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Factor Analysis of the Morphostructure of Mature Balami Sheep

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Abstract: Ten body measurements were taken on 100 Balami sheep aged 18-24 months within the humid southwest Nigeria. The body measurements were Wither Height (WH), Body Length (Bl), Rump Height (RH), Rump Width (RW), Rump Length (RL), Shoulder Width (SW), Tail Length (TL), Heart Girth (HG), Neck Circumference (NC) and Body Weight (BW). The study was aimed at investigating the variance structure and to provide a description of the conformation of the sheep using a cluster analysis. Applying wither height for size estimation, the animal measured 83.96±5.99 cm. The other body measurements for the age group were BL = 96.06±11.45 cm, RL = 28.13±5.19 cm, RW = 23.14±2.07 cm, RH = 87.18±5.99 cm, SW = 27.85±4.37 cm, TL = 57.56±4.56 cm, HG = 95.68±5.31 cm, NC = 41.26±8.36 cm and BW = 53.01±9.50 kg. Variability was high within body measurements.

Key words: Assessment, Balami sheep, management, morphostructure, variability, Nigeria

INTRODUCTION

The Nigerian sheep population is comprised of large number of flocks managed extensively under harsh environmental and traditional conditions with large variation in size of flock and individual animal. Common management practices are employed in sheep production (Otoikhian *et al*., 2008). Some of these practices help to obtain information useful in herd management. In meat production, the major focus is with growth and development. Patterns of development and growth are useful in the assessment of conformation. Therefore, an attempt to measure these parameters in ways other than conventional weighing and grading seems appropriate (Salako, 2006a). Body measurements in addition to weight measures describe more completely an individual or population than do the conventional weighing and grading (Salako, 2006a). Body measures have been used at various times for the estimation of weights when live weights are measured with these parameters. Body parameters have been used to indicate breed, origin and relationship through the medium of herd measurement (Jewel, 1963; Itty *et al*., 1973) or to indicate size. EAAP and FAO have used wither height for example as a prime indicator of type (Simon and Buchenauer, 1993; Wilson, 1995). Alternative body measurements and indices estimated from various combinations of conventional and non conventional body parameters not only provide superior guide to weight but also used as indicators of type and function in domestic animal populations (Salako, 2006b). In an attempt to improve conformation, knowledge of possible correlations and mutual dependence among the body measurement and possible implication of the genetic control of certain parts on the same genomic region may be crucial to the constructive manipulation of measurable parts. The Balami sheep are one of the sheep types in Nigeria and their body measurements and conformation have been minimally studied. In this light, this study is aimed at analysing the body parameters of Balami sheep apart from their commonly reported relationship to live weight. In this investigation, the Principal Component Analysis (PCA) is used as a tool in the assessment of the body shape. This could be of evolutionary significance as well as permit an understanding of the growth pattern of the complex process among the body measurements within the species. Salako (2006a) and Brow *et al.* (1973) used PCA of linear measurements and weight in an effort to elicit an objective description of different pre-yearling and up to yearling body shapes.

MATERIALS AND METHODS

Nine different body measurements and body weight were taken on 100 Balami sheep comprising 38 males and 62 females of 18-21 months of age. They comprised animals that have been extensively managed. Body measurements taken on each animal were Wither Height (WH), Body Length (BL), Rump Height (RH), Rump Width (RW), Rump Length (RL), Shoulder Width (SW), Tail

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Length (TL), Heart Girth (HG), Neck Circumference (NC) and Body Weight (BW). The reference points used for the body measurement were as described by Salako and Ngere (2002). Data were entered into a standard format and then transferred to the computer for analysis as appropriate. Pregnant animals and animals with physical defects were avoided during sampling because of the effect of pregnancy and body defects on the thoracic measurements.

Statistical analysis: Means and standard deviation, Pearson's correlation among the measurements and factor analysis-PCA were performed in a single step using the factor programme of SPSS statistical package. After the correlation matrix which served as the primary data for the PCA was generated, it was inspected for sampling adequacy (Kaiser-Meyer-Okin Test) and sphericity (Battlet's Test).

RESULTS AND DISCUSSION

Results of the descriptive analysis are shown in Table 1. It shows that the Balami sheep are 83.96±5.99 cm tall. This indicates the size of the animal for the age group under consideration. The rump height measurement of 87.18±5.99 cm shows that the animal is not sloppy on standing. The rump width of 23.14±2.07 cm and shoulder width of 27.85±4.37 cm indicates that the animal is wider at the shoulder than at the rump.

