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PRINCIPAL COMPONENT ANALYSIS OF MORPHOMETRIC TRAITS OF INDIGENOUS AND BOER GOATS IN SEMI-ARID, NIGERIA

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ABSTRACT

The aim of the study was to assess the traits of economic importance for selection in the indigenous and Boer goat breeds. A total of 100 goats consisting of Kano Brown, Sahel and exotic Boer goats were used for the study. Live body weight (kg) of animals were taken using weighing scale while morphometric traits were measured using measuring tape in cm. Body weight (BW), body length (BL), heart girth (HG), tail length (TL), height at wither (HW), neck length (NL), cannon length (CL), head Length (HL), head circumference (HC), ear length (EL) and hip height (HH) were the parameters measured. Data were collected from Teaching and Research farm of Faculty of Agriculture, Bayero University Kano, Bellmari Farm, Kano State and Gujungu Market, Jigawa State. Multivariate analysis was carried out using JMP pro 14.0 (SAS, 2018). The results of the study revealed that five principal components of the morphometric traits were extracted which accounted for 102.01%, 82.99% and 90.32% of the total variance in the Kano Brown, Sahel and Boer breeds, respectively. Principal Components identify body weight, body length, head length, head circumference, height at wither, heart girth, hip height, cannon length, ear length and tail length as the major traits common in all the breeds of goats. In conclusion, the principal component analysis in the study identified the morphometric traits of the breeds that accounts for most of the variability among the traits which will be useful in selecting animals in designing breeding programs for the genetic improvement of the indigenous stock.

Key words: Boer, morphometric traits, principal components, Red Sokoto and Sahel.

INTRODUCTION

Domestic goats (*Capra hircus*, L.) are important and adaptable domesticated animals that provide products to humans which include meat, milk, skin and hair (Abdel Aziz, 2010). The number of goats has increased globally to an estimated population of about 1,184,298,887 out of which 79,382,178 are reared in Nigeria (FAOSTAT, 2018). The three most important goat breeds traditionally recognized in Nigeria are the Red Sokoto (RS), the West African Dwarf and the Sudan Sahel (Ebozoje & Ikeobi, 1998). The RS Goats are well known for their usefulness in the tanning industries. Boer goat *(Capra aegagrus hircus)* is considered to be one of the most desirable goat breeds for meat production, they are generally white colored with brown or red heads (Lu, 2001). Morphometric measurements have been used to evaluate the characteristics of various breeds of animals by several researchers, and could provide first-hand information on the suitability of animals for selection (Ogah, 2011; Oseni & Ajayi, 2010). Principal component analysis is a multivariate technique which could be used with success when morphological variables are interdependent (Truxillo, 2003). It helps in data reduction, and breaks multicollinearity which may lead to wrong inferences (Yakubu & Ayoade, 2009). Therefore, the present study aimed to assess traits of economic importance in the selection of Kano Brown, Sahel and Boer breeds.

MATERIALS AND METHODS

The study was carried out in the Teaching and Research Farm of Faculty of Agriculture, Bayero University, Kano; N11°59.022' E008°25.415'; Bellmari Farm, Kano State, (N11°40'3.65' and E008°15'43.20) and Gujungu Market in Jigawa State, (N12°21.811' E009°34.788') (GPS; global positioning system). A total of 100

goats consisting of Kano Brown, Sahel and Boer goats were used for the study. The animals were managed under semi-intensive system as they were released for grazing in the morning and housed at night.

Live body weight (kg) of animals was taken using weighing scale while morphometric traits were measured using measuring tape in cm. Body weight (BW), body length (BL), heart girth (HG), tail length (TL), height at wither (HW), neck length (NL), cannon length (CL), head circumference (HC), head length (HL), ear length (EL) and hip height (HH) were the parameters measured. Prior to weighing the animals, the weight of the observer was taken and recorded, then each animal was taken by carrying the animal individually and standing on a weighing scale. The difference between the final combined weight and carrier weight was taken as the weight of the animal (Akpa *et al.,* 1998). The ages of the animals were estimated using dentition (Macdonald and Low, 1985).

Statistical Analysis

The data were subjected to Principal component analysis (PCA) using the multivariate procedure components of JMP pro 14.0 (SAS, 2018).

RESULTS AND DISCUSSION

Table 1 presents the Eigen values and share of total variance along with factor loadings of the morphometric traits of Kano Brown goat. Principal component analysis pooled for Kano Brown goat revealed five principal components which accounted for 102.01% of the total variance. PC1 accounted for 42.32% of the total variance, PC2 (25.67%), PC3 (17.88%), PC4 (9.72%) and PC5 (6.43%). Karacaoren and Kadarmideen (2008) reported that the first principal component was measure of overall size in yearling Swiss dairy cattle. Dudusola, Oseni, Popoola and Jenyo (2019) obtained high loadings in the first PC for HG, BW, BL, RW and SW in all the age groups studied.

