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# AGE BASED CLASSIFICATION OF MORPHOMETRIC TRAITS OF DIFFERENT NIGERIA GOAT BREEDS

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## ABSTRACT

A total of nine hundred (900) goats comprising of three hundred Sahel goats from Borno state, three hundred Red Sokoto goats from Sokoto state and three hundred West African Dwarf goats from Ogun state were used for the study. Each breed consist of three hundred goats each, made up of fifty males and fifty females distributed in the following age groups <1, 1-2 and 2-3 years. These were evaluated for morphometric characteristics. The pairs of permanent incisors in the dentition of the goat were used to determine age. The effects of age, breed, and sex on linear measurement were estimated using the GLM procedure of the statistics analysis software package. These were computed on the basis of interaction with age groups. Means were separated within age groups using Duncan multiple range test. The result of this study indicated that the Sahelian breed was superior to other breeds across all age groups in body weight, while the red Sokoto was intermediate followed by the West African Dwarf. However, variations in morphometric measurements did not follow this trend and indicates that body parts are influenced differently by age, breed and sex. The variability of body weight suggests possibility of improving this trait through careful selection. Present results showed that age has strong influence, as there were consistent increases in all the traits studied as the animals aged. The scenario is however not surprising since the size and shape of the animal is expected to increase as the animal is growing with age.

## INTRODUCTION

Goats are the largest in number among ruminant livestock in Nigeria totaling about 58.3 million (FAOSTAT, 2008). Goats, predominantly are kept by the rural household and ownership is spread across all human age groups and sexes (Akpa,1999).The importance of goat stem from its ability to convert forages and household by-product into high quality human food and their role as locally available source of food, fibre, power and other products to suit local community needs. The indigenous breeds found in Nigeria are, Red Sokoto, Sahel, and West African Dwarf (WAD) goat (Adu and Ngere, 1979). These differ considerably in size, coat colour, horn length, etc. Their broad genetic variability enables them to survive under stressful environmental condition including high disease incidence, poor nutrition which may increase animal susceptibility to disease, high temperature, and traditional husbandry system.

In Nigeria, work has been done extensively on goats (Adu and Ngere, 1979; Dettmers, 1983; Bunge *et al.*, 1990 and Hall, 1991). But majority of these were carried out on herds from research institute and universities while there exist little information on morphological and morphometric characteristics and their differentiation in the Nigerian breeds of goat based on on-farm (small holder herds) since these farm herds make up the

bulk of the goat population of Nigeria, they serve as a true reflection of the genetic potential of this specie, therefore this study is designed to supplement existing literatures on Nigerian goats using on-farm herds from smallholder stocks. The influence of age on production characteristics cannot be overemphasized, reports on the impact of age on puberty, kidding, growth and growth rate, birth weight etc. has been documented (Banerjee *et al.*, 2000; Mamabolo and Webb, 2005; Akpa *et al.,* 2013 ). That morphometric measurement varies positively with age of the animals and the correlations of body weight with diagonal body length, height at wither, sac pelvic width and hearth girth were high, positive and significant has been reported (Ojedapo *et al*., 2007). This study was designed to characterize age based variations of morphological traits within the different breeds.

## MATERIALS AND METHODS

The study was carried out in Borno, Sokoto and Ogun States. These states were selected because they are locations having close to pure breeds of the goats. Animals used for this study were sampled in the abattoir, of Borno, Sokoto and Ogun states when brought for slaughter either by the owner or by the slaughter man. It is believed that all animals find their way into the abattoir from villages and local markets, where they are kept in small numbers by local farmers; they are raised under the extensive system of management. A total of nine hundred (900) goats comprising of three hundred (300) Sahel goats from Borno state, three hundred (300) Red Sokoto goats from Sokoto state and three hundred (300) West African Dwarf goats from Ogun state were used for the study. Each breed consisted of three hundred goats each, made up of fifty males and fifty females distributed in the following age groups <1, 1-2 and 2-3 years. These were evaluated for morphometric characteristics. The pairs of permanent incisors in the dentition of the goat were used to determine age.

The following metric characters were measured on each animal: Body Weight (BW), Age, Horn Length (HL), Ear length (EL), Shoulder width (SW), Neck circumference (NC), body length (BL), Withers Height (WH), Heart Girth (HG), Pouch Girth (PG), Tail Length (TL) and Scrotal circumference (SC). Weights of the animals were taken using a spring balance and Walk-in weighing scale. Flexible measuring tape was used to take the body measurement. During body measurement, animals were made to stand upright and restrained by two assistants in such a way that their heads, necks, and chest were stretched almost in a straight line. Each measurement was taken at least three times and the mean recorded to the nearest centimeter or kilogram. Reference marks used for body measurement according to the method of and Salako and Ngere (2002).

