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Morphological indices and stepwise regression for assessment of function and type of Uda sheep.

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Abstract

A total of 250 sexually mature Uda sheep were used for morphological indices, assessing type and function and stepwise regression of Uda sheep. The morphometric traits measured were body length (BL), height-at-withers (HTW), chest circumference (CC), head length (HDL), head wide (HDW), ear length (EL), horn length (HNL), horn circumference (HNC), tail length (TL), rump wide (RW), rump length (RL), height-at-rump (HTR), foreleg (FLG), hind leg (HLG), height at rump (HTR) and neck length (NL). The morphological indices calculated were length index (LI), pelvic index (PI), body index (BI), proportionality (Ipr), thoracic development (TD), baron crevet (BC), compact index 1 (CI1), area index (AI) and relative cannon thickness index (RCTI). Pearson correlation and stepwise regression equation were computed. The analysis was performed with SPSS. The results showed morphological indices mean for LI, PI, BI, Ipr, TD, BC, CI1, AI and RCTI were 0.64, 85.71, 64.02, 159.48, 1.00, 2.00, 0.01, 1.59 and 99.81, respectively. The results of correlation among the indices showed both positive and negative correlation (rp). LI correlated positively with all the morphological indices except PI (rp=-0.02) and Ipr (-0.99) are negatively correlated. BI negatively correlated all the morphological indices. TD showed (1.00) with baron crevet, relative cannon thickness index. The stepwise regression R2 ranged from 77.1-95.7. This study could serve as a baseline for classification of Uda sheep into type and function.

Keywords: Morphological, Indices, Uda sheep, Regression.

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Introduction

There are four main breeds of sheep in Nigeria. The breeds are Balami, Yankasa, West Africa Dwarf and Uda. Uda is a breed of African long-legged sheep common in Chad, Niger, northern Cameroon, and northern Nigeria. There are several varieties of Uda sheep. Typically the front half of Uda sheep is brown or black and the back half white. The ears are long large and pendulous. The rams have large wide and spiral horns, which are usually absent in the ewes. The breed appears to thrive in hot, dry environment and suffers from poor survival outside this ecological zone; it is particularly adapted to extensive grazing and is renowned for its trekking abilities. Mature weights range from 35-45 kg for ewes and 45-55 kg for rams [1,2]. Body measurements have also been used to assess type and function in beef and dairy cattle, sheep and goats and the animal's value as a potential breeding stock [3,4]. Apart from taking live weight of meat animals, researchers also use other parameters such as body length, width of pelvis, wither height, and chest girths in order to adequately evaluate live animals [5]. The reliability of single measurements such as wither height, body length, hearth girth, rump height and width in the estimation of weight at both traditional and institutional levels have been widely documented. Others have even used cephalic dimension as indicators of breed origin and relationships within species [6]. Indices are also considered a superior option for assessment of weight because it incorporates measures of desirable conformation, namely, length and balance [3]. It is expected to provide tested empirical alternative to the limited use of single measurements for the assessment of type, weight and function as well as enhance the ability of breeders to select potential breeding stock [4], it also provide potential purchasers with a reliable evaluation of animals since the measurements are associated with production characteristics. Desirable body conformation from the viewpoint of meat production is such a complex character that little progress has been made in reducing it to a single body measurement which can be taken on the live animal [4]. There is scanty of information on the morphological indices of Uda sheep, therefore this study was designed to evaluate the use of morphological indices to assess type and function and prediction of body weight using morphometric traits of Uda sheep.

Materials and Methods

Study area

The study was carried out in Maiduguri, Borno State, Nigeria. Maiduguri is the capital and the largest urban center of Borno State, North Eastern Nigeria. Maiduguri lies between latitude 11°32′ North and 11°40′ North and latitude 13°20′ East and 13°25′ East between the Sudan Savanna and Sahel Savanna vegetation zones, characterized by short rainy season of 3-4 months (June-September) followed by a prolonged dry season of 7-8 months duration [7].

Morphometric traits measured

Total of 250 sexually mature sheep of both sexes were randomly

sampled based on absence of physical deformity, health and alertness of the animal. The morphometric traits measured were body length (BL), height-at-withers (HTW), chest circumference (CC), head length (HDL), head wide (HDW), ear length (EL), horn length (HNL), horn circumference (HNC), tail length (TL), rump wide (RW), rump length (RL), height-at-rump (HTR), foreleg (FLG), hind leg (HLG), height at rump (HTR) and neck length (NL). Linear body parameters were measured with a meter rule.

Morphological indices calculated

The morphological indices of Uda sheep was calculated based on the formular described [4,3,8]. The indices calculated were further subjected to Pearson correlation and the morphometric traits measured were also used for stepwise regression to determine the best prediction equation of body weight using SPSS (2015). The following are formulae used for morphological indices.

