{g}	117.97±1.16^{g}	119.36±1.02^{g}	140.04±1.40^{f}	142.87±1.02^{e}	139.11±1.16^{f}	140.36±1.02^{f}	0.71
BLT (cm)	105.87±0.87^{f}	102.70±0.63^{g}	99.31±0.72^{h}	102.05±0.64^{g}	124.63±0.87^{c}	117.67±0.63^{d}	117.31±0.72^{d}	115.37±0.63^{e}	0.46
LGT (cm)	128.31±1.62^{h}	127.61±1.18^{h}	125.87±1.35^{i}	128.81±1.18^{h}	144.87±1.62^{g}	153.02±1.18^{d}	147.50±1.35^{f}	149.57±1.18^{e}	0.70
RHT (cm)	106.91±0.72^{h}	110.32±0.53^{g}	110.24±0.60^{g}	111.98±0.53^{f}	120.54±0.72^{f}	124.58±0.53^{d}	123.08±0.60^{d}	124.27±0.53^{d}	0.38
RLL (cm)	68.30±0.82^{j}	73.78±0.60^{g}	70.88±0.68^{i}	72.72±0.60^{h}	72.96±0.82^{h}	82.46±0.60^{d}	76.96±0.68^{f}	81.83±0.60^{e}	0.36
TLT (cm)	66.96±1.57^{i}	80.73±1.14^{g}	78.85±1.31^{h}	79.99±1.15^{g}	79.13±1.57^{h}	99.69±1.14^{d}	94.56±1.31^{f}	95.10±1.14^{e}	0.61

BWT: Body weight, FLT: Face length, HWD: Head width, HLT: Horn length, ELT: Ear length, NLT: Neck length, NCR: Neck circumference, FLL: Fore leg length, HTW: Height at withers, CGT: Chest girth, BLT: Body length, LGT: Loin girth, RHT: Rump height, RLL: Rear leg length, TLT: Tail length, abc; Means with different superscripts along same row shows significant differences (P<0.01).