## DATA ANALYSIS

The effects of age, breed, and sex on linear measurement were estimated using the GLM procedure of the statistics analysis software (SAS, 1990) package. These were computed on the basis of interaction with age groups. Means were separated within age groups using Duncan multiple range test.

## RESULTS

Mean body weight in Red Sokoto, Sahel and West African Dwarf goats less than one year are presented in Table 1. The Sahel breed is superior to the other breeds with a body weight of 13.56±0.56Kg and 14.94±0.52Kg in does and bucks respectively. Within the Red Sokoto population, body weight in doe and buck was 13.73±0.51Kg and 12.86±0.42Kg respectively while in West African Dwarf, 10.44Kg±0.22 and 10.62±0.21Kg for does and bucks. Coefficient of variation ranges between 13.98% and 29.40%

suggesting the influence of major genes on this trait. The standard deviation estimates associated with the mean liveweight were generally small, (1.49-3.90). There were no significant ($p>0.05$) differences in liveweight between the sexes within breeds. In Horn length, the Sahel had the highest (7.21±0.33cm and 7.42±0.31cm), while the least values (5.24±0.30cm and 4.99±0.28cm) for does and bucks respectively. Averagely, Red Sokoto showed an intermediate distribution (6.20±0.32cm and 5.22±0.23cm) respectively. Associated coefficient of variation and standard deviation ranges between 29.10% – 40.93% and 1.60-2.27 respectively, suggesting that the measurement is almost independent of the environment. Ear length in the Sahel had the highest values (11.52±0.25cm and 11.06±0.27cm), while the least values (9.56±0.15cm and 9.43±0.17cm) for does and bucks respectively. Averagely, Red Sokoto showed an intermediate distribution (10.22±0.17cm and 9.86±0.15cm) respectively. Associated coefficient of variation and standard deviation ranged between 10.81% – 16.96% and 1.07-1.88 respectively. Red Sokoto goats had the highest values for height at withers (52.06±0.87cm and 51.63±0.81cm), while the least values (42.47±1.42cm and 45.80±1.34cm) for does and bucks respectively was observed in Sahel. West African Dwarf buck had withers height of 47.93±1.13cm and does have 48.07±1.07cm. Associated coefficient of variation and standard deviation ranges between 11.03% – 23.64% and 5.69-10.04 respectively.

For mean pouch girths, Red Sokoto had the highest values (55.37±1.32cm and 59.61±1.11cm), while the lowest values of 51.42±0.77cm and 50.99±0.71cm were observed for does and bucks respectively in WAD. In Sahel goats, pouch girth measured 52.20±0.49cm in bucks and 50.63±0.66cm in does. The coefficient of variation for this trait ranged from 6.70% to 16.83% while standard deviation was from 3.50 to 9.32. Red Sokoto goats had the highest HG values (53.33±1.31cm and 57.53±1.17cm), while Sahel had 49.90±0.49cm and 48.77±0.66cm for does and bucks respectively. WAD bucks had a mean heart girth of 50.15±0.78cm and 49.71±0.73cm for does. Coefficient of variation and standard deviation for heart girth were between 6.74% – 17.33% and 3.46 – 9.24 respectively.

WAD had the highest BL values (42.04±0.83cm and 41.88±0.73cm), while the least values (35.36±1.01cm and 39.56±1.31cm) were for Sahel does and bucks respectively. Red Sokoto bucks and does had body lengths of 41.92±0.67cm and 41.97±0.56cm respectively. Coefficient of variation between 9.50%–23.39% and standard deviation from 3.99 to 9.25 were obtained for this trait. WAD goats had the highest NC values (23.47±0.59cm and 24.39±0.59cm), while the least values (21.02±0.52cm and 23.31±0.64cm) for does and bucks respectively were observed in Sahel goats. Neck circumference was 22.69±0.72cm in does and 23.43±0.61cm in bucks of Red Sokoto. Associated coefficient of variation and standard deviation ranges were between 17.04%–22.48% and 3.67-5.10 respectively. Red Sokoto goats had the highest tail length 11.71±0.30cm (bucks) and 12.08±0.26cm (does). The lowest length of 10.29±0.19cm and 10.27±0.21cm for doe and buck respectively was observed in WAD goat, while Sahel does and bucks had 11.62±0.32cm and 11.97±0.32cm respectively. Associated coefficient of variation and standard deviation were between 12.90% –19.52% and 1.33 – 2.28 respectively. Shoulder width in Sahel does and bucks were 18.18±0.43cm and 18.59±0.36cm, 13.34±0.56cm and 13.83±0.48cm in WAD and 12.75±0.43 and 12.99±0.48 in Red Sokoto does and bucks respectively. Coefficient of variation for this trait was between 13.80% – 29.57% and standard deviation from 2.57-3.94.