LI=Body length/Height at Wither

PI=(Rump width/Rump length) × 100

BI=(Body length/Heart girth) × 100 When this measure is greater than 0.90, the animal is longiline; between 0.86 to 0.88 is medigline; and less than 0.85, it is brevigline

Ipr=(Height at withers/Body length) × 100.

TD=Heart girth/Height at withers. This indicates thoracic development of animal, with values above 1.2 indicating animal with good TD.

BC=(Heart girth) 2/Height at withers. The result should be close to 2.1 the bigger the index, the closer the animal is to the traction type; the smaller this index, the weaker the animal will be.

CI1=(Weight/Height at withers)/100. Compact index indicates how compact the animal is. Meat type animals have values above 3.15. Value close to 2.75 indicates dual purpose and close to 2.60 indicates that the animals are more suitable for milk purpose.

AI=Height at withers × Body length

RCTI=(Cannon circumference/Height at withers) × 100.

Results and Discussion

The results of morphological indices are presented in Table 1. The result revealed length index value of 0.64 which is lower than the value of 0.96, 0.91 and 1.03 for Khargram, Sagardighi and Nakeshipara sheep respectively reported [7]. This means that Uda sheep is short bodied sheep compared to the aforementioned sheep. This variation in the length index could be due to breeds or environmental factor. Since, productivity of sheep is affected by many factors, such as breed improvement programs based on the maximum utilization of genetic variation, but these features may also vary due to certain environmental factors [9]. This study revealed pelvic index value of 85.71, body index 64.02 and proportionality 159.48 which is higher than the pelvic index of 81.89 and body index of 63.12 for Koroji sheep. Pelvic index provide information about the animal ability or potential of meat production. Although index is complex, requiring more than one measurement such as body length, hip width and chest depth. The width slope and length indices are useful parameters for estimating balance, and may serve as important index in assessment of function [4]. Beside the proportionality value reported in this study is slightly lower than 160.18 for Koroji sheep [10,11]. Proportionality is an important index that correlates with good health and better disease resistance [12], it also provides information about the length of the animal. When body index value is greater than 0.90, the animal is longiline; between 0.86 to 0.88 is medigline; and less than 0.85, it is brevigline as described [4,3,8]. An average Uda sheep is breviline in nature, breviline means that the animal has a tendency to form a rectangular pelvis (18). The indices are considered as an option for assessment of weight because they incorporate measures of desirable conformation, namely, length and balance [3]. Indices that are produced from measurements that are more closely associated with bone growth such as foreleg length, height slope and length index are more appropriate for assessment of type [4]. Assessment of type by using body measurements is more objective than those obtained by visual appraisal, though both are still inferior to 'function' as criteria for selecting breeding stock [11]. Although concepts of perfect conformation vary among breeds, all breed registries agrees that the overall quality and balance of an animal should be symmetrical and proportional to its size [13]. The thoracic development value of 1.00 is lower than the 2.1 recommendation for good thoracic development. The value from this study is also lower than 1.86, 2.14 and 2.33 for Khargram, Sagardighi and Nakeshipara ram respectively reported by Banerjee [14]. This means that Uda sheep is poor in thoracic development (TD) area. This could be an indication of thin animals and tall due to high value of proportionality observed in this study. The baron crevet value obtained in this study 2.00 is close to 2.1 recommended [3,8], as a good indicator of animals that are fit for traction. The compact index value 0.01 observed in this study is far lower than 2.60 described [4,3,8]. The low value of compact index in this study could be a direct reflects of age, breed and feeding. Thus, classification of animal based on compact index could not be accessed. Since compact index is a useful indicator of the overall value of the animals due to combination of more than one morphological traits used for the calculation, it provides an accurate picture of type and function of ruminant animals [8]. The area index 1.59 and relative cannon thickness index 99.81 are related to animal balance. The animal depends on these traits for resistance during long arduous treks. Imbalance in this index may indicate a susceptibility to problems in the joints of the

Table 1. *Morphological indices, mean and standard deviation of Uda sheep.*

Indices	Mean	Std Deviation
LI	0.64	0.07
PI	85.71	13.34
BI	64.02	7.6
Ipr	159.48	18.44
TD	1	0.11
BC	2	0.22
CI1	0.01	0.002
AI	1.59	0.18
RCTI	99.81	10.79

LI: Length Index; PI: Pelvic Index; BI: Body Index; Ipr: Proportionality; TD: Thoracic Development; BC: Baron Crevet; CI1: Compact Index 1; AI: Area Index; RCTI: Relative Cannon Thickness Index.

anterior and posterior limbs of the animal, thereby damaging the skeleton [15].

The results of correlation among morphological indices of Uda sheep are presented in Table 2. The results revealed both positive and negative correlation among the morphological indices. Length index showed positive correlation with all the morphological indices except pelvic index (rp=-0.02) and proportionality (-0.99) are negatively correlated. Body index showed negative correlation with all the morphological indices. The correlation between thoracic developments with baron crevet, relative cannon thickness index showed value of 1.00. The morphological index that showed negative to low correlation are probable to be inherited autonomously. This concurred with the report of Salako [4] who opined that type and performance (function) have low genetic correlation and as a result, they are likely to be inherited independently. This could also stand that indices which showed positive correlation are likely to be controlled by same gene.