Table 5 . Effect of age distribution on biometric traits of cattle

Traits	N	1year	2years	3years	4years	5years	6years	7years	P value
BWT (kg)	1008	147.29 ± 2.21^{f}	224.83 ± 2.90^{e}	275.11 ± 3.19^{d}	370.14 ± 2.81^{c}	420.30 ± 4.81^{b}	454.52 ± 7.53^{a}	467.50 ± 14.33^{a}	0.0001
FLT (cm)	1008	35.16 ± 0.22^{c}	42.11 ± 0.30^{b}	43.82 ± 0.32^{b}	50.14 ± 0.28^{a}	50.85 ± 0.48^{a}	51.10 ± 0.75^{a}	50.13 ± 1.43^{a}	0.0001
HWD (cm)	1008	15.50 ± 0.23^{d}	17.92 ± 0.30^{c}	19.40 ± 0.33^{bc}	20.50 ± 0.29^{ab}	21.35 ± 0.50^{ab}	22.03 ± 0.78^{a}	21.75 ± 1.49^{a}	0.0001
HLT (cm)	1008	7.72 ± 1.06^{c}	18.69 ± 1.38^{b}	21.97 ± 1.52^{b}	37.91 ± 1.34^{a}	39.76 ± 2.30^{a}	38.66 ± 3.59^{a}	38.88 ± 6.84^{a}	0.0001
ELT (cm)	1008	18.12 ± 0.13^{c}	19.72 ± 0.17^{b}	20.60 ± 0.19^{b}	23.46 ± 0.16^{a}	24.13 ± 0.28^{a}	23.66 ± 0.44^{a}	23.88 ± 0.84^{a}	0.0001
NLT (cm)	1008	26.99 ± 0.65^{c}	31.99 ± 0.85^{bc}	34.14 ± 0.93^{ab}	35.95 ± 0.82^{ab}	36.92 ± 0.41^{ab}	38.03 ± 2.20^{ab}	39.88 ± 4.19^{a}	0.0001
NCR (cm)	1008	62.40 ± 0.48^{f}	71.36 ± 0.63^{e}	76.10 ± 0.69^{d}	86.39 ± 0.61^{c}	93.99 ± 1.04^{b}	99.10 ± 1.63^{a}	100.63 ± 3.10^{a}	0.0001
FLL (cm)	1008	65.83 ± 0.35^{f}	71.64 ± 0.45^{e}	75.12 ± 0.50^{d}	84.85 ± 0.44^{bc}	86.37 ± 0.75^{ab}	87.97 ± 1.18^{a}	82.50 ± 2.24^{c}	0.0001
HTW (cm)	1008	106.41 ± 0.27^{d}	118.48 ± 0.36^{c}	122.78 ± 0.40^{b}	132.68 ± 0.35^{a}	134.15 ± 0.60^{a}	134.97 ± 0.93^{a}	133.38 ± 1.77^{a}	0.0001
CGT (cm)	1008	118.87 ± 0.53^{f}	137.57 ± 0.70^{e}	147.11 ± 0.77^{d}	164.77 ± 0.68^{c}	172.56 ± 1.16^{b}	179.03 ± 1.82^{a}	180.88 ± 3.46^{a}	0.0001
BLT (cm)	1008	102.23 ± 0.37^{f}	116.61 ± 0.48^{e}	121.41 ± 0.53^{d}	132.52 ± 0.46^{c}	135.45 ± 0.79^{bc}	136.62 ± 1.24^{b}	142.00 ± 2.37^{a}	0.0001
LGT (cm)	1008	127.68 ± 0.65^{e}	145.92 ± 0.85^{d}	155.86 ± 0.94^{c}	171.15 ± 0.82^{b}	175.94 ± 1.41^{b}	185.10 ± 2.20^{a}	174.50 ± 4.19^{b}	0.0001
RHT (cm)	1008	110.25 ± 0.30^{e}	122.39 ± 0.40^{d}	126.22 ± 0.43^{c}	135.60 ± 0.38^{b}	137.27 ± 0.65^{ab}	138.59 ± 1.02^{a}	138.00 ± 1.94^{ab}	0.0001
RLL (cm)	1008	71.90 ± 0.40^{e}	78.50 ± 0.52^{d}	82.31 ± 0.57^{c}	93.21 ± 0.51^{b}	94.77 ± 0.86^{ab}	97.07 ± 1.35^{a}	91.75 ± 2.58^{b}	0.0001
TLT (cm)	1008	77.85 ± 0.72^{d}	91.65 ± 0.94^{c}	97.86 ± 1.04^{b}	111.31 ± 0.91^{a}	114.45 ± 1.56^{a}	114.90 ± 2.44^{a}	115.25 ± 4.65^{a}	0.0001

BWT: Body weight, FLT: Face length, HWD: Head width, HLT: Horn length, ELT: Ear length, NLT: Neck length, NCR: Neck circumference, FLL: Fore leg length, HTW: Height at withers, CGT: Chest girth, BLT: Body length, LGT: Loin girth, RHT: Rump height, RLL: Rear leg length, TLT: Tail length, N: Number, abcdef: Means with different superscripts along same row shows significant differences (P<0.01).

