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STUDIES ON SOME PHENOTYPIC TRAITS OF WEST AFRICAN DWARF GOATS IN DERIVED SAVANNAH ZONE OF NIGERIA

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ABSTRACT

In the Ejigbo Local Government Area of Osun State, a Nigerian derived savanna zone, a study was carried out to examine certain phenotypic characteristics of West African dwarf goats. Three hundred ninety-nine (399) West African dwarf goats were sampled in order to determine their live weight and body measurements. Analysis was done on data pertaining to 194 bucks and 205 does. These were categorised into six age groups (milk teeth, 2-teeth, 4-teeth, 6-teeth, 8-teeth, and worn teeth) and recorded by sex. In order to characterise the goat breeds in the trial region, the goal was to give comprehensive information on linear body measurements. For both sexes, body measurement values rose significantly ($P<0.05$) with age. For bucks, the mean body weight was 5.32 ± 0.15 to 29.63 ± 1.88 kg, while for does, it was 5.75 ± 0.13 to 30.29 ± 1.22 kg physical weight and other physical characteristics were discovered to differ by sex. In animal genetic resources, body weight and linear body measurements are economically significant features, particularly for small ruminants like goats during selection and to give precise weight determination in remote locations without a scale. Linear measurements and body weight are important traits in meat animals. Quantitative measurements of the ideal body size and form are obtained from the analysis of body measuring data, which enables the computation of genetic parameters for these features and their incorporation into breeding plans. Given the high correlation and regression coefficients of linear body measurements in West African dwarf goats, the results of this study suggest that live weight can be predicted using certain body measurements. Lastly, there was a significant and favourable correlation between body weight and body measurements. Given this, it might be applied as a criterion for selection.

1. INTRODUCTION

Goats are the most prolific livestock species produced in Africa, where they make up to 35% of the global population Olutogun et al., (2023). This may be as a result of the important responsibilities that goats play in helping families in the majority of rural Africa, as well as their contributions to employment, money creation, soil fertility management, nutrition, and food security. In Nigeria, they are present in all of this genetic part of the country. Their geographical locations depend on their relative abilities to adapt to a particular environmental condition and stress.

The resources, which are contingent upon access to variety, as the breeder must work with the amount of variation present in the population Idowu & Adelabu (2018). A thorough understanding of phenotypic diversity is thus required, as it serves as an objective foundation for any improvement program, necessitating the research of breed-important features. Variation can occur from either a phenotypic or genetic basis. The former contained quantitative and qualitative features, whereas the latter included structural loci (electrophoretic variation) and *DNA* variation, respectively Khan et al., (2006).

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Domestic animal estimation has been a disaster for breeders and researchers. Previously, this was primarily regarded as an art of estimation based on the actual or alleged relationship between the conformation and productive qualities of the animals Alefe (2014). With the advent of body measurements towards the end of the last century, the evaluation of domestic animals gained significant technical and scientific importance.When it was realised both phenotypic as well as genotypic assessments of animal species were necessary for successful selection programs, which is one of the tools a breeder must use, the evaluation of morphological types by merely examining the relationship between body measurements and production was rightfully revalued over the past century Zehnder et al., (1997).

Goat populations from several sub-regions of Sub-Saharan Africa have remained genetically separate, with significant variety in size and coat colors Morruppa and Ngera (1986) & Osinowo et al., (1989). Morphometric data are critical for evaluating the characteristics of animal breeds and providing critical insight on the appropriateness of animals for sustainable breeding and conservation Slippers et al., (2000) & Pace and Wakeman (2003).

When approximated, an observable or measurable difference among individuals within a population for a specific characteristic provides a viable direction in creating a long-term genetic improvement program. Mohammed and Amin (1996) observed that the beginning points for defining a quantitative attribute in a population is the mean of that population; the remainder of the description may then include how many people ranked above or below the population mean. The phenotypic variance among West African dwarf goat populations in the derived savanna zone of Nigeria is the focus of this study. This investigation will contribute to the Nigerian small ruminant genetic resources databank and complete some of the systematic evaluation of size and conformation for the populations under study, in addition to offering an objective foundation for focussing future development initiatives. The goal of this project is to create a database of genetic resources for small ruminant animals in Nigeria.

2. MATERIALS AND METHODS

Location of the study

The study was conducted in the rural regions of six LGAs in Oyo and Osun State, Nigeria: Ogbomoso North, Ogbomoso South, Ogo-Oluwa, Surulere, Orire, and Ejigbo. Situated at latitude 8.1227°North of the equator and longitude 4.2436°East of the Greenwich Meridian, the research regions were part of Nigeria's derived savanna region. It is between 300 and 6000 meters above sea level, and it receives 1247 mm of rainfall and 27°C in temperature annually Idowu and Adelabu (2018). The dry season, which lasts from November to February and has an average rainfall of less than 25 mm, is typically followed by a strong rainfall period from March to October. During the peak of the dry season, vegetable growth slows down, which lowers the amount of feed available for growth. In the regions, cattle, goats, sheep, and poultry are the most common native livestock.