The results of stepwise regression for prediction of body weight are presented in Table 3. The regression coefficient R^2 in this study ranges from 77.1-95.7. The high value of coefficient of prediction revealed in this study could also reflect in the fattening status of the animals [6], provided that the animals are from same breed, age, sex, feeding and care conditions. Hearth girth which is affected by fattening status exhibits the highest correlation with body weight [16]. Morphometric traits such as wither height and hip width may be best skeletal parameters to measure in certain instants because they are not influenced by body condition. Hence, fattening performance would not change the relationships and balance between body parts under the acceptable ranges [17-19].

Conclusion

Based on this study Uda breeds are short bodied, large proportionality which correlate with good health, breviline, poor thoracic development which is an indication of poor traction. The correlation among morphological indices revealed low to high positive and negative correlation. The positive correlation among the indices could be that the indices are controlled by same gene. Beside the negative correlation among the indices could be that there are likely to be inherited independently. The stepwise regression equation revealed high coefficient of determination R^2 in most of the prediction equation. This could means that morphometric traits may reflect in fattening status of Uda breeds if the animals grow are the same breed, age, sex, feeding and care. This study could serve as a baseline for classification of Uda sheep into type and function.

Table 2. *Correlation among morphological indices.*

	LI	PI	BI	Ipr	TD	BC	CII	AI
LI								
PI	-0.02							
BI	0.35	0.37						
Ipr	-0.99	0.01	-0.38					
TD	0.59	-0.33	-0.53	-0.56				
BC	0.59	-0.33	-0.53	-0.56	1.00			
CII	0.68	-0.40	-0.17	-0.66	0.80	0.80		
AI	-0.99	0.01	-0.38	1.00	-0.56	-0.56	-0.66	
RCTI	0.59	-0.33	-0.53	-0.56	1.00	1.00	0.80	-0.56

LI: Length Index; PI: Pelvic Index; BI: Body Index; Ipr: Proportionality; TD: Thoracic Development; BC: Baron Creve; CI1: Compact Index 1; AI: Area Index; RCTI: Relative Cannon Thickness Index.

Table 3. *Stepwise regression.*

Prediction Equation	R^2	SEM	LOS
-39.19+1.92BL	77.1	8.5	*
-53.47+0.68BL+0.97CC	91.1	5.31	*
-54.66+0.68BL+0.96CC+0.08EL	90.9	5.35	*
-79.60+0.61BL+0.88CC-0.18EL+0.76FL	92.1	5	*
-79.50+0.61BL+0.88CC-0.15EL+0.78FL-0.03HL	91.9	5.05	*
-96.90+0.45BL+0.78CC-0.24EL+0.89FL-0.16HL+0.49HW	92.8	4.78	*
-99.70+0.44BL+0.68CC+0.71EL+0.35FL-1.10HL+0.21HW+1.38HTR	94.4	4.2	*
-100.60+0.44BL+0.68CC+0.77EL+0.38FL-1.11HL+0.23HW+1.37HTR-0.09HL	94.3	4.25	*
-99.80+0.41BL+0.71CC+0.87EL+0.77FL-0.93HL+0.20HW+0.99HTR-0.92HL+1.22HW	95.2	3.91	*
-104.80-0.43BL+0.71CC+1.18EL+0.64FL-1.05HL+0.22HW+1.30HTR-0.99HL+0.92HW-0.32NL	95.2	3.89	*
-105.40+0.43BL+0.64CC+1.45EL+1.16FL-0.49HL+0.26HW+0.59HTR-2.07HL+0.65HW-0.39NL+0.75RL	95.5	3.77	*
-103.60+0.47BL+0.63CC+0.41EL+1.24FL-0.13HL+0.10HW+0.60HTR-1.75HL+0.49HW-0.39NL+0.74RL-0.02RW	95.4	3.81	*
-102.50+0.47BL+0.63CC+1.41EL+1.24FL-0.13HL+0.10HW+0.60HTR-1.75HL+0.49HW-0.39NL+0.86RL-0.42RW-0.42TL	95.7	3.68	*

R^2: Regression Coefficient;

*Significant at the 0.01 level body length.

LOS: Level of Significance; SEM: Standard Error of Mean; BL: Body Length; HW: Height at Wither; CC: Chest Circumference; HDL: Head Length; (-HDW: Head Wide; EL: Ear Length; HNL: Horn Length; HNC: Horn Circumference; TL: Tail Length; RW: Rump Wide; RL; Rump Length; HR: Height at Rump; FLG: Foreleg; HLG: Hind Leg; HTR: Height at Rump; NL: Neck Length.

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