**Table 1: Least squares means (X), standard deviation (SD), and coefficient of Variation (CV) of Morphological traits among Red Sokoto, Sahel and WAD goat (< 1 year)**

| | | RED SOKOTO | | | SAHEL | | | WAD | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | | **Doe** | **Buck** | **Total** | **Doe** | **Buck** | **Total** | **Doe** | **Buck** | **Total** |
| BW | N | 50 | 50 | 1 00 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 13.73 | 12.86 | 13.30 | 13.56 | 14.94 | 14.25 | 10.44 | 10.62 | 10.53 |
| | SD | 3.62 | 3.00 | 3.33 | 3.90 | 3.70 | 3.89 | 1.53 | 1.49 | 1.50 |
| | CV | 26.38 | 23.36 | 25.12 | 29.40 | 24.78 | 27.30 | 14.65 | 13.98 | 14.27 |
| EL | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 10.22 | 9.86 | 10.04 | 11.52 | 11.06 | 11.29 | 9.56 | 9.43 | 9.49 |
| | SD | 1.17 | 1.07 | 1.13 | 1.79 | 1.88 | 1.83 | 1.08 | 1.20 | 1.13 |
| | CV | 11.46 | 10.81 | 11.24 | 15.53 | 16.96 | 16.28 | 11.27 | 12.70 | 11.95 |
| SW | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 13.34 | 13.83 | 13.59 | 18.18 | 18.59 | 18.39 | 12.75 | 12.99 | 12.87 |
| | SD | 3.94 | 3.40 | 3.68 | 3.02 | 2.57 | 2.79 | 3.02 | 3.40 | 3.20 |
| | CV | 29.57 | 24.65 | 27.06 | 16.60 | 13.80 | 15.20 | 23.70 | 26.21 | 24.90 |
| NC | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 22.69 | 23.43 | 23.06 | 21.02 | 23.31 | 22.17 | 23.47 | 24.39 | 23.93 |
| | SD | 5.10 | 4.30 | 4.71 | 3.67 | 4.53 | 4.26 | 4.16 | 4.16 | 4.16 |
| | CV | 22.48 | 18.35 | 20.41 | 17.47 | 19.43 | 19.22 | 17.73 | 17.04 | 17.40 |
| BL | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 41.92 | 41.97 | 41.95 | 35.36 | 39.56 | 37.46 | 42.04 | 41.88 | 41.96 |
| | SD | 4.70 | 3.99 | 4.33 | 7.16 | 9.25 | 8.50 | 5.85 | 5.13 | 5.48 |
| | CV | 11.20 | 9.50 | 10.33 | 20.25 | 23.39 | 22.68 | 13.92 | 12.27 | 13.06 |
| WH | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 52.06 | 51.63 | 51.85 | 42.47 | 45.80 | 44.13 | 47.93 | 48.07 | 48.00 |
| | SD | 6.13 | 5.69 | 5.89 | 10.04 | 9.44 | 9.84 | 7.98 | 7.53 | 5.33 |
| | CV | 11.78 | 11.03 | 11.36 | 23.64 | 20.62 | 22.30 | 16.65 | 15.67 | 16.08 |
| HG | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 53.33 | 57.53 | 55.43 | 49.90 | 48.77 | 49.33 | 50.15 | 49.71 | 49.93 |
| | SD | 9.24 | 8.29 | 8.98 | 3.46 | 4.68 | 4.14 | 5.51 | 5.18 | 5.33 |
| | CV | 17.33 | 14.40 | 16.21 | 6.74 | 9.60 | 8.39 | 10.98 | 10.43 | 10.67 |
| PG | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 55.37 | 59.61 | 57.49 | 52.20 | 50.63 | 51.41 | 51.42 | 50.99 | 51.19 |
| | SD | 9.32 | 8.40 | 9.08 | 3.50 | 4.68 | 4.18 | 5.48 | 5.05 | 5.25 |
| | CV | 16.83 | 14.09 | 15.79 | 6.70 | 9.24 | 8.14 | 10.65 | 9.91 | 10.25 |
| TL | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 12.08 | 11.71 | 11.807 | 11.62 | 11.97 | 11.79 | 10.29 | 10.27 | 10.28 |
| | SD | 1.84 | 2.13 | 1.99 | 2.27 | 2.28 | 2.27 | 1.33 | 1.46 | 1.39 |
| | CV | 15.24 | 18.17 | 16.71 | 19.52 | 19.06 | 19.25 | 12.90 | 14.24 | 13.52 |