Experimental animals and management

For the study, a sample of 399 West African dwarf goats in various age categories was selected. Depending on the owner's financial situation and the availability of crop residues, grains, seasons, and kitchen wastes, these goats were traditionally raised using extensive or semi-intensive husbandry. These changes were typically made to complement the primary feed source, which is forage browsing along major roads, fallow plots, and backyard areas. They were typically not intentionally fed, and supplements were typically given based on availability.

In the roaming range, flocks of numerous owners typically lacked boundaries, and male and female animals ran together in the flocks. Thus, numerous flocks could be considered one flock. The animals were not recorded. Not many owners brought their animals to graze on verdant pastures. Generally speaking, ethno-veterinary medicine was widely practiced. They were not improved by deliberate breeding and selection.

Age determination

The ages of the animals were generally unknown due to the nature of management and the lack of animal records. As a result, the primary function of dentition was to estimate the animals' age range. Dentition Pace and Wakeman (2003) was nevertheless utilised to place the animals into predetermined age brackets in the few instances where the owner was unaware of the true ages of his animals. Table 1 shows the number of pairs of permanent incisors or their absence in the lower jaw.

Duration/periods of data collection

The measurements were taken between November 2013 and May 2014, a span of twenty-seven weeks. With the exception of Ejigbo, the sixth local government area, where sixty-nine goats were measured, sixty-six goats were selected at random and measured in each of the five local governments. For precise measurements, which are accessible in the morning and evening, each local government area was

visited fifteen times. The tattooing technique was utilised to distinguish the prior sample.

Sample size

In all, 399 West African dwarf goats—194 males and 205 females—were sampled for quantitative characteristics (body measurements). These were documented based on the six age categories and sex. The following were the sample sizes for milk teeth, two teeth, four teeth, six teeth, eight teeth, and wither teeth: 29 (12 males and 17 females), 30 (11 males and 19 females), 18 (10 males and 8 females), 68 (47 males and 21 females, 39 (8 males and 31 females), and 215 (106 males and 109 females) were all present.

Body measurements

An attendant hired for the purpose of the study properly restrained the animals in a standing position while taking detailed measurements. Live weight (LW), height at withers (WH), rump height (RH), shoulder width (SW), rump width (RW), heart girth (HG), body length (BL), foreleg length (FL), tail length (TL), face length (FL), and rump length (RL) are among the ten metric features that are measured on each animal. For each animal sampled, the corresponding age group and sex were noted. The linear body measures' anatomical points of reference followed the procedures of Greyling et al (1994), Krausgrill et al (1996) & Searle et al (1989). Live weight was measured using an electronic Camry scale of model TCS-100-JE62ZB, sensitivity of 50g witha capacity of 100kg of class 111 with serial number:210400549 Raymond *et al* (1982).

A flexible tape was used to take measurements of the length and circumference, and a measuring stick was used to measure the height Khan et al., (2003) & Hassan and Ciroma (1992)

The parts measured were as follows:

Withers height (WH): The separation between the ground and the most cranial, perceptible spinous. The distance between the top of the pelvic girdle and the floor is known as the "rump height" (RH). Shoulder width (SW), commonly known as the broadest point over the intra-spinatus muscle, is measured as the horizontal distance between the two shoulders.

When viewed from the upper surface or from the acetabulum at the fermoralanticalation, the width across the fusion of the animal's sacral vertebrae and pelvic bone towards the posterior end is known as the "rump width" (RW).

The measurement of the body's circumference at the narrowest point, directly below the shoulder, perpendicular to the body axis, was called the heart girth (HG).

Rump length (RL): The separation between the pin bone (Tuber ischi) and the pelvic girdle (Tuber coxa). To make measurement easier, two assistants held each animal in an unforced position. Body length (BL): Measured diagonally between the pin bone and the scapular lateral tuberosity. The distance between the mid-lateral point of the coronet and the proximal extremity of the olecranon process is known as the foreleg length (FL). Tail length (TL): The distance between the base of the tail and the coccygeal vertebrae's end.

Statistical analysis

The SAS (2003) statistical program was used to calculate descriptive statistics for each parameter, including mean, standard deviation, standard error, and coefficient of variation. Additionally, a General Linear Model was used to analyse the data. Age group and sex were the variables that were incorporated into the model as sources of variation. The statistical model used was:

$Yijk = \mu = ti + bij + \varepsilon ijk$

Where Yijk– Individual observation for the jth treatment

μ = General mean

ti = Effect of ith (age-group)

bij = Effect of jth (sex)

εijk = Experimental error

Under the following presumptions:

a. The effects of sex and age group were cumulative.

b. The experimental errors had a shared variance, NID (0, $\sigma 2$), and were independently, randomly, and normally distributed with a mean of zero. To examine the discrepancies between means, Duncan's Multiple Range test was employed.

