

EVALUATION OF BODY CONFORMATION OF SAHELIAN GOATS USING PRINCIPAL COMPONENT ANALYSIS (PCA)

*Rotimi, E.A., Aruwayo, A. and Lamido, M.

Department of Animal Science, Federal University Dutsin-Ma, Katsina State, Nigeria.

*earotimi@gmail.com, +2347037968698

ABSTRACT

This study was carried out to characterize the Sahelian goat breed in Katsina state, Nigeria, at the phenotypic level. Data were collected on 163 goats from the Sahelian breed (male and female) between one to four years. Physically healthy and non-pregnant goats were randomly selected for this study. Data measured were taken on body weight (kg) and ten (10) body morphometric traits on individual goats. The results obtained revealed that most of the goats sampled were female (60.7%). Most of the goats sampled (44.2%) were also within one (1) year old. Two principal components (PCs) extracted explained 74.90% of the total variations of the body composition. Only heart girth was not included in PC1 explaining 61.28% of the total variances while PC2 consists of height at wither and neck length accounting for 13.61%. The explained body variations can be employed in goat selection and breeding programs to improve goat production in the study area.

Key words: Body measurement, breed, Qualitative, Semi-arid region, Traits.

INTRODUCTION

Goats (*Capra hircus*) are small ruminant animals commonly found and are more evenly distributed in towns and villages than other ruminant animals in Nigeria (Komolafe *et al.*, 2007).

The phenotypic characterization of animal genetic resources played a vital role in the classification of goats (Yakubu *et al.*, 2010). The knowledge of morphometric variables in goats could be utilized for sustainable management, production and utilization of goats' genetic resources.

Sahelian goat originated from the Sudan desert. The breed is sometimes referred to as the Tuareg or Fulani. They have long legs with an average height of 70 - 85 cm for adult bucks and about 65 – 75 cm for does. Mature bucks weigh between 38 to 56 kg and the average weight of the does is about 25 – 35 kg. The long horns of the male are directed backwards. The coat is often white but there can be has two or three patches of black, red and white colours. The male sometimes has a beard with wattles and is often manned. They have pendulous ears and well adapted to a hot dry environment but not used to a humid area. They produce high grade skin (Mason, 1996).

The characterization of this goat population will play significant role in the conservation as well as the utilization of these genetic resources; this also serves as the base-line for their genetic improvement (Birteeb *et al.*, 2012a). This study, therefore, was undertaken to evaluate the body conformation of Sahelian goats in Katsina state using principal component analysis procedures.

MATERIALS AND METHODS

The study was conducted in Katsina state of Nigeria. The study area is located within the semi-arid zone in Nigeria. Katsina state lies between latitude 12° 59' N and longitude 7° 36' E with elevation of about 529 m above the sea level (Rotimi *et al.*, 2018). A total of 163 (99 does and 64 bucks) Sahelian goats were randomly sampled for this study. Parameters measured included; body weight (BWT), height at wither (HW), body length (BL), paunch girth (PG), heart girth (HG), ear length (EL), tail length (TL), horn length (HoL), neck length (NL), neck circumference (NC). Data were measured early in the morning before they were allowed to go for feeding to avoid error in data collection due to feeding. As much as possible, measurements were taken on apparently healthy, non-pregnant goats. The procedures adopted were as described by Birteeb *et al.* (2012b). Visual observations were used in identifying the coat colour and sex. Age of animals was identified, according to their dentition as reported (FAO 2012; Dereje *et al.*, 2013).

Data obtained were analyzed following the procedures of Statistical Package for the Social Sciences (SPSS version 23.0.0). The body composition of the goats was evaluated using Principal Component Analysis (PCA) procedures. **Multivariate procedure of discriminant analysis was carried out to ascertain the variables that best combine to discriminate the two sexes.**

RESULTS AND DISCUSSION

The result demonstrates that there was significant ($P < 0.01$) unequal representation of the sex ratio, with female goats accounting for 60.7 % of the population and the males, 39.3% out of the 163 goats studied

(Table 1). The values obtained in this study are similar to the results reported by Katongole *et al.* (1994), who reported 69 % were female goats while 31 % were male goats. The high number of female goats observed is because farmers normally retain the does for multiplication purposes while the bucks are sold as source of income. The number of goats aged one (1) year was significantly ($p<0.001$) more than those aged two (2) years, three (3) years and four (4) years, representing 72, 28, 32 and 31 respectively (Table 1). The goats in the study area had two coat colour variations with the single (white) colour dominant (62.0% and 38.0% respectively). The double colour variation comprised of the combination of white with brown, black and grey.

Table 1. Distribution of the qualitative traits of Sahelian goat in Katsina state.

Traits	Class	Frequency	Percentage (%)	Chi-square	Sig.
Sex	Female	99	60.7	7.515	.006
	Male	64	39.3		
	Overall	163	100.0		
Age (Years)	1	72	44.2	39.491	.000
	2	28	17.2		
	3	32	19.6		
	4	31	19.0		
	Overall	163	100.0		
Coat colour pattern	Unicolour (white)	101	62.0	9.331	.002
	Bicolour	62	38.0		
	Overall	163	100.0		

Table 2 shows the KMO test and the Bartlett's tests for data adequacy was carried out to test for the validity of the results. Significantly high value of KMO (0.903) was recorded in this study, confirming the validity of the results. This value was close to the results obtained on sheep by Birteeb *et al.* (2012b) in Ghana (0.91) and Yakubu *et al.* (2011) in Nigeria (0.93). However, the value is higher than that of Salako (2006) in Uda sheep (0.85).