Horn Length (HL), Ear Length (EL) Shoulder Width (SW) Neck Circumference (NC) Body Length (BL) Wither Height (WH) Heart Girth (HG), Pouch Girth (PG), tail length (TL), scrotal circumference (SC) and Body Weight (BW)

**Table 2: Least squares means (X), standard deviation (SD), and coefficient of variation (CV) of Morphological traits in Red Sokoto, Sahel and WAD goat (1-2years of Age)**

| | | RED SOKOTO | | | SAHEL | | | WAD | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | | **Doe** | **Buck** | **Total** | **Doe** | **Buck** | **Total** | **Doe** | **Buck** | **Total** |
| BW | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 13.60 | 13.51 | 13.56 | 17.13 | 16.86 | 16.99 | 15.45 | 17.65 | 16.55 |
| | SD | 3.25 | 3.03 | 3.12 | 3.01 | 3.48 | 3.24 | 3.79 | 3.14 | 3.63 |
| | CV | 23.85 | 22.40 | 23.03 | 17.56 | 20.61 | 19.04 | 24.51 | 17.81 | 21.96 |
| EL | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 12.24 | 11.88 | 12.06 | 13.82 | 12.81 | 13.32 | 11.25 | 10.52 | 10.89 |
| | SD | 2.15 | 2.24 | 2.19 | 2.81 | 2.67 | 2.77 | 1.54 | 1.63 | 1.62 |
| | CV | 17.58 | 18.83 | 18.17 | 20.30 | 20.80 | 20.79 | 13.70 | 15.47 | 14.87 |
| SW | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 13.31 | 13.54 | 13.42 | 23.24 | 22.58 | 22.91 | 14.12 | 16.23 | 15.18 |
| | SD | 2.12 | 2.86 | 2.51 | 3.10 | 2.99 | 3.05 | 3.42 | 3.44 | 3.57 |
| | CV | 15.91 | 21.11 | 18.66 | 13.32 | 13.26 | 13.30 | 24.21 | 21.19 | 23.54 |
| NC | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 25.87 | 26.16 | 26.01 | 25.33 | 25.97 | 25.65 | 24.73 | 24.69 | 24.71 |
| | SD | 3.72 | 4.61 | 4.17 | 3.14 | 2.44 | 2.82 | 2.49 | 3.29 | 2.90 |
| | CV | 14.37 | 17.63 | 16.03 | 12.38 | 9.43 | 10.98 | 10.07 | 13.34 | 11.76 |
| BL | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 50.93 | 46.83 | 48.88 | 61.14 | 53.76 | 54.77 | 51.84 | 49.23 | 50.54 |
| | SD | 8.54 | 8.47 | 8.71 | 6.56 | 5.28 | 7.03 | 6.86 | 6.13 | 6.60 |
| | CV | 16.76 | 18.10 | 17.82 | 10.73 | 9.81 | 12.84 | 13.24 | 12.44 | 13.07 |
| WH | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 55.47 | 53.60 | 54.53 | 60.58 | 60.12 | 60.63 | 52.20 | 49.37 | 50.79 |
| | SD | 5.42 | 6.44 | 5.99 | 6.16 | 6.22 | 6.37 | 7.40 | 8.51 | 8.06 |
| | CV | 9.78 | 12.01 | 10.99 | 10.17 | 10.33 | 10.52 | 14.17 | 17.24 | 15.87 |
| HG | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 63.92 | 62.14 | 63.03 | 60.58 | 59.87 | 60.23 | 60.80 | 54.73 | 57.77 |
| | SD | 4.22 | 5.07 | 4.73 | 6.16 | 5.56 | 5.85 | 6.37 | 4.75 | 6.37 |
| | CV | 6.61 | 8.16 | 7.50 | 10.17 | 9.29 | 9.72 | 10.47 | 8.68 | 1.103 |
| PG | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 66.13 | 64.49 | 65.31 | 62.98 | 62.06 | 62.51 | 62.54 | 56.01 | 59.28 |
| | SD | 4.11 | 5.29 | 4.78 | 6.18 | 6.74 | 6.45 | 6.99 | 4.82 | 6.82 |
| | CV | 6.21 | 8.20 | 7.32 | 9.82 | 10.86 | 10.32 | 11.19 | 8.61 | 11.51 |
| TL | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 12.27 | 12.79 | 12.53 | 13.48 | 13.43 | 13.45 | 10.95 | 11.56 | 11.25 |
| | SD | 1.91 | 1.76 | 1.85 | 1.81 | 2.20 | 2.01 | 2.05 | 1.74 | 1.92 |
| | CV | 15.55 | 13.80 | 14.74 | 13.49 | 16.41 | 14.94 | 18.78 | 15.08 | 17.07 |