3. RESULTS AND DISCUSSION

Live weight, wither height, and rump height

Live weight changes of West African Dwarf goats are presented in Table 1. The results showed that mean live weight increased steadily from 5.31± 0.51 to 29.63 ± 1.88 kg in buck and from 5.75 ± 0.13 to 30.29 ± 1.22 kg in the does. The standard deviation within the group did not follow any particular trend. Coefficient of variation ranges from 3.77 to 29.22% in buck and 4.41 to 23.55% in does within the age-group. Age-group significantly ($P<0.05$) influenced live weight as it increased from zero teeth to wither age.

Sex did not show any significant difference (P> 0.05) within the age-group.

Descriptive statistics of wither height are presented in Table 2. mean value ranges from 29.39 ± 0.43 to 55.77 ± 2.04 cm in male and 29.60 ± 0.33 to 56.61 ± 1.3 cm in female. Wither height increased significantly (P<0.05) with age in both sexes. There were no significant differences (P>0.05) between sexes in 0 and 2 teeth ages for this parameter, significant differences (P>0.05) were not observed for 4 teeth, 6 teeth, 8 teeth and worn teeth (Table 2). Standard deviation did not follow any definite pattern, coefficient of variation ranges from 4.39 to 15.05% in male and 5.36 to 11.81% in female, respectively.

Results obtained for rump height are presented in Table 3. Mean value ranged from 32.00 ± 0.43 to 59.09 ± 1.89cm in male and 32.98 ± 0.31 to 59.74 ± 1.24cm in female, the result indicates that mean value increased significantly (P<0.05), with age in both sexes and their standard deviation did not follow any definite pattern. Coefficient of variations is within the range of 3.60 to 13.89% in male and 5.90 to 9.89 % in female. Males were generally more variable than female, and they were significantly (P<0.05) longer than females in all ages except worn out teeth age where no significant difference was observed.

Shoulder width, rump width, and heart girth

Trends in the growth of shoulder width are summarized in Table 4 with respect to sex; and the mean value showed that male WAD goats were within the range of 13.17±0.94 to 24.27±0.73cm and female were within the range of 13.54 ± 0.10 to 23.26 ± 0.39cm. Mean value increased (P<0.05) with age in both sexes. Coefficient of variation ranged from 7.37 to 9.94% and 3.87 to 7.28% in male and female WAD goats, respectively. The trait showed no sexual dimorphism.

Rump width (Table 5) was within the range of 11.42 ± 0.11 to 21.82 ± 0.89 cm in male WAD and 11.86 ± 0.11 to 21.79 ± 0.63cm in female WAD goats. Males were significantly longer (P<0.05) at 0 teeth, 4 teeth, and wither age than females. The mean value generally increased with age in both sexes (P<0.05). Coefficients of variation are within the range of 3.08 to 13.57 in males and 3.97 to 12.55% in females.

Results also revealed that heart girth (Table 6) mean value ranged from 41.83±0.61 to 86.14±2.16 cm and 42.84±0.49 to 87.13±1.97 cm in male and female WAD goats respectively. Coefficients of variations are within the range of 4.14 to 14.91% in male and 4.41 to 9.89% in female. No significant differences (P>0.05) were observed between sexes at all ages, however, the trait increased with age in both sexes while the highest value was observed for wither age.

Body length, foreleg length and tail length

Changes in body length of the studied WAD goats are presented in Table 7. The result showed that mean body length measured from 26.58 ± 0.45 to 43.27 ± 0.27cm in male and 26.94 ±0.37 to 43.53 ± 0.33cm in female. Significant differences (P< 0.05) were observed between ages in both sexes. Co-efficient of variation ranged between 1.37 to 17.49% and 2.23 to 14.18% in male and female WAD goats respectively.

Changes in foreleg length of the studied WAD goats are presented in Table 8. The results showed that mean foreleg length increased from 19.20±0.27 to 32.88±0.68 cm in male and 19.51±0.23 to 33.19±0.61cm in female WAD goats. Significant differences (P<0.05) were observed between ages in both sexes. Coefficient of variation ranged between 2.36 to 14.65% and 3.82 to 12.29% in male and female WAD goats, respectively.

Descriptive statistics of tail length (Table 9) showed that the mean value ranged from 6.41±0.13 to 9.0±0.01cm for male and 6.61±0.12 to 9.0 ± 0.01 cm for female, the value increased significantly (P<0.05) with respect to age in both sexes. Coefficients of variation were within the range of 5.79 to 20.51% for male and 6.03 to 19.34%. Both sexes were generally variable, and standard deviation did not follow any definite trend.

Face length and rump length

Mean face length of WAD goat population is presented in Table 10 with respect to sex. The value ranged from 11.45±0.21 to 20.27±0.19 cm in male and 11.19± 0.16 to 20.00±0.25 cm in female. The value increased significantly (P<0.05) with age in both sexes (Table 10). Significant differences (P<0.05) were also observed between sexes in favour of female WAD goat. Coefficient of variation ranged from 1.96 to 18.40% for male and 2.98 to 16.79% for the female.