Table 2. KMO and Bartlett's Test for data adequacy.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.903
Bartlett's Test of Sphericity	Approx. Chi-Square	6799.199
	Df	45
	Sig.	0.000

Table 3 shows the values of communalities obtained in this study. The values were generally high, ranging from 0.776 to 0.918, except in HG (0.401). Two Principal Components (PCs) were extracted, accounting for 80.53% of the total variations of the body conformation in the Sahelian goats. The first PC comprised of RH, BL, HoL, EL, TL, NC, PG and NL which explained a variation of 66.768%. The second PC accounted for 13.763% of the total variation, having HW, BL and HG. The second PC seemed to describe body size of the goats. The variations explained were lower than the report of Okpeku *et al.* (2011) on WAD and Sokoto Red goats. The information from PC analysis could be employed to select animals based on a few body traits.

Table 3. Communalities and variance explained by PC factors.

Traits	PC1	PC2	Communalities
HW	0.062	0.950	0.906
RH	0.815	0.420	0.840
BL	0.575	0.686	0.802
HG	0.145	0.616	0.401
HoL	0.719	0.548	0.817
EL	0.873	0.337	0.876
TL	0.822	0.406	0.841
NC	0.935	0.208	0.918
PG	0.921	0.165	0.876
NL	0.880	-0.038	0.776
Eigenvalue	6.677	1.376	

Explained Variance (%)	66.768	13.763
Cumulative variance (%)	66.768	80.530

Table 4 presents the cluster analysis by sex. The result from the two clusters obtained corroborated the already known discrimination of the two sexes, where 99 females associated with cluster 1 while 64 males were recorded for cluster 2. In cluster 1, the percentage of correctly classified female goats was 85.9% while the percentage of correctly classified male 65.6%. after cross-validation 77.9% of the goats were correctly classified into right cluster. Pinto *et al.* (2006) also applied discriminant analysis procedure to assign the sexes of horses.

Table 4. Results of the **classification of the discriminant analysis showing the predicted group.**

		Sex	F	M	Total
Original	Count	F	85	14	99
		M	21	43	64
	%	F	85.9	14.1	100.0
		M	32.8	67.2	100.0
Cross-validated ^b	Count	F	85	14	99
		M	22	42	64
	%	F	85.9	14.1	100.0
		M	34.4	65.6	100.0

CONCLUSION

The discriminant analysis however revealed that body length (BL), horn length (HoL) and paunch girth (PG) were more powerful discriminating variables in separating the two sexes. Body weight (BWT) had the highest correlation values with Rump height (RH), this shows that RH is the best predictor of body weight in the goat population studied.

REFERENCES

- Birteeb, P.T., Olusola, S.P., Yakubu, A., Adeke, M.A. and Ozoje, M.O. (2012b). Multivariate characteristics of the phenotypic traits of Djallonke and Sahel sheep in Northern Ghana. *Tropical Animal Health and Production*, DoI: 10.1007/s11250-012-4.
- Birteeb, P.T. and Ozoje, M.O. (2012a). Prediction of live body weight from linear body measurement of West African long-legged and West African dwarf sheep in Northern Ghana. *Online Journal of animal and Feed Research*, 2: 425-434.
- Dereje, T., Berhanu, B. and Aynalem, H. (2013). Morphological Characterization of Indigenous Hararghe Highland Goat Breed in their Native Environment, West Hararghe, Ethiopia. *American-Eurasian Journal of Scientific Research*, 8 (2): 72-79.
- FAO (2012). Phenotypic characterization of animal genetic resources. FAO Animal Production and Health Guidelines No.11. Rome, Italy.
- Katongole, J.B.D., Sebolai, B. and Madimabe, M.J. (1994). Morphological characterization of the Tswana goat. In: S.H.B. Lebbie and E. Kagwini (ed.) Small Ruminant Research and Development in Africa. Proc. 3rd Biennial Conference of the African Small Ruminant Research Network, UICC, Kampala, Uganda. 5-9th Dec. 1994: 43- 46.
- Komolafe, M.F., Adegbola, A.A., Are, L.A. and Ashaye, T.I. (2007). Agricultural Science for West African Schools and Colleges. Revised Edition. Oxford University press, 22-23.
- Mason, I.L. (1996). A World Dictionary of Livestock Breeds, Types and Varieties. Fourth Edition. C.A.B International. 273 pp
- Okpeku, M., Yakubu, A., Olusola, P., Ozoje, M.O., Ikeobi, C.O., Adebambo, O.A. and Imumorin, I.G. (2011). Application of multivariate principal component analysis to morphological characterization of indigenous goats in Southern Nigeria. *Acta Agriculturae Slovenica*, 98: 101-109.
- Pinto, L.F.B., Dacker, I.U., Demelo, C.M.R., Ledur, M.C. and Coutinho, L.L. (2006). Principal components analysis applied to performance and carcass traits in the chicken. *Animal Research*, 55: 419-425.
- Rotimi, E.A., Momoh, O.M. and Egahi, J.O. (2018). Evaluation of some qualitative traits in Sahelian goats in Katsina State, Nigeria. *FUDMA Journal of Agriculture and Agricultural Technology*, 4 (2): 207-211.
- Salako, A.E. (2006). Principal component factor analysis of the morphostructure of mature Uda sheep. *International Journal of Morphology*, 24: 571-574.

- SPSS (2015). Statistical Package for the Social Sciences. User's Guide, Version 23.0. Armonk, NY: IBM Corp.
- Yakubu, A., Idahor, K.O., Haruna, H.S., Wheto, M. and Amusan, S. (2010). Multiple analysis of phenotypic differentiation in Bunaji and Sokoto Gudali cattle. *Acta Agriculturae Slovenica*, 96: 78-80.
- Yakubu, A., Salako, A.E. and Abdullah, A.R. (2011). Varimax rotated principal component factor analysis of the zoometrical traits of Uda sheep. *Archivos de Zootecnia*, 60: 813–816.