Summarized in Table 2 are Sahel goats had a mean weight of 17.13±0.43Kg and 16.86±0.49Kg followed by West African Dwarf goats with 15.45Kg±0.54 and 17.65±0.44Kg for does and bucks respectively. Red Sokoto goats weighed 13.60±0.46Kg (does) and

13.51±0.43Kg (bucks). Coefficient of variation from 17.56% – 23.85% suggest the influence of major genes on body weight. The standard deviation estimates associated with the mean liveweight were generally small, (3.01-3.79). There was no significant ($p>0.05$) difference between does and bucks within breeds. Results for horn length in goats showed that Sahel had 9.45±0.31cm and 8.64±0.40cm, Red Sokoto (6.91±0.31cm and 6.70±0.24cm) and WAD (6.23±0.33cm and 5.64±0.23cm) for does and bucks respectively. Coefficient of variation (23.27% – 37.42%) was moderate and standard deviation ranged from 1.63 to 2.82. Mean ear lengths indicated the Sahel goats had ear lengths of 13.82±0.40cm and 12.81±0.38cm, 12.24±0.30cm and 11.88±0.32cm for Red Sokoto goats and 11.25±0.22cm and 10.52±0.23cm for WAD does and bucks respectively. Associated coefficient of variation for ear lengths was 13.70% – 20.80%. The mean wither heights in Red Sokoto, Sahel and West African Dwarf goats. Sahel had the highest values (60.58±0.87cm and 60.12±0.88cm), while the least values (52.20±1.04cm and 49.37±1.20cm) for doe and buck respectively was observed in WAD. Red Sokoto showed an intermediate distribution of 55.47±0.77cm for does and 53.60±0.91cm in bucks. Associated coefficient of variation and standard deviation ranges between 9.78–17.24 and 5.42%-8.51% respectively. The mean pouch girth in Red Sokoto had the highest values (55.37±1.32cm and 59.61±1.11cm), followed by Sahel with 52.20±0.49cm and 50.63±0.66cm while the least values of 51.42±0.77cm and 50.99±0.71cm for doe and buck respectively were observed in WAD. Coefficient of variation for pouch girth was between 6.70%–16.83% with standard deviation ranging from 3.50 to 9.32. Mean heart girth in Red Sokoto goats had 63.92±0.60cm and 62.14±0.72cm, Sahel goats had 60.58±0.87cm and 59.87±0.79cm while West African Dwarf goat had 60.80±0.90cm and 54.73±0.67cm for does and bucks respectively. Associated coefficient of variation and standard deviation were between 6.61%–10.47% and 4.22-6.37 respectively. Body length in Sahel does was 61.14±0.97cm and 53.76±0.75cm for bucks, WAD does have a mean body length of 51.84±0.97cm and bucks measured 49.23±0.87cm while Red Sokoto does measured 50.93±1.21cm and 46.83±1.99cm for bucks. Associated coefficient of variation and standard deviation ranges between 9.81%–18.10% and 5.28-8.71 respectively. Mean neck circumference showed WAD goats had the highest values (25.87±0.53cm and 26.16±0.65cm), followed by Sahel goats (25.33±0.44cm and 25.97±0.35cm), then Red Sokoto goats (24.73±0.35cm and 24.69±0.47cm) for does and bucks respectively. Coefficient of variation was from 9.43%–17.63% and standard deviation lies between and 2.44 - 4.61. Tail length in Sahel does was 13.48±0.26cm and 13.43±0.31cm in bucks, 12.27±0.27cm in does and 12.79±0.25cm for Red Sokoto bucks, 10.95±0.29cm and 11.56±0.25cm in West African Dwarf does and bucks respectively. Coefficient of variation for tail length in goats studied ranged between 13.49%–18.78%. The shoulder width measurement showed the Sahel had the highest values (23.24±0.44cm and 22.58±0.42cm), while the least values (13.31±0.30 and 13.54±0.40) for doe and buck respectively were observed in Red Sokoto. Averagely, WAD showed an intermediate distribution (14.12±0.48cm and 16.23±0.49cm) respectively. Associated coefficient of variation and standard deviation ranges between 13.26–24.21 and 2.12-3.57 respectively.