Results also revealed that the mean values ranged from 14.29±0.18 to 21.64±0.20 cm in male and

14.9±0.12 to 21.53±0.47 cm in female. Age significantly (P<0.05) affects the growth of the trait as it increases with the age in both sexes. Coefficients of variation are within the range of 4.4 to 15.08% in male and 4.89 to 18.15% in female populations. Sex significantly affects the growth of the trait in favor of male WAD goats.

Mean values rump length ranged from 14.29±0.18 to 21.64±0.20 cm in male and 14.9±0.12 to 21.53±0.47 cm in female. Age significantly (P<0.05) affects the growth of the trait as it increases with the age in both sexes. Coefficients of variation are within the range of 3.12 to 15.08% in male and 4.89 to 18.15% in female populations. Sex significantly affects the growth of the trait in favour of male WAD goats.

Live weight

Live weight is the most often used size measurement in ruminant production. Morruppa and Ngere (1986) indicated that live weight of Red Sokoto goats ranged from 6.3 to 7.0 kg at milk teeth age; however, the values found in this study ranged from 5.3 to 5.75 kg for male and female goats, respectively. An animal's physical measurements are heavily influenced by its age. Individual components of bodily size are growing at a disproportionate rate. The study found that the age group had a substantial effect on linear body measurements. This finding was consistent with previous research on goats Akpa *(*1998) & Mohammed and Amin (1996). The lower value could be attributed to the herd's nutritional status as well as breed differences, as WAD goats are a small breed of goat. This is consistent with Hall (1991), who observed that sheep and goats in Southern Nigeria were significantly smaller than those in Northern Nigeria. The value obtained in this study differed slightly from that of Osinowo et al., (1989) for Red Sokoto goats but coincided with the findings of Otoikhian (2005). Fajemilehin and Salako (2008) showed comparable results for the same age group of WAD in Nigeria's forest zone.

Slippers et al., (2000) reported higher value in Nguni goats of South Africa. Values reported for other ages groups; 2 teeth age, 4 teeth age, 6 teeth age, 8 teeth age, worn wither teeth age are 10.38 kg, 13.81 kg, 16.47 kg, 20.48 kg and 29.63 kg for males and 10.22 kg, 13.62 kg, 17.31 kg, 21.50 kg and 30.29 kg for female goats, respectively. Khan et al., (2006) reported that for 4-12 months, 12-18 months, 19-24 months and 25-36 months and above were 18.6±1.81 kg, 25.25±2.76 kg, 29.86±1.2 kg and 41.47±1.63 kg for male and 14.50± 1.19 kg, 21.0±3.47 kg, 24.00±1.21 kg and 33.95±4.97 kg for female goats, respectively. These variations may be due to better nutritional and environmental conditions, however, Mukherjee et al., (1986) reported values closer to the one observed in this study. Ngere et al., (1984) and Egena (2010) associated variation in body weight values to affect breed and environment, however, Fajemilehin and Salako (2008) in their study reported closer results for the same age group.

Withers height, rump, height and shoulder width

Mean wither height of West African Dwarf goat observed in this study showed a steady increase with age (Table 4.2). This is in line with reports of Hassan and Ciroma (1992) in both sexes that body measurements increased as the animals advanced in age, however, value reported for different age groups, 1-2 yrs, 3-4yrs and 5 yrs were 16.67±0.56, 24.01±0.62 and 30.30±0.10cm for males and 16.16±0.55, 21.65±0.68, and 29.75±1.26cm in females. For the present study, values obtained were 29.39±0.43 cm, 36.79±0.38, 41.75±0.65, 44.10±0.69, 50.00±1.13 and 55.77±2.04cm for male and 29.6±0.33, 35.62±0.77, 40.60±0.39cm, 46.25±1.51, 48.71±0.75 and 56.61±1.33cm for female. Male WAD goats showed superior values over female at zero teeth age, 2 teeth age, 4 teeth age and 8 teeth age, respectively. Female showed superior values at other age groups. From Fajemilehin and Salako (2008) it was observed that height at withers were within the range of 29.02±1.07 to 45.22±0.37 cm for both sexes, thus very similar to values obtained in this study. Mean value of rump height likewise increased with age. Salako (2004) reported values similar to the results of this study, however, there was a large variation when compared with the work of Hassan and Ciroma (1992) in similar age groups, where they reported 57.49±0.51 to 67.39±0.63 cm in both sexes compared to 32.00±0.43 to 59.74±1.24cm in both sexes in this study. These variations might be due to breed differences, effect of sex followed the same trend with high at wither.

The results for shoulder width in this study compared favourably well with the results of Slippers et al. (2000) who reported higher value in South African goats. The values obtained in this study for males range from 13.17±0.94 cm to 24.27±0.73 cm for male and 13.54±0.40 to 23.26±0.39cm for female in all age groups. Morruppa and Ngera (1986) reported closer

values for Red Sokoto goats of similar age groups. The differences observed in favour of the male goats agreed with earlier reports by Ngere et al., (1984).

