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RESEARCH ARTICLE

Morphometrical Indices of Dwarfism in the West African Dwarf Sheep as Compared to the Yankassa Sheep

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ABSTRACT

Genetic improvement is currently being focused on indigenous breeds because of their special attributes that make them adaptable to their local environments. The West African Dwarf (WAD) sheep is a very important breed in this category but the morphometrical indicators of dwarfism undermines its utility as a good meat type because it is short and small bodied. This study seeks to investigate the morphometrical indicators of this syndrome-dwarfism on the West African Dwarf sheep. Eleven body measurements (wither height, body length, foreleg length, thorax depth, horck length, rump length, face length, face width, rear leg length, Cannon bone length and shin length were determined by using 150 (94 males and 56 females) matured West African dwarf sheep and 120 (77 males and 43 females) Yankassa sheep for phenotypic comparison. All animals were aged between four and five years. Results revealed that all body measurements were significantly higher in the Yankassa sheep than in the West African Dwarf sheep except shin length where no significant differences exists. The West African Dwarf Sheep appear long bodied with a short stature, while the Yankassa sheep stood tall with a compact body size relative to its height; a characteristic common to desert animals. Body size reduction was more drastic in wither height (19.51%), fore leg length (23.01%),rear leg length (21.33%) and Cannon bone length (45.26%) than body length (12.36%), thorax depth (13.17%) and horck length (11.23%), revealing a pattern of disproportionate reduction which was more prominent in the limbs. Body indices values shows that the West African Dwarf Sheep has a higher depth index of 0.51 as against 0.47 in the Yankassa sheep but the Yankassa shows superiority in height index (0.875), area index (4489.34) and rump index (0.922) as compared to 0.837, 3167.13 and 0.922 in WAD, respectively. More effort is required as regards studying the activities of the dwarf gene and also environmental interaction on gene as it affects limb development in sheep.

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INTRODUCTION

The major essence of livestock production is to meet the critical food need of man. There is however a deficit of food production as compared to world population and more chronic is protein intake of which meat is a major source. The development of existing animal genetic resources has been identified as a means to achieving food security situation (FAO, 1990). Comparative genetic diversity can be determined using phenotypic characteristics of the animals and/or molecular markers. Phenotypic characteristics, including adaptive characteristics as seen in the WAD sheep are important in identifying breed attributes in ways that are relevant to the immediate farming needs and utility. With more emphasis on sustainable agricultural systems, adaptation of breeds to their environment is of particular importance. Animals that are well adapted to their environment are essential component of such systems especially where genotype-environment interactions are important. The WAD sheep has been identified to have a good genetic resource that requires attention because of its trypanotolerance and adaptability to the warm humid tropics. However, its utilisation as a meat type breed is constrained due to its short and small size compared to other sheep breeds in the region. Patterns of body development are useful in the assessment of quantitative traits and conformation (Salako, 2006). Body measurements have been used to assess utilisation type and body function in relation to body morphology among various classes and breeds of farm animals (Brotherstone *et al.*, 1991; Fernandez *et al.*, 1997; Alderson, 1999).

Animal species that are relatively short statured or small are referred to as dwarf because of genetic disorders of cartilage and/or bone. The influence of dwarfism on skeletal development result in reduced body size, delay bone age, deformation of tarsus, metatarsus and phalanges (Hall *et al.,* 2005). Achondroplasia as a form of dwarfism has been described as a disproportionate form of dwarfism where the limbs are considerably shorter than the trunk and especially the upper limbs arising from hyper-functioning of the fibroplast growth factor receptor-3 (FGFR-3) gene. Hereditary achondroplasia has been shown to be due to simple recessive inheritance (Rook *et al.*, 1986; 1988).

This study was carried out to provide information on the morphometric characteristics of the West African Dwarf Sheep and their implication on Dwarfism. Comparison is being made between the WAD sheep and Yankassa sheep, a non-dwarf breed (Adu and Ngere, 1979). Since the body dimensions measured in this study are skeletal dimensions, they elucidate more of the genetic variation of the animals than dimensions that are more environmentally induced.

MATERIALS AND METHODS

Study area and body measurement: Data were collected from 150 (94 males and 56 females) matured West African dwarf sheep and 120 (77 males and 43 females) Yankassa sheep from the breeding herd of the teaching and research farm, University of Ibadan, Nigeria for phenotypic comparison. The farm is located in the Ibadan North East local government of Oyo state, Nigeria. All studed animals were between four and five years old. The body dimensions included in this study was: Wither height (WH), body length (BL), foreleg length (FLL), thorax depth (TD), hock length (HL), rump length (RL), face length (FL), face width (FW), rear leg length (RLL), Cannon bone length (Can) and shin length (SL). The anatomical points of reference for the body dimensions were as described in literature (Salako, 2004; Pesmen *et al.*, 2008). All measurements were determined by using a linear tape and a rigid rule graduated in centimetres (cm). Readings were taken in the morning before feeding the animals.