Mean liveweight in Red Sokoto, Sahel and West African Dwarf goats above 2 years are presented in Table 3. Results showed that Sahel goats had a mean weight of 23.60±0.69Kg and 25.12±0.73Kg in doe and buck respectively is superior to Red Sokoto and WAD goats. Within the Red Sokoto population, mean weight was 18.95±0.47Kg and 19.21±0.47Kg; and 19.13Kg±0.29 and 19.35±0.24Kg in West African Dwarf does and bucks respectively. Coefficient of variation ranged from 8.80 –

20.74 suggesting the influence of major genes on live weight of goat breeds studied and standard deviation of 1.70 to 5.05. Sahel goats had the highest horn lengths of 10.53±0.38cm and 10.76±0.36cm, followed by Red Sokoto goats (7.47±0.29cm and 7.29±0.25cm) and least in WAD goats (7.25±0.30cm and 6.81±0.28cm) for doe and buck respectively. Coefficient of variation and standard deviation were between 23.50 – 29.36% and 1.77 - 2.72 respectively. Mean ear length in Sahel had the highest values (13.71±0.33cm and 13.70±0.29cm), while the least values (11.22±0.32cm and 10.64±0.24cm) for doe and buck respectively in WAD breed. Red Sokoto does have a mean ear length 12.33±0.33cm and 11.88±0.21cm in bucks. Coefficient of variation ranged from 12.43%–20.06% and standard deviation was from 1.48 to 2.35. The mean wither height in Sahel goats had 70.51±0.67cm and 72.02±0.58cm, followed by 58.17±0.85cm and 58.56±0.81cm in Red Sokoto goats and 46.62±0.87cm and 45.42±0.78cm in WAD goats for doe and buck respectively. Coefficient of variation and standard deviation were 5.74%–13.19% and 4.14-6.15 respectively. The mean pouch girth in WAD was the highest (69.94±0.92cm and 69.47±0.95cm), Sahel had 66.96±0.48cm and 67.27±0.77cm and Red Sokoto had the lowest (63.46±0.65cm and 63.23±0.57cm) for doe and buck respectively. Coefficient of variation was 5.11%–9.46% and standard deviation ranged from 3.43 to 6.75. The mean heart girth in Red Sokoto goats had the highest (68.93±0.64cm and 68.57±0.54cm), followed by Sahel goats (64.61±0.48cm and 65.69±0.33cm) and WAD goats with 61.15±0.65cm and 60.64±0.58cm for doe and buck respectively. Associated coefficient of variation and standard deviation ranges between 3.58%–7.57% and 2.35-4.53 respectively. Body length for Sahel goats was 58.53±0.82cm and 56.28±0.99cm, 43.76±0.86cm and 43.69±0.66cm in West African Dwarf goats and 43.76±0.86cm and 43.69±0.66cm in Red Sokoto goats for doe and buck respectively. Associated coefficient of variation and standard deviation ranges between 9.86%–23.35% and 4.70-10.51. Mean neck circumference was 27.70±0.37cm and 27.15±0.35cm in Red Sokoto goats, 27.16±0.61cm and 26.52±0.55cm in Sahel goats and WAD goats had 24.91±0.51cm and 24.66±0.38cm respectively in does and bucks. Coefficient of variation was from 9.06% to 15.70% and standard deviation ranged from 2.44 - 4.61 for this trait. Similar and high tail lengths for Sahel (12.69±0.27cm and 12.90±0.31cm) and Red Sokoto goats (13.15±0.30cm and 12.45±0.24cm) were observed while WAD goats had 11.81±0.22cm and 11.93±0.20cm for does and bucks respectively. Coefficient of variation was between 11.97% and 16.84%; standard deviation ranged from 1.71 to 2.13. The shoulder width measurement in Red Sokoto, Sahel and West African Dwarf breed in this study. Sahel goats had 24.97±0.37cm and 24.71±0.44cm, followed by WAD (19.65±0.58 and 19.93±0.70) and Red Sokoto goats with 14.98±0.38cm and 15.40±0.41cm for doe and buck respectively. Associated coefficient of variation was 10.61%–24.96% and standard deviation ranged from 2.65 to 4.97.