Influence of age distribution on biometric traits of cattle

The effect of age distribution on biometric traits of cattle are shown on table 5. The results revealed significant (P<0.01) differences among all the biometric traits measured. Generally, animals within the age of 6years showed superiority in terms of BWT (454.52±4.81kg), FLT (51.10±0.75cm), HWD (22.03±0.78cm), HLT (38.66±3.59cm), ELT (23.66±0.44cm), NCR (99.10±1.63cm), FLL (87.97±1.18cm), HTW (134.97±0.93cm), CGT (179.03±1.82cm), LGT (185.10±2.20cm), RHT (138.59±1.02cm), RLL (97.07±1.35cm) and TLT (114.90±2.44cm). The animals within age 7 were also superior for BWT (457.50±14.33kg), FLT (50.132±1.43cm), HWD (21.75±1.49cm), HLT (38.88±6.84cm), ELT (23.88±0.84cm), NLT (39.88±4.19cm), NCR (100.63±3.10cm), FLL HTW (133.38±1.77cm), CGT (180.88±3.46cm), BLT (142.00±2.37cm) and TLT (115.25±4.65cm). Animals within the ages of 4 and 5 were statistically similar for FLT (50.14±0.28cm; 50.85±0.48cm), HLT (37.91±1.34cm; 39.76±2.30cm), ELT (23.46±0.16cm; 24.13±0.28cm), HTW (132.68±0.35cm; 134.15±0.60cm) and TLT (111.31±0.91; 114.45±1.56cm) while the least body weight and sizes were recorded in animals within age 1, followed by ages 2 and 3. The majority of the animals with superiority in terms of biometric traits measured falls within 6 years of age compared to those within 7 years of age. This might be as a result of old age as the animals tends to decrease as they reach the point of diminishing with age. Although, other biometric traits were statistically the same, which also showed similarity trend as the animals increases in age. The ideal age for selection in cattle may be at age 6 because most or all the phenotypic traits or genetic potentials of the animals have been properly manifested and exposed. Some studies have revealed that body measurements increased with body condition score and age (26). Abiola (27) also reported that age of cattle significantly contributed to variation in all linear body measurements except length of hindquarters.

Pairwise correlation coefficients between biometric traits of cattle

Correlated relationships between biometric traits of cattle are revealed in table 6. The traits were significantly (p<0.05, 0.01) and positively correlated amongst themselves (r=0.20-0.96) with the exception of non-significant (p>0.05) relationships, which existed between neck length and head width (p>0.05; r=0.16). The magnitude of correlations between body weight and body dimensions were high (r=0.47-0.96) except that between body weight and neck length which was low (r=0.33). Body weight was positively and highly correlated (p<0.01) with face length (r=0.82), head width (r=0.47), horn length (r=0.52), ear length (r=0.69), neck circumference (r=0.84), fore leg length (r=0.80), height at wither (r=0.90), chest girth (r=0.96), body length (r=0.87), loin girth (r=0.89), rump height (r=0.87), rear leg length (r=0.80) and tail length (r=0.75). However, head width had low relationships (p<0.05) with horn length (r=0.20), ear length (r=0.39), neck length (r=0.16) and tail length (=0.37). Neck length had low correlations (r=0.20-0.28) with face length (r=0.31), head width (r=0.16), horn length (r=0.23) and ear length (r=0.28). low relationships (p<0.05) were also observed between neck length and neck circumference (r=0.30), fore leg length (r=0.34), height at wither (r=0.35), chest girth (r=0.33), body length (r=0.34), loin girth (r=0.32), rump height (r=0.33), rear leg length (r=0.30) and tail length (r=0.37). Other body dimensions

had moderate to high positive correlations amongst themselves (r=0.40-0.96). Correlation coefficient showed that body weight was highly correlated with chest girth compared to the other body measurements, which evidently indicated that chest girth is the most reliable measurement that most correlated with body weight as well as face length, ear length, neck circumference, fore leg length, height at wither, body length, loin girth, rump height, real leg length and tail length. Generally, high, strong and positive relationships ($p<0.01$) were recorded between body and other biometric traits of cattle. This means that as the body weight of cattle increases, other body linear traits also increases. Positive correlations that existed between body weight and biometric traits mean that the traits are controlled by the same gene (pleiotropic). On the other hand, it is an indication that any of those biometric traits could serve as a predictor of body weight (28). This may also lead to an improvement in other trait. The results of this study is similar with the report of John and Iyiola-Tunji. (29) who reported positive and high relationships between body weight and morphometric characteristics of Donkeys in North-Western Nigeria. Berry *et al.* (30) found positive and moderate to high genetic correlation values between body conformation traits. High correlation coefficients have been found between chest girth, and body weight (31). Okeh and Uguru (32) also reported in Kuri and Sokoto Gudali that body length was significantly ($p<0.05$) correlated to other body parameters. Similar to the results of this study, Anya *et al*. (33) also reported highest level of correlated relationships between chest girth ($p<0.01$; r=0.943) and body weight among all the body linear measurements of cattle.