Statistical analysis: Mean (X), standard deviation (SD), coefficient of variation, and standard error of the body dimensions were calculated. The proportion and reduction of WAD sheep in comparison with the Yankassa Sheep with respect to the body measurements were calculated and the morphometrical indices among the measurements of WAD Sheep was determined and compared with values for the Yankassa Sheep. Data analysis was done using SAS software (SAS, 1999).

RESULTS

The results from Table 1 and 2 showed that the phenotypic description of the WAD sheep is comparable with previous records (Hall, 1991; Wilson, 1991). Results also indicated that while the Yankassa sheep is more tall than long relative to its size, with WH 68.76±6.0 and BL 65.29±6.3, while in the WAD sheep there is reduction in size with height more affected than body length hence it is more long than tall which have WH of 55.35±4.7 and BL 57.22±5.4. This type of body structure is considered to have evolved as a result of its being more effective in dissipating heat than a short, squat body size (Goe *et al.*, 2001).

There were highly significant differences ($P< 0.05$) in the wither height, body length, foreleg length, thorax depth, horck length, rump length, face length, face width, rear leg length, Cannon bone length measurements of West African dwarf sheep as compared to the Yankassa sheep, while no significant differences ($P >0.05$) were exist in the shin length measurements. The WAD sheep is long bodied with short stature while the Yankassa sheep appear tall with a compact body size. There was about 19.51% reduction in wither height, 13.17% in thorax depth, 12.36% in body length, 23.01% in fore leg length, 21.33% in rear leg length. By comparing the WAD and Yankassa sheep with relation to these traits, greater reduction in limb size than other body parts was noted. Indices values obtained for WAD include 0.837 in height index, 0.901 in rump index, 3167.127 in area index, 0.288 in fore leg index while values for Yankassa are 0.875, 0.922, 4489.34 and 0.406, respectively. Depth index values of 0.51 and 0.47 in WAD and Yankassa sheep respectively were recorded.

Table 1: Mean (X), Standard Deviation (SD) and Standard Error (SE) For Body Dimensions of West African Dwarf and Yankassa Sheep

	Wad Sheep				Yankassa sheep			
Dimension	Mean (X)	N	S.D	S.E	Mean (X)	N	S.D	S.E
WH	55.35	150	4.7	0.4	68.76	120	6	0.5
BL	57.22	150	5.4	0.4	65.29	120	6.3	0.6
TD	28.23	150	4.5	0.3	32.51	120	3.6	0.3
FLL	46.36	150	4.1	0.3	60.21	120	5.8	0.5
RLL	49.92	150	4.1	0.3	63.45	120	5.7	0.5
HL	26.88	150	2.5	0.2	30.27	120	2.4	0.2
RL	16.36	150	2.6	0.2	19.26	120	2.7	0.2
FL	9.12	150	1.9	0.8	8.45	120	0.8	0.1
FW	6.34	150	0.8	0.1	7.03	120	0.7	0.1
SL	0.62	150	0.1	0.005	0.61	120	0.1	0.003
Can	13.38	150	9.7	0.8	24.46	120	2.3	0.2

Table 2: T-Test Showing Differences in Body Dimensions of West African Dwarf and Yankassa Sheep

Parameter	Breed	X+S.D	Significance	>0.05%
WH	WAD	55.35+4.7		
	YANKASSA	68.76+6.0	*	
BL	WAD	57.22+5.4		
	YANKASSA	65.29+6.3	*	
TD	WAD	28.23+4.5		
	YANKASSA	32.51+3.6	*	
FLL	WAD	46.36+4.1		
	YANKASSA	60.21+5.8	*	
RLL	WAD	49.92+4.1		
	YANKASSA	63.45+5.7	*	
HL	WAD	26.88+4.1		
	YANKASSA	30.28+2.4	*	
RL	WAD	16.36+2.7		
	YANKASSA	19.26+2.7	*	
FL	WAD	9.12+1.9		
	YANKASSA	8.45+0.8	*	
FW	WAD	6.34+0.9		
	YANKASSA	7.03+0.7	*	
SL	WAD	0.62+0.1	ns	
		0.61+0.1		
Can	WAD	13.39+9.8		
	YANKASSA	24.46+2.3	*	

*Means are significantly different at 5% (P<0.05); *Ns-Not significantly different at 5% (P>0.05)