As opposed to the Uda sheep which is reported to be taller than it is long (Salako, 2006a), the Balami sheep has a body length of 96.06±11.45 cm which indicates that it is longer than it is tall. This suggests that the Balami may not have originally been a tropical breed as most tropical animals are reported to be taller than they are long. Hall (1991) reports that tropical breeds are taller than they are long contrary to what obtains in western meat livestock. Again, the height in comparison to body length is suggestive of the adaptation to long distance treks which is typical in tropical animal production (Table 1). Large variations within certain measurements suggest absence of selection or indicate that the parts respond more to environmental influence than others. In the case of heart girth, variability is usually high because of the influence of gut fill. The high variability shown by standard deviation values in this study may also be a reflection of variations among actual age of the animals used in this study which were not known. According to Salako (2006a), it is likely that the figures obtained be lower than those reported for the same animals of known actual ages.

Negative and non significant correlation ($p<0.05$) observed between RL and other body parameters measured apart from NC (Table 2) is an indication of low predictability and a weak relationship between them. However, other body parameters measured have positive and significant ($p<0.01$) correlation, suggesting high predictability and positive influence on one another. The coefficient observed ranged from -0.412 (NC/RL) to 0.996 (RH/WH).

Kaiser-Meyer-Okin (KMO) measure of sampling adequacy (0.809) indicating the amount of variation in the body measurements caused by the underlying factor and the Bartlett's test of sphericity ($p<0.01$), the communalities (0.763-0.971) representing the explained portion of the variance and the determinant (2.30E-007) obtained from the correlation matrix permit all body measurements into reasonable factor analysis-PCA. Three principal

Table 1: Mean and standard deviation of body measurement of Balami sheep aged 18-21 months (Number of animals = 100)

Body measurement	Mean (X)	SD	SE
Wither height	83.96 cm	5.99	0.60
Body length	96.06 cm	11.45	1.14
Rump length	28.13 cm	5.19	0.52
Rump width	23.14 cm	2.07	0.21
Rump height	87.18 cm	5.99	0.60
Shoulder width	27.85 cm	4.37	0.44
Tail length	57.56 cm	4.56	0.46
Heart girth	95.05 cm	5.31	0.53
Neck circumference	41.26 cm	8.36	0.84
Body weight	53.01 kg	9.50	0.95

Table 2: Correlation among the body measurement of Balami sheep aged 18-21 months

Body measurements	WH	BL	RL	RW	RH	SW	TL	HG	NC	BW
WH	1.000									
BL	0.860**	1.00								
RL	-0.130	-0.05	1.00							
RW	0.470**	0.59**	0.12	1.00						
RH	0.996**	0.86**	-0.11	0.48**	1.00					
SW	0.670**	0.82**	-0.03	0.88**	0.66**	1.00				
TL	0.520**	0.54**	-0.06	-0.05	0.51**	0.19	1.00			
HG	0.690**	0.77**	-0.15	0.46**	0.67**	0.65**	0.59**	1.00		
NC	0.790**	0.86**	-0.41**	0.46**	0.77**	0.71**	0.50**	0.80**	1.00	
BW	0.730**	0.79**	0.07	0.71**	0.73**	0.79**	0.40**	0.80**	0.67**	1.00

Table 3: Component matrix of the PCA showing the factor solution

	Factors (components)		
Body measurements	1	2	3
Wither height**	0.907	-0.138	0.069
Body length**	0.950	-0.005	0.066
Rump length	-0.126	0.615	0.760
Rump width**	0.667	0.659	-0.223
Rump height**	0.901	-0.124	0.088
Shoulder width**	0.856	0.392	-0.208
Tail length*	0.539	-0.561	0.517
Heart girth**	0.859	-0.145	0.073
Neck circumference**	0.889	-0.261	-0.232
Body weight**	0.881	0.231	0.095

Extraction method: Principal component analysis, **elements of the first component; *element of the second component

components are yielded by the factor solution (Table 3). The first principal component comprising eight measurements (WH, BL, RW, RH, SW, HG, NC, BW) explains 63.26% of the generalized variance observed in the body measurements (0.667-0.950) and can be considered to be a generalized size factor. In a similar investigation with Uda sheep, Salako (2006a) reports that 67.7% of the generalized variance was explained by the first principal component.

With cattle, Carpenter *et al.* (1971) reports that 75% of the generalized variance was explained by the first factor. The second principal component comprising only one body dimension (TL) explains 14.58% of the generalized variance while the third principal component comprising only RL explains 10.23% of the generalized variance. It is clear from the resulting principal components that the observed clusters (Table 3) may be due to two major underlying factors as reported by Salako (2006a). These may be related to the different association of the individual measurement with bone, environment or time taken to attain maturity. These also may mean more importantly that the elements in each of the components have common genomic sites for their genetic control which means pleiotropic is likely implicated (Salako, 2006a).

CONCLUSION

The factor solution from Principal Component Analysis (PCA) produced three principal components. The first principal component containing measurements that are closely associated with bone growth (WH, BL, RW, RH, SW, HG, NC and BW) explained 63.26% of the generalized variance observed in body measurement, while the second and third components which produced dimensions that are relatively less associated with bone growth (TL and RL) explained 14.58 and 10.23%, respectively of the generalized variance in body measurements.

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