Rump width, heart girth, body length, and foreleg length

Rump width, heart girth, body length, and foreleg length increased significantly ($P<0.05$) in both sexes up to wither age, indicating that WAD goat had fully expressed their genetic potentials at this age groups and that selection for any particular trait can best be carried out at this age-group for breed improvement. For this research, heart girth value ranged from 41.83±0.61 to 86.14±2.16cm for male and 42.84±0.49 to 87.13±1.97cm for female. Sex differences in tooth age and wither age were noticeable but favored females; this result confirmed the study of Fajemilehin and Salako (2008), who observed values ranging from 38.36±1.8 to 59.51±0.21 cm in both sexes. They proposed that sex was a major source of variance for bodyweight and other body measures, and that does (females) outgrew bucks (males) because females grow faster. This observation was supported by the findings of Devendra and Burns (1983), Ifut *et al.*, (1991) & Akpa *(*1998), as opposed to Olutogun et al., (2023). The tendency was also seen in rump width, foreleg length, and body length.

Tail length, face length and rump length

Tail length, face length, and rump length all grew at the same rate as the other body parameters studied in this study. Tail length ranged from 6.41±0.13 to 9.00±0.00 cm for males and 6.61±0.12 to 9.0±0.00 cm for females, while face length ranged from 11.45±0.21 to 20.27±0.19cm for males and 11.19±0.16 to 20.00±0.52cm for females. Male rump length ranges from 14.29±0.18 to 21.64±0.20 cm, while female rump length ranges from 14.91±0.12 to 21.52±0.47 cm. These findings were consistent with those of other researchers. Morruppa and Ngera (1986) claimed a greater value for Red Sokoto goats, however Osinowo et al., (1989) reported a lower value.

4. CONCLUSION

Based on linear body measures, estimating the body weight of West African dwarf goats is easy and precise. Linear measurements and body weight are important traits in meat animals. Quantitative measurements of the ideal body size and form are obtained from the analysis of body measuring data, which enables the computation of genetic parameters for these features and their incorporation into breeding plans.

Any development program aimed at increasing goat meat yield should take into account the significant effects that both sex and age have on body measurements at various ages. Finally, body measures exhibited a substantial and positive connection with body weight. In light of this, it could be utilized as a selection criterion. Earlier investigations also revealed that selecting based on measures boosted meat production.

5. RECOMMENDATIONS

Changes in body weight require adjustments to linear body measures. Because different livestock species have distinct parameter connections, equivalent database information must be created for more livestock species to prevent mistakes from the past. The relationships between body weights and linear body measurements in all goat breeds at different ages and localities in West Africa require further study.

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7. CONFLICT OF INTEREST

All authors declared that there is no conflict of interests regarding the publication of this article.

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Table 1. Least square means, standard deviation, standard error, and coefficient of variation, for body weight (BW) of WAD goat at various age groups

Age group	Parameter	Male	Female	Total
0 teeth	N	106	109	215
	$\bar{X}$	5.31	5.75	5.55
	S.D	1.55	1.35	1.47
	S.E	0.15	0.13	0.10
	CV	29.22	23.55	26.53
2 teeth	N	47	21	68
	$\bar{X}$	10.38	10.22	10.33
	S.D	1.13	1.26	1.17
	S.E	0.17	0.27	0.14
	CV	10.93	12.32	11.30
4 teeth	N	8	31	39
	$\bar{X}$	13.83	13.62	13.66
	S.D	1.07	0.77	0.83
	S.E	0.38	0.14	0.13
	CV	7.72	5.68	6.07
6 teeth	N	10	8	18
	$\bar{X}$	16.47^{b}	17.31^{a}	16.84
	S.D	0.62	0.96	0.88
	S.E	0.20	0.34	0.21
	CV	3.77	5.55	5.21
8 teeth	N	12	17	29
	$\bar{X}$	20.48^{d}	21.08^{c}	20.63
	S.D	0.95	3.07	1.46
	S.E	0.28	1.08	0.27
	CV	4.65	4.41	6.91
Wither	N	11	19	30
	$\bar{X}$	29.63	30.29	30.05
	S.D	6.22	7.12	6.70
	S.E	1.88	1.63	1.22
	CV	20.99	23.50	22.30

Means with different superscripts within age group are significantly different (P<0.05

Table 2. Least Square Means, Standard Deviation, Standard Error and Coefficient of Variation of Wither Height (WH) for WAD Goats at Various Age Groups

Age group	Parameter	Male	Female	Total
0 teeth	N	106	109	215
	$\bar{X}$	29.39[f]	29.60[e]	29.50
	S.D	4.43	3.50	3.98
	S.E	0.43	0.33	0.27
	CV	15.08	11.81	13.48
2 teeth	N	47	21	68
	$\bar{X}$	36.79[c]	35.62[d]	36.43
	S.D	2.57	3.51	2.92
	S.E	0.38	0.77	0.35
	CV	7.00	9.87	8.02
4 teeth	N	8	31	39
	$\bar{X}$	41.75[d]	40.60[e]	40.83
	S.D	1.83	2.18	2.14
	S.E	0.65	0.39	0.34
	CV	4.39	5.36	5.24
6 teeth	N	10	8	18
	$\bar{X}$	44.10	46.25	45.06
	S.D	2.14	4.27	3.35
	S.E	0.69	1.51	0.79
	CV	4.95	9.23	7.44
8 teeth	N	12	17	29
	$\bar{X}$	50.00	48.71	49.24
	S.D	3.91	3.10	3.45
	S.E	1.13	0.75	0.64
	CV	7.82	6.36	7.01
Wear Worn teeth				
	N	11	19	30
	$\bar{X}$	55.77	56.61	56.30
	S.D	6.78	5.80	6.07
	S.E	2.04	1.33	1.10
	CV	12.16	10.24	10.79

Means with different superscripts within age group are significantly different (P<0.05).