Table 6: Correlated relationships between biometric traits of cattle

Traits	BWT (kg)	FLT (cm)	HWD (cm)	HLT (cm)	ELT (cm)	NLT (cm)	NCR (cm)	FLL (cm)	HTW (cm)	CGT (cm)	BLT (cm)	LGT (cm)	RHT (cm)	RLL (cm)	TLT (cm)
FLT (cm)	0.82**	-													
HWD (cm)	0.47**	0.43**	-												
HLT (cm)	0.52**	0.49**	0.20*	-											
ELT (cm)	0.69**	0.66**	0.39*	0.46**	-										
NLT (cm)	0.33*	0.31*	0.16^{NS}	0.23*	0.28*	-									
NCR (cm)	0.84**	0.74**	0.42**	0.37*	0.61**	0.30*	-								
FLL (cm)	0.80**	0.76**	0.41**	0.48**	0.67**	0.34*	0.74**	-							
HTW (cm)	0.90**	0.84**	0.47**	0.56**	0.71**	0.35*	0.80**	0.84**	-						
CGT (cm)	0.96**	0.81**	0.47**	0.51**	0.67**	0.33*	0.81**	0.77**	0.87**	-					
BLT (cm)	0.87**	0.77**	0.46**	0.49**	0.62**	0.34*	0.78**	0.72**	0.88**	0.86**	-				
LGT (cm)	0.89**	0.80**	0.45**	0.45**	0.64**	0.32*	0.80**	0.76**	0.85**	0.87**	0.83**	-			
RHT (cm)	0.87**	0.82**	0.46**	0.55**	0.68**	0.33*	0.78**	0.81**	0.95**	0.86**	0.84**	0.83**	-		
RLL (cm)	0.80**	0.76**	0.40**	0.50**	0.66**	0.30*	0.72**	0.88**	0.82**	0.77**	0.71**	0.76**	0.80**	-	
TLT (cm)	0.75**	0.73**	0.37**	0.53**	0.60**	0.27*	0.67**	0.71**	0.75**	0.73**	0.67**	0.75**	0.74**	0.73**	-

BWT: Body weight, FLT: Face length, HWD: Head width, HLT: Horn length, ELT: Ear length, NLT: Neck length, NCR: Neck circumference, FLL: Fore leg length, HTW: Height at withers, CGT: Chest girth, BLT: Body length, LGT: Loin girth, RHT: Rump height, RLL: Rear leg length, TLT: Tail length. ******p<0.01, *****p<0.05.

Conclusion and Applications

1. Majority of the biometric traits of cattle increased with the advances of age.
2. Correlation coefficient showed that body weight was highly and positively correlated with chest girth (r=0.96; $p<0.01$) compared to the other body measurements, which evidently indicated that chest girth is the most reliable measurement that most correlated with body weight as well as ear length, neck circumference, fore leg length, height at wither, body length, loin girth, rump height, real leg length and tail length.
3. Sokoto Gudali adult cattle breed showed the highest superiority for

body weight, face length, head width, neck circumference, fore leg length, height at wither, chest girth, loin girth, rump height, real leg length and tail length compared to other breeds of cattle.

4. Body weight and body linear traits, such as head width, horn length, neck length and tail length should be employed in selection criteria because of their high coefficient of variation amongst other traits measured.
5. Chest girth alongside face length, ear length, neck circumference, fore leg length, height at wither, body length, loin girth, rump height, real leg length and tail length should be exploited for genetic improvement of the cattle.

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