Table 3: Proportion of WAD Sheep Body Parameters in Yankassa Sheep and Their Reduction

Parameters	Proportion (%)	Reduction (%)
WH	80.49	19.51
BL	87.64	12.36
TD	86.83	13.17
FLL	76.99	23.01
RLL	78.67	21.33
HL	88.77	11.23
RL	84.94	15.06
FL	107.92	-7.92
FW	90.18	9.82
SL	101.64	-1.64
Can	54.74	45.26

Table 4: Indices from the Body Parameters of WAD Sheep and Yankassa Sheep

Indices	WAD Sheep	Yankassa sheep
Height index	0.837	0.875
Rump index	0.901	0.922
Area index	3167.127	4489.34
FaL	7.03	8.45
FaW	6.34	7.03
Foreleg-index	0.288	0.406
Rear leg index	0.538	0.477
Depth index	0.51	0.47

HEIGHT INDEX=FLL/WH	WH-Whither Height
RUMP INDEX=RL/WH	RL-Rump Length
AREA INDEX=WH*BL	FaL- Face Length
FORELEG INDEX=CAN/FLL	FaW- Face width
REAR LEG INDEX=HL/RLL	BL-Body Length
DEPTH INDEX=TD/WH	CAN-cannon Bone
	FLL-Fore leg length
	RLL-Rear leg length
	TD-Thorax depth
	HL-Horck Length

DISCUSSION

Table 1 indicated that the Yankassa sheep is a heavier breed compared to the WAD sheep haven had higher values in all body dimensions except face length and shin length. These values are significantly (P < 0.01) different from those of the WAD sheep. It is also observable that while the Yankassa sheep had higher values of wither height compared to body length, the WAD sheep had longer body length compared to wither height. Hence while the Yankassa sheep is said to be taller than long, the WAD sheep is referred to as longer than tall. Body dimensions have been recommended as a good predictor of weight and size especially in traditional systems where breeding practices are not documented and in a less complicated and expensive way (Fitzhugh *et al.*, 1983).

The head profile of the Yankassa sheep showed a convex face while the WAD sheep had a flat face profile. The shin bone of the WAD sheep is as well developed as that of the Yankassa sheep indicating absence of any form of structural disability in bone formation in the WAD sheep.

The reduction in body size of WAD sheep comparing with the Yankassa sheep indicated that height reduction was more vigorous than length measurements and especially the long bones of the limb is more affected showing a disproportionate reduction in skeletal development. However, the lower portion of the limbs that is the horck were considerably reduced compared to the upper part of the limb. This pattern of reduction is not indicative of achondroplasia as commonly believed.

Body indices from Table 4 showed in general that Yankassa sheep is bigger bodied than WAD sheep in height index, rump index, area index. But the WAD sheep has a higher depth index compared to the Yankassa sheep and this portion of the body can be an index of meatiness. The WAD sheep has a more compact body and smaller body surface area compared to the Yankassa sheep. This may be an adaptive feature to the more humid environment where it thrives. Animals that thrive in hot humid regions have been found to possessing these adaptive features to cope with relative humidity. The very long legs of the Yankassa sheep are characteristic of all desert animals such as the Balami and Uda sheep as well as other livestock species (Fitzhugh *et al.*, 1983). This type of body structure is considered to have evolved as a result of its being more effective in dissipating heat than a short, squat body size (Devendra *et al.*, 1988). Small size is more directly related to adaptation to the humid tropical environment (Hall, 1991).Variability among body dimensions were small and comparable considering their standard deviation and standard error values. Wither height and body length are not environmentally sensitive therefore they are indicators of inherent size especially at maturity.

With the obvious reduction in body size showing a considerable limb shortening than overall body size, the effect of environmental-genetic interaction would still need to be studied in the WAD sheep to elucidate more on this pattern of reduction.

The result of this study revealed that there was reduction in limb to trunk but the reduction in limb was more prominent on the lower part of the limb than the upper limb. There are no significant differences in the shin bone development between the two breeds hence reduction was majorly a size issue and may not affect structural integrity of the bones. Thus it may not be true to classify the West African Dwarf sheep as a dwarf type as it is popularly called. The Djallonké sheep has been preferred to West African Dwarf Sheep by earlier studies (Devendra *et al.*, 1988). In that report, they opined that the sheep are relatively small but they are not achondroplastic.

Conclusion

The result of this study indicated that the Yankassa sheep exhibited a taller than long body, while the West African dwarf Sheep has a longer than tall body. The stature of the WAD sheep though short, may not be due to achondroplasia. Further studies on environmental-genetic interaction may need to be carried out on the WAD sheep to provide more details with respect to the body size reduction pattern noted in this breed.

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