Table 3. Least Square Means, Standard Deviation, Standard Error and Coefficient of Variation (CV) of Rump Height (RH) of WAD Goats at Various Ages

Age group	Parameter	Male	Female	Total
0 teeth	N	106	109	215
	$\bar{X}$	32.00[f]	32.38[e]	32.19
	S.D	4.44	3.20	3.86
	S.E	0.43	0.31	0.26
	CV	13.89	9.89	11.99
2 teeth	N	47	21	68
	$\bar{X}$	39.57[d]	38.64[e]	39.28
	S.D	2.69	3.04	2.83
	S.E	0.39	0.67	0.34
	CV	6.80	7.97	7.20
4 teeth	N	8	31	39
	$\bar{X}$	44.38[c]	43.08[d]	43.35
	S.D	1.60	2.54	2.42
	S.E	0.56	0.46	0.39
	CV	3.60	5.90	5.58
6 teeth	N	10	8	18
	$\bar{X}$	47.60	49.25	48.33
	S.D	2.01	3.85	2.99
	S.E	0.64	1.36	0.70
	CV	4.22	7.81	6.19
8 teeth	N	12	17	29
	$\bar{X}$	53.71	53.00	53.29
	S.D	2.71	2.32	2.47
	S.E	0.78	0.56	0.46
	CV	5.04	4.38	4.63
Wither	N	11	19	30
	$\bar{X}$	59.09	59.74	59.50
	S.D	6.28	5.42	5.65
	S.E	1.89	1.24	1.03
	CV	10.63	9.08	9.50

Means with different superscripts within age group are significantly different (P<0.05).

Table 4. Least Square Means, Standard Deviation, Standard Error and Coefficient of Variation of Shoulder Width (SW) of WAD Goats at Various Age Groups

Age group	Parameter	Male	Female	Total
0 teeth	N	106	109	215
	$\bar{X}$	13.17	13.54	13.36
	S.D	0.97	1.00	1.00
	S.E	0.94	0.10	0.07
	CV	7.37	7.42	7.51
2 teeth	N	47	21	68
	$\bar{X}$	14.40[f]	14.43[e]	14.11
	S.D	0.95	0.93	0.93
	S.E	0.14	0.20	0.11
	CV	6.58	6.42	6.48
4 teeth	N	8	31	39
	$\bar{X}$	16.25	16.35	16.33
	S.D	0.71	1.14	1.06
	S.E	0.25	0.20	0.173
	CV	4.35	6.42	6.49
6 teeth	N	10	8	18
	$\bar{X}$	17.70	18.25	17.94
	S.D	0.48	0.71	0.64
	S.E	0.15	0.25	0.15
	CV	2.73	3.87	3.56
8 teeth	N	12	17	29
	$\bar{X}$	19.92	21.12	20.62
	S.D	0.90	1.05	1.15
	S.E	0.26	0.26	0.21
	CV	4.52	4.99	5.56
Wither				
	N	11	19	30
	$\bar{X}$	24.27	23.26	23.63
	S.D	2.41	1.69	2.01
	S.E	0.73	0.39	0.37
	CV	9.94	7.28	8.50

Means with different superscripts within age group are significantly different ($P<0.05$)

Table 5. Least Square Means, Standard Deviation, Standard Error and Coefficient of Variation of Rump Width (RW) of WAD Goat at Various Age Groups

Age group	Parameter	Male	Female	Total
0 teeth	N	106	109	215
	–	11.42	11.86	11.64
	$\bar{X}$	1.14	1.18	1.18
	S.D	0.11	0.11	0.08
	S.E	9.98	9.46	10.13
	CV			
2 teeth	N	47	21	68
	–	12.96[d]	13.19[f]	13.01
	$\bar{X}$	1.01	1.03	1.01
	S.D	0.15	0.22	0.12
	S.E	7.80	7.81	7.80
	CV			
4 teeth	N	8	31	39
	–	14.50	14.35	14.38
	$\bar{X}$	0.53	0.84	0.78
	S.D	0.19	0.15	0.13
	S.E	3.69	5.84	5.44
	CV			
6 teeth	N	10	8	18
	–	15.70	16.13	15.88
	$\bar{X}$	0.48	0.64	0.58
	S.D	0.15	0.23	0.14
	S.E	3.08	3.97	3.67
	CV			
8 teeth	N	12	17	29
	–	17.58	18.71	18.24
	$\bar{X}$	0.90	1.26	1.24
	S.D	0.26	0.31	0.23
	S.E	5.12	6.75	6.82
	CV			
Wither		11	19	30
	N	21.82	21.79	21.80
	–	2.96	2.74	2.77
	$\bar{X}$	0.89	0.63	0.51
	S.D	13.57	12.58	12.71
	S.E			
	CV			