**Table 3 : Least squares means (X),standard deviation (SD),standard error( SE), and coefficient of variation (CV) of morphological traits among Red Sokoto, Sahel and WAD goat of Age > 2years**

| | | RED SOKOTO | | | SAHEL | | | WAD | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Parameter** | | **Doe** | **Buck** | **Total** | **Doe** | **Buck** | **Total** | **Doe** | **Buck** | **Total** |
| BW | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 18.95 | 19.21 | 19.80 | 23.60 | 25.12 | 24.36 | 19.13 | 19.35 | 19.24 |
| | SD | 3.30 | 3.33 | 3.30 | 4.85 | 5.18 | 5.05 | 2.06 | 1.70 | 1.88 |
| | CV | 17.39 | 17.34 | 17.29 | 20.55 | 20.64 | 20.74 | 10.76 | 8.80 | 9.78 |
| HL | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 7.47 | 7.29 | 7.38 | 10.53 | 10.76 | 10.64 | 7.25 | 6.81 | 7.03 |
| | SD | 2.06 | 1.77 | 1.91 | 2.72 | 2.53 | 2.61 | 2.13 | 1.97 | 2.05 |
| | CV | 27.54 | 24.22 | 25.87 | 25.82 | 23.50 | 24.56 | 29.36 | 28.94 | 29.21 |
| EL | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 12.33 | 11.88 | 12.11 | 13.71 | 13.70 | 13.71 | 11.22 | 10.64 | 10.93 |
| | SD | 2.34 | 1.48 | 1.96 | 2.35 | 2.05 | 2.19 | 2.25 | 1.72 | 2.01 |
| | CV | 18.90 | 12.43 | 16.19 | 17.11 | 14.97 | 15.99 | 20.06 | 16.19 | 18.44 |
| SW | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 19.65 | 19.93 | 19.79 | 24.97 | 24.71 | 24.84 | 14.98 | 15.40 | 15.19 |
| | SD | 4.08 | 4.97 | 4.53 | 2.65 | 3.10 | 2.87 | 2.72 | 2.91 | 2.81 |
| | CV | 20.77 | 24.96 | 22.88 | 10.61 | 12.55 | 11.56 | 18.13 | 18.91 | 18.49 |
| NC | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 24.91 | 24.66 | 24.76 | 27.16 | 26.52 | 26.91 | 27.70 | 27.15 | 27.42 |
| | SD | 3.58 | 2.67 | 3.15 | 4.26 | 3.87 | 4.06 | 2.59 | 2.46 | 2.53 |
| | CV | 14.38 | 10.83 | 12.69 | 15.70 | 14.54 | 15.09 | 9.36 | 9.06 | 9.22 |
| BL | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 45.01 | 45.93 | 45.47 | 58.53 | 56.28 | 57.40 | 43.76 | 43.69 | 43.72 |
| | SD | 10.51 | 9.75 | 10.10 | 5.77 | 5.58 | 5.76 | 6.07 | 4.70 | 5.40 |
| | CV | 23.35 | 21.23 | 22.20 | 9.86 | 9.92 | 10.03 | 13.88 | 10.76 | 12.35 |
| WH | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 58.17 | 58.56 | 58.37 | 70.51 | 72.02 | 71.26 | 46.62 | 45.42 | 46.02 |
| | SD | 5.98 | 5.71 | 5.82 | 4.76 | 4.14 | 4.50 | 6.15 | 5.54 | 5.85 |
| | CV | 10.28 | 9.75 | 9.97 | 6.75 | 5.74 | 6.31 | 13.19 | 12.20 | 12.72 |
| HG | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 61.15 | 60.64 | 60.89 | 64.61 | 65.69 | 65.15 | 68.93 | 68.57 | 68.75 |
| | SD | 4.63 | 4.09 | 4.35 | 3.39 | 2.35 | 2.95 | 4.53 | 3.79 | 4.16 |
| | CV | 7.57 | 6.74 | 7.15 | 5.25 | 3.58 | 4.53 | 6.58 | 5.52 | 6.05 |
| PG | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 63.46 | 63.23 | 63.35 | 66.96 | 67.27 | 67.12 | 69.94 | 69.47 | 69.71 |
| | SD | 4.62 | 4.05 | 4.32 | 3.43 | 5.46 | 4.54 | 6.50 | 6.75 | 6.60 |
| | CV | 7.28 | 6.41 | 6.83 | 5.11 | 8.11 | 6.76 | 9.29 | 9.72 | 9.46 |
| TL | N | 50 | 50 | 100 | 50 | 50 | 100 | 50 | 50 | 100 |
| | X | 13.15 | 12.45 | 12.80 | 12.69 | 12.90 | 12.80 | 11.81 | 11.93 | 11.87 |
| | SD | 2.13 | 1.71 | 1.96 | 1.92 | 2.17 | 2.04 | 1.57 | 1.43 | 1.49 |
| | CV | 16.20 | 13.77 | 15.28 | 15.12 | 16.84 | 15.96 | 13.30 | 11.97 | 12.59 |

