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Phenotypic characterization of yankasa breed of sheep in Maiduguri, North-Eastern Nigeria

Henry, A. J., Halilu, A. and Dauda, A.
Department of Animal Science,
University of Calabar, Calabar, Nigeria.
Corresponding email: adbhalilu@gmail.com. +234(0)8065240821

Abstract

A total of 255 (65 males and 190 females) Yankasa breeds of sheep were randomly sampled to evaluate the effect of age and sex on morphometric characteristics using descriptive statistics, correlation and regression coefficient. The morphometric traits evaluated were; body weight (BW), body length (BL), height at wither (HW), chest circumference (CC), head length (HDL), head width (HDW), ear length (EL), tail length (TL), rump width (RW), rump length (RL), foreleg (FLG), hind leg (HLG), height at rump (HTR) and neck length (NL). Body weight was measured with weighing while the morphometric characteristic was measured with measuring tape. The data was analyzed using GENSTAT 2011. The result revealed that age has significant ($P<0.05$) effect on morphometric characteristics of Yankasa sheep. Increase in age lead to increase in morphometric characteristics. Sex also has significant ($P<0.05$) influence on morphometric traits. Male shows superiority over female in all the traits except CC and NL. The Coefficient of Variation (CV) ranged from 7.31 – 26.86) with HDW having the highest (26.86) while CC had the lowest (7.31). The phenotypic correlation of morphometric characteristics varied in magnitude and direction. BW showed positive correlation with most of the morphometric traits. The positive correlation of BW with other traits showed that they are controlled by same gene. The regression analysis indicated that body weight of Yankasa sheep could easily be predicted from any of the linear body measurements. The traits combined could be the best predictor of body weight of these breed of sheep.

Keywords: Yankasa, Phenotypic, Breed, Characterization, Age

Introduction

In breed identification and classification, phenotypic characterization is important in ways that both research scientists and farming communities can relate with (Adejoro and Salako, 2012; Dauda *et al*., 2018a). Information on the weight of sheep is important for different sheep management practices such as medication, marketing, breeding and sometimes for supplemental feeding (Taye *et al*., 2016). Characterization of Farm Animal Genetic Resources (FAnGR) consists of all activities associated with the identification, quantitative and qualitative description, and documentation of breed populations and the natural habitats and production systems to which they are or are not adapted (Gizaw *et al*., 2011). The usefulness of breed characterization of livestock in general and sheep in particular is never in doubt, because characterization, inventory and monitoring of animal genetic resources (AnGR) are essential to their sustainable management and facilitate effective planning of how and where they can best be used and developed (FAO, 2015). Phenotype characterization of the existing sheep population, is the base for designing community based breed improvement and genotypic characterization, since genetic resources and production systems are not static and thus routine inventories and thus on-going monitoring is needed (Sölkner *et al*., 1998; Tesfay *et al*., 2017). Under traditional farm conditions where access to a weighing scale is difficult, other easier options are mandatory. The most widely used methods for estimating the weight of sheep under farm conditions are using a regression equation developed from other linear body measurements for the breed/population of interest (Melesse *et al*., 2013b). The Yankasa sheep is a meat breed in found in North and North Central Nigeria. It is a medium sized breed of sheep. The tail is long and thin, the ears moderately long and somewhat droopy. Rams have curved horns and a hairy white mane and ewes are polled. They have white coat colour with black patches around the eyes, ears and muzzle (Adu and Ngere, 1979), although, there is little information on morphometric variables of Yankasa breed of sheep to aid breeders in the selection and improvement of these sheep. Thus, this study was design to carry out phenotypic characterization of Yankasa breed of sheep in Nigeria.

Materials and methods

Study area

The study was carried out at Maiduguri metropolis. Maiduguri is the capital and the largest urban center of Borno State, North Eastern Nigeria. The state 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 vegetational zones, characterized by short rainy season of 3 - 4 months (June - September) followed by a prolonged dry season of more than 8 months duration (BMLS, 2016).

Management system of the experimental animals

The animals were managed under the traditional extensive system, with little or no provision for shelter in the day and night. They grazed during the day on natural pasture containing forages such as northern gamba grass (*Andropogon gayanus*), stylo (*Stylosanthes gracilis*) and *leucaena* (Leucaena leucocephala). Occasionally, supplements such as cassava and yam peels, cereal offal and crop residues were provided prior and/or after grazing of natural pastures. Adequate health care was virtually non-existent while non-directional breeding was the practice (Yakubu and Ibrahim, 2011).

Morphometric variables of yankasa sheep

A total of 255 (65 males and 190 females) Yankasa breeds of sheep in the same age group were randomly sampled from a population of the breed for morphometric traits. The traits measured were bodyweight (BW), body length (BL), height at wither (HW), chest circumference (CC), head length (HDL), head width (HDW), ear length (EL), tail length (TL), rump width (RW), rump length (RL), foreleg (FLG), hind leg (HLG), height at rump (HTR) and neck length (NL). The bodyweight (Kg) were measured by using of weighing scale with model number WJ515 and the height measurement (cm) was done using a graduated measuring stick. The length and circumference measurements (cm) were carried out using a measuring tape and a wooden ruler. Measurements were done in the morning before the animals were released for grazing. All measurements were carried out by the same person, in order to avoid inter-individual variations as outlined by (Yakubu and Ibrahim, 2011).