Means with different superscripts within age group are significantly different (P< 0.05)

Table 6. Least Square Means, Standard Deviation, Standard Error and Co-efficient of Variation of Heart Girth of WAD Goats at Various Age Groups

Age group	Parameter	Male	Female	Total
0 teeth	N	106	109	215
	$\bar{X}$	41.83[f]	42.84[e]	42.35
	S.D	6.24	5.12	5.71
	S.E	0.61	0.49	0.39
	CV	14.91	11.94	13.48
2 teeth	N	47	21	68
	$\bar{X}$	55.68[d]	54.42[e]	55.29
	S.D	5.06	4.21	4.82
	S.E	0.74	0.92	0.58
	CV	9.09	7.74	8.72
4 teeth	N	8	31	39
	$\bar{X}$	62.63[c]	62.00[d]	62.13
	S.D	1.77	3.28	3.02
	S.E	0.63	0.59	0.48
	CV	2.82	5.29	4.86
6 teeth	N	10	8	18
	$\bar{X}$	68.20[b]	69.63[a]	62.13
	S.D	3.05	3.07	3.05
	S.E	0.96	1.08	0.72
	CV	4.47	4.41	4.44
8 teeth	N	12	17	29
	$\bar{X}$	75.00	75.35	75.21
	S.D	3.10	3.33	3.19
	S.E	0.90	0.81	0.59
	CV	4.14	4.42	4.24
Wither				
	N	11	19	30
	$\bar{X}$	86.14	87.13	86.77
	S.D	7.16	8.60	7.99
	S.E	2.16	1.97	1.46
	CV	8.32	9.87	9.20

Means with different superscripts within age are significantly different ($P < 0.05$).

Table 7. Least Square Means, Standard Deviation, Standard Error and Coefficient of Variation of Body Length (BL) of WAD Goats at Various Age Groups

Age group	Parameter	Male	Female	Total
0 teeth	N	106	109	215
	$\bar{X}$	26.58[e]	26.94[d]	26.76
	S.D	4.65	3.82	4.24
	S.E	0.45	0.37	0.29
	CV	17.49	14.18	15.85
2 teeth	N	47	21	68
	$\bar{X}$	33.23	33.57	33.34
	S.D	2.48	1.03	2.13
	S.E	0.36	0.22	0.26
	CV	7.46	3.06	6.40
4 teeth	N	8	31	39
	$\bar{X}$	36.13[c]	36.24[b]	36.22
	S.D	1.46	1.33	1.34
	S.E	0.52	0.24	0.21
	CV	4.04	3.68	3.70
6 teeth	N	10	8	18
	$\bar{X}$	38.50[b]	39.25[a]	38.83
	S.D	0.53	1.13	0.91
	S.E	0.17	0.40	0.21
	CV	1.37	2.89	2.34
8 teeth	N	12	17	29
	$\bar{X}$	41.58[a]	41.82[a]	41.72
	S.D	0.67	0.93	0.83
	S.E	0.19	0.23	0.15
	CV	1.61	2.23	1.99
Wither		11	19	30
	N	43.27[a]	43.53[a]	43.43
	$\bar{X}$	0.90	1.43	1.25
	S.D	0.27	0.33	0.23
	S.E	2.09	3.28	2.88
	CV			

Means with different superscripts within age group are significantly different ($P < 0.05$

Table 8. Least Square Means, Standard Deviation, Standard Error and Coefficient of Variation of Foreleg Length (FL) of Male and Female WAD Goats

Age group	Parameter	Male	Female	Total
0 teeth	N	106	109	215
	$\bar{X}$	19.20[d]	19.51[c]	19.35
	S.D	2.81	2.40	2.61
	S.E	0.27	0.23	0.18
	CV	14.65	12.29	13.48
2 teeth	N	47	21	68
	$\bar{X}$	24.71[c]	24.45[d]	24.63
	S.D	1.62	1.48	1.58
	S.E	0.24	0.32	0.19
	CV	6.57	6.06	6.40
4 teeth	N	8	31	39
	$\bar{X}$	27.13	27.48	27.41
	S.D	1.73	1.41	1.46
	S.E	0.61	0.25	0.23
	CV	6.37	5.11	5.32
6 teeth	N	10	8	18
	$\bar{X}$	27.75[c]	28.25[b]	27.97
	S.D	1.59	1.98	1.74
	S.E	0.50	0.70	0.41
	CV	5.71	7.02	6.21
8 teeth	N	12	17	29
	$\bar{X}$	30.54[a]	29.94[b]	30.19
	S.D	0.72	1.14	1.02
	S.E	0.21	0.28	0.19
	CV	2.36	3.82	3.38
Wither	N	11	19	30
	$\bar{X}$	32.88	33.19	33.08
	S.D	2.24	2.64	2.47
	S.E	0.68	0.61	0.47
	CV	6.82	7.96	7.46