## DISCUSSION

Live weight is important for assessing the condition of the animal and represents a criterion of selection. Mean live weight of 13.73 Kg, 13.56 Kg, 10.44 Kg and 12.86 Kg, 14.94 Kg and 10.44 Kg for does and bucks for the three breeds respectively for age less than one year are within the range of 12-18 Kg reported by Katongole *et al*. (1996) for indigenous goats in Kenya. Mean live weight of 13.60 Kg, 17.13 Kg, 15.45 Kg and 13.51 Kg, 16.84 Kg and 17.65 Kg for does and bucks between the age one through two years are lower than values of 20-40kg reported by several authors (Akpa *et al*., 1998, Otoikhan *et al*., 2008 and Salako *et al*., 2006) in different breeds of goat. Mean live weight of 18.95 Kg, 23.60 Kg, 19.13 Kg and 19.21, 25.12 Kg and 19.35 Kg for does and bucks above two years are closer to the range reported by several authors (Akpa *et al*., 1998, Osuhor *et al*., 2002 and Otoikhan *et al*., 2008), with Sahel breed fell within the specified range of 20-40 Kg. The average body weight at different ages fell within the range of 16-30 Kg specified by Hassan and Ciroma (1990) for both does and bucks from age 1-5 years in different breeds of goats. The associated coefficient of variation which range between 13.98 and 29.40 across the breeds suggests absence of selection criterion and is also a pointer to the presence of major genes since live weight is a quantitative trait and under the influence of many genes of small effect.

The body confirmation traits measured in this present study were comparable to those reported by Ibrahim (2010) for Red Sokoto goats. These measurements were less variable than previous measurements on Red Sokoto goats (Akpa *et al*. 1998) including for both lactating and dry does. The variability of body weight suggests possibility of improving this trait through careful selection. The sex dependent variation recorded among the breeds was also observed by Salako *et al*., (2006) who commented that the does differ from the bucks in that they have slower growth rate, earlier maturing carcass and reaches a lower matured sized due to the effect of oestrogen in restricting the growth of long bones of the body. Hassan and Ciroma (1990) also reported that bucks were heavier than does which lend credence to the findings of this study on the average. Results revealed that sex is an important source of variation for liveweight and body measurements. The sex influenced might be partly due to hormonal effect, that is, non-release of androgen (which is partly due to have weight and growth stimulating effects) in male animals until testes are well developed (Akpa *et al.*, 1998). This report is in consonance with the report of Devendra and Burns, (1983) that both sex and strains significantly influenced bodyweights and linear traits. This however contrast the report by Otoikhan *et al*. (2008) that sex has no influence on weight gain of Red Sokoto and West African Dwarf goat since non-significant difference was found on the overall body weight of the animals. The discrepancy in the reports could be ascribed to breed, age and environmental differences. Umoren and Orok (1994) observed that male animals generally have higher linear body measurement than females. Adu *et al*. (1978) made similar observations in the four indigenous sheep breeds of Nigeria, Salako and Ngere (2002) in WAD. The observation is comparable to the values obtained in this study where inspection of ordinary mean figures showed that males appear superior to females. The relationships between BW and morphological traits appeared to be higher in bucks than in does.

The average height at wither for bucks and does in this study (58.91 and 57.23 cm) is within the range reported by Hassan and Ciroma (1990) whose observations ranged between 56-67 cm. The average body length (48.25 and 47.92 cm), horn length (7.88 and 7.89cm), heart girth (59.42 and 58.67 cm), pauch girth (60.05 and 60.68 cm), neck circumference (24.36 and 25.23 cm), ear length (11.64 and 11.57 cm), tail length (11.89 and 12.07 cm) and scrotal circumference (0.00 and 17.04 cm) for does and bucks are within the range reported by Salako (2002) in different goat breeds. Katongola *et al*.(1996) for

indigenous goats in Kenya, Samakula *et al*. (2010) for Mubemde and South East African goat breed, and Abubakar (2012) in Red Sokoto goats. Also, the report of this finding is in agreement with the observation of Salako and Ngere (2002) on body parameters in WAD. However, Ibrahim (2010) reported a shorter body length in Red Sokoto goats which was contrary to the observed longer body length recorded in this study. This could probably be due to the different age classification methods used in this study. In normal animals, increase in age leads to increase in size; this may be the cause of variation in body length. The observed body measurements are within the range reported by Hassan and Ciroma (1990). The low coefficient of variation among the morphometric traits reflects poor environmental sensitivity in all the studied breeds.

## CONCLUSION

Present results showed that age has strong influence, as there were consistent increases in all the traits studied as the animals aged. The scenario is however not surprising since the size and shape of the animal is expected to increase as the animal is growing with age. There was wide variability as the age of the animals increased most particularly in the bodyweight. This was in consonance with the report of Orheruata and Olutogun, (1984) in cattle.

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