Table 1: Eigen values and share of total variance along with factor loadings of the morphometric traits of Kano Brown goat

Traits	Prin1	Prin2	Prin3	Prin4	Prin5
Body weight(kg)	**6.64**	**3.33**	**9.70**	**1.13**	**1.44**
Body length(cm)	**7.19**	**3.43**	**3.51**	**0.50**	**4.46**
Heart Girth(cm)	**9.65**	**1.48**	**1.73**	**0.54**	**6.01**
Neck Length (cm)	0.06	**12.40**	**7.64**	0.02	**16.48**
Cannon Length(cm)	**2.06**	**11.13**	**1.25**	**4.88**	**1.04**
Ear Length (cm)	**6.74**	**2.99**	**0.81**	**12.27**	**13.32**
Head Length (cm)	**1.08**	**5.80**	**15.66**	**2.49**	**19.44**
Head Circumference (cm)	**8.16**	**1.51**	**0.58**	**8.02**	**0.82**
Height at wither (cm)	**9.82**	**1.96**	**0.42**	**2.40**	**6.12**
Hip Height (cm)	**8.78**	**1.29**	**1.05**	**3.88**	**4.26**
Tail Length (cm)	**4.23**	**3.37**	**13.70**	**1.97**	**14.79**
Eigen value	**7.62**	**4.62**	**3.22**	**1.75**	**1.16**
Percent variance (%)	**42.32**	**25.67**	**17.88**	**9.72**	**6.43**
Cumulative percent (%)	**42.32**	**67.99**	**85.87**	**95.59**	**102.01**

Prin=principal component

Table 2 presents the Eigen values and share of total variance along with factor loadings of the morphometric traits of Sahel Goat. Principal component analysis pooled for Sahelian Goat extracted five principal components which accounted for 82.99% of the total variance. PCs identify body weight, body length, head length, head circumference, height at wither and tail length as the major traits which corroborates with the findings of Sadek, Al-Aboud, Ashmawy (2006), Yakubu, Ogah and Idahor (2009) and Okpeku *et al.* (2011) who had some similar conformation traits with the present study.

Table 2: Eigen values and share of total variance along with factor loadings of the morphometric traits of Sahel Goat

Traits	Prin1	Prin2	Prin3	Prin4	Prin5
Body Weight (kg)	**2.16**	**0.30**	**7.12**	**13.50**	**0.64**
Body Length(cm)	**8.02**	**1.13**	**3.59**	0.32	**16.79**
Heart Girth(cm)	**9.49**	0.07	0.33	0.02	**20.43**
Neck Length(cm)	**5.60**	0.15	**18.99**	**0.56**	0.10
Cannon Length(cm)	**6.47**	0.26	0.27	**15.47**	**2.39**
Ear Length(cm)	**6.78**	0.04	**1.40**	**2.25**	**25.20**
Head Length(cm)	**2.08**	**6.50**	**14.67**	**1.72**	**3.10**
Head Circumference(cm)	**8.75**	0.03	0.04	**0.46**	**9.25**
Height at Wither(cm)	**6.78**	**1.43**	**3.68**	**16.95**	0.04
Hip Height(cm)	**10.16**	**0.95**	0.33	**1.26**	0.09
Tail Length(cm)	**4.59**	0.04	**2.61**	**18.10**	**1.40**
Eigen value	**7.13**	**2.707**	**2.47**	**1.59**	**1.05**
Percent variance (%)	**39.62**	**15.04**	**13.7**	**8.81**	**5.83**
Cumulative percent (%)	**39.62**	**54.66**	**68.36**	**77.16**	**82.99**

Prin=principal component

Eigen values and share of total variance along with factor loadings of the morphometric traits of Boer Goats are shown in Table 3. Principal component analysis pooled for Boer Goat extracted five principal components which accounted for 90.32% of the total variance. Yakubu, Ogah and Idahor (2009) stated that conformation traits are good traits for selection and evaluation, the five factors obtained in this study could be used to select animals based on group traits. Sadek, Al-Aboud, Ashmawy (2006), Yakubu, Ogah and Idahor (2009) and Okpeku *et al.* (2011) had some similar conformation traits in the factor loadings with the present study.

Table 3: Eigen values and share of total variance along with factor loadings of the morphometric traits of Boer Goats

Traits	Prin1	Prin2	Prin3	Prin4	Prin5
Body weight(kg)	**1.60**	**5.66**	**9.41**	**19.37**	**0.67**
Body length(cm)	**8.87**	0.00	0.03	**3.79**	**10.34**
Heart Girth(cm)	**7.13**	**1.22**	**4.44**	0.03	**7.20**
Neck Length (cm)	0.22	**5.36**	**26.47**	**1.90**	**4.37**
Cannon Length(cm)	**2.73**	0.27	**17.38**	**6.76**	0.01
Ear Length (cm)	**6.51**	**0.86**	**1.68**	**11.74**	**2.18**
Head Length (cm)	**7.46**	**1.00**	**4.43**	**2.77**	**6.19**
Head Circumference (cm)	**8.37**	0.12	0.00	**2.96**	**7.45**
Height at wither (cm)	**9.56**	**0.40**	**0.50**	**0.42**	0.23
Hip Height (cm)	**10.03**	**1.06**	0.03	0.03	**0.69**
Tail Length (cm)	**4.82**	0.00	**4.56**	**3.12**	**19.97**
Eigen value	**8.47**	**2.56**	**2.27**	**1.86**	**1.11**
Percent variance (%)	**47.04**	**14.20**	**12.62**	**10.31**	**6.14**
Cumulative percent (%)	**47.04**	**61.25**	**73.87**	**84.18**	**90.32**

Prin=principal component

CONCLUSION

In conclusion, the principal component analysis in the study reduced the morphometric traits of the breeds that accounts for most of the variability among the traits which will be useful in selecting animals in designing

breeding programs for the genetic improvement of the indigenous stock. It could also help in order to acquire highly coordinated animal bodies using fewer traits.

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