Means with different superscripts within age group are significantly different ($P < 0.05$)

Table 9. Least Square Means, Standard Deviation, Standard Error and Coefficient of Variation of Tail Length (TL) of WAD Goats at Various Age Groups

Age group	Parameter	Male	Female	Total
0 teeth	N	106	109	215
	$\bar{X}$	6.41	6.61	6.51
	S.D	1.32	1.28	1.30
	S.E	0.13	0.12	0.09
	CV	20.51	19.34	19.92
2 teeth	N	47	21	68
	$\bar{X}$	7.95[a]	7.86[b]	7.92
	S.D	0.53	0.69	0.58
	S.E	0.08	0.15	0.07
	CV	6.72	8.80	7.37
4 teeth	N	8	31	39
	$\bar{X}$	8.56[c]	8.40[d]	8.44
	S.D	0.50	0.51	0.62
	S.E	0.18	0.09	0.15
	CV	5.79	6.03	7.29
6 teeth	N	10	8	18
	$\bar{X}$	8.50[e]	8.38[f]	8.44
	S.D	0.53	0.74	0.62
	S.E	0.17	0.26	0.15
	CV	6.20	8.88	7.29
8 teeth	N	12	17	29
	$\bar{X}$	9.00	9.00	9.00
	S.D	0.00	0.00	0.00
	S.E	0.00	0.00	0.00
	CV	0.00	0.00	0.00
Wither	N	11	19	30
	$\bar{X}$	9.00	9.00	9.00
	S.D	0.00	0.00	0.00
	S.E	0.00	0.00	0.00
	CV	0.00	0.00	0.00

Means with different superscripts within age group are significantly different ($P< 0.05$)

Table 10. Coefficient of Variation of Face Length (FAL) of WAD Goats at Various Age Groups

Age group	Parameter	Male	Female	Total
0 teeth	N	106	109	215.
	$\bar{X}$	11.45	11.19	11.32
	S.D	2.11	1.70	1.91
	S.E	0.21	0.16	0.13
	CV	18.40	15.15	16.87
2 teeth	N	47	21	68
	$\bar{X}$	14.01^{c}	12.57^{d}	13.57
	S.D	2.35	2.11	2.36
	S.E	0.35	0.46	0.29
	CV	16.75	16.79	17.38
4 teeth	N	8	31	39
	$\bar{X}$	14.62^{c}	16.29^{b}	15.95
	S.D	2.07	2.36	2.37
	S.E	0.73	0.42	0.38
	CV	14.13	14.56	14.88
6 teeth	N	10	8	18
	$\bar{X}$	17.90^{b}	18.00^{a}	17.94
	S.D	1.97	1.85	1.86
	S.E	0.62	0.65	0.44
	CV	11.00	01.29	10.38
8 teeth	N	12	17	29
	$\bar{X}$	19.83	19.71	19.76
	S.D	0.39	0.59	0.51
	S.E	0.11	0.14	0.09
	CV	1.96	2.98	2.59
Wither	N	11	19	30
	$\bar{X}$	20.27	20.00	20.10
	S.D	0.65	2.29	1.84
	S.E	0.19	0.52	0.37
	CV	3.19	11.43	9.18

Means with different superscripts within age groups are significantly different ($P < 0.05$),

Table 11. Least Square Means, Standard Deviation, Standard Error and Co-efficient of Variation of Rump Length (RL) of WAD Goats at Various Age Groups

Age group	Parameter	Male	Female	Total
0 teeth	N			
	$\bar{X}$	106	109	215
	S.D	14.29	14.91	14.60
	S.E	1.88	1.22	1.61
	CV	0.18	0.12	0.11
		13.15	8.19	11.00
2 teeth	N	47	21	68
	$\bar{X}$	15.17^{c}	14.62^{f}	15.00
	S.D	2.29	2.13	2.24
	S.E	0.33	0.47	0.27
	CV	15.08	14.59	14.93
4 teeth	N	8	31	39
	$\bar{X}$	15.25^{h}	17.13^{g}	16.74
	S.D	2.12	3.17	3.06
	S.E	0.75	0.59	0.49
	CV	13.91	18.51	18.27
6 teeth	N	10	8	18
	$\bar{X}$	18.80	19.00	18.89
	S.D	1.14	1.69	1.39
	S.E	0.36	0.60	0.32
	CV	6.04	8.90	7.24
8 teeth	N	12	17	29
	$\bar{X}$	20.42^{b}	21.06^{a}	20.79
	S.D	0.67	1.03	0.94
	S.E	0.19	0.25	0.17
	CV	3.27	4.89	4.52
Wither	N	11	19	30
	$\bar{X}$	21.64	21.53	21.56
	S.D	0.67	2.07	1.68
	S.E	0.20	0.47	0.31
	CV	3.12	9.59	7.77

Means with different superscripts within age groups are significantly different ($P< 0.05$)