Statistical analysis

The data collected from the quantitative variables were analyzed with General Linear Model (GLM) procedures of the GenStat software (Payne *et al*., 2010). Age was analyzed using ANOVA while significant means were separated using Duncan Multiple Range Test. Sex was computed using T-Test. Pearson correlation coefficient (r) values for the Yankasa sheep was also computed using same software to assess the relationship between body measurement traits. In addition, regression analyses in GenStat of GLM were used to predict body weights of the sheep from the measured traits. The following model was used for the estimation of body weight from linear body measurements.

$Yij = \mu + Si + Aj + eij$

Where Yij= individual observation of each body traits;

μ = overall mean;

Si = fixed effect of ith sex (i = male, female);

Aj = fixed effect of jth age (j < 1 year old, 2 years old, and > 2 years old)

eij=random residual error associated with record of each animal

Data collected were also subjected to Pearson correlation and regression analysis using (GENSTAT, 2011) version to determine the phenotypic correlation values among the phenotypic traits and prediction equations from the traits.

Results and discussion

The effect of age on body traits of Yankasa breed of sheep is presented in Table 1. Age had significant ($P<0.005$) influence on BL, HDW, TL, RL, RW and HTR. The older animals had higher values for all these parameters. Increase in age had led to significant increase in these parameters. Although other parameters that were statistically similar also follow the same trend with increase in age of Yankasa breed of sheep. This showed that as these animals increased in age, those parameters also increased. This result agreed with Dauda *et al*. (2018a) who also reported a significant effect of age in Belami sheep. Adejoro and Salako (2012) also reported that the general positive influence of age of animals on body size and weight is not surprising since the size and shape of animals were expected to increase with increasing age of the animals. The influence of age of the animals on phenotypic parameters can be attributed to the size and shape of the animals because it is expected to change with changing age of the animals. Many previous studies reported significant effects of environmental factors such as age, and herd on body weight in accordance with our results (Maria *et al*., 2003; Fasae *et al*., 2005; Afolayan *et al*., 2006; Musa *et al*., 2006).

Table 1: Effect of age on morphometric traits of Yankasa breed of sheep

	Age			
Traits	**0 – 1 year**	**>1 – 2 years**	**>2 years**	**SEM**
Body weight	48.10	51.80	53.50	3.17
Body length	46.29^b	51.80^a	53.00^a	1.44
Height at wither	72.00^b	77.20^a	79.80^a	2.20
Chest circumference	74.80	77.00	78.80	2.07
Head length	20.00	20.80	21.83	1.03
Head wide	10.43	12.00	12.83	1.08
Ear length	16.57	17.80	18.42	0.71
Tail length	38.00^b	47.60^a	48.80^a	2.62
Rump length	17.14^b	22.00^a	23.00^a	1.09
Rump wide	15.29^b	18.20^a	18.50^a	0.75
Height at rump	64.70^b	71.40^a	71.20^a	1.95
Foreleg	49.60	49.80	55.20	1.89
Hind leg	57.00	62.80	59.80	2.53
Neck length	29.10	28.80	34.30	1.76

SEM=Standard Error of Mean; a,b = Means with different superscripts on the same row differ significantly ($P<0.05$)

The effect of sex on body traits of Yankasa sheep is presented in Table 2. Sex had significant (P<0.005) effect on BL, H@W, HDL and HDW with males showing superiority over females in all parameters except for CC and NL where the females were numerically (P>0.005) higher than males. In this study male showed superiority to female, this agreed with the report of Yakubu and Akinyemi (2010) on the superiority of males over female sheep. These differences between male and female lambs were similar to those reported in lambs (Gilbert *et al*., 1993; Afolayan *et al*., 2006; Dauda *et al*., 2018b) that male lambs were heavier, taller and bigger in girth; more muscled but with less fat compared to heifers and female lambs both at weaning and post-weaning ages and in lambs (Afolayan *et al*., 2006). The superiority of males over females in this study might be due to testosterone secretion which is released in the male animals since testosterone is known to stimulate muscular development (Maria *et al*., 2003). The TL, RL, RW, FLG were higher in male than what was obtained in female Yankasa breed of sheep in this study which is at variance with the result of (Adejoro and Salako, 2012; Dauda *et al*., 2018b). The HNL, HNC and HDW were higher in male than female in this study. The superiority of male over female in some of the body trait could be as a result of secretion of testosterone hormone which is secreted in male animal (Dauda *et al*., 2018b). The result of the summary of statistics on body traits of Yankasa sheep is presented in Table 3. The summary of statistics on phenotypic parameter of BW (37 - 70 kg), BL (42.00 – 62.00 cm), HW (66.00 – 90.00 cm), CC (68.00 – 88.00 cm), HDL (17 – 28 cm), HDW (8 – 19 cm), EL (14 – 22 cm), TL (29 – 64 cm), RL (12 – 27 cm), RW (14 – 23 cm), HTR (60 – 82 cm), FLG (20 – 61 cm), HLG (45 - 74 cm) and NL (22 – 57 cm) was obtained for Yankasa breed of sheep.

Table 2: Effect of sex on morphometric traits of Yankasa breed of sheep

	Sex						
Traits	**Male**	**CV**	**P value**	**Female**	**CV**	**SEM**	**P value**
Body weight	54.00	16.22	2.53	49.35	16.23	1.79	0.859
Body length	51.55[a]	11.56	1.33	49.25[b]	6.07	0.86	0.011
Height at wither	78.10[a]	10.12	1.77	74.75[b]	5.29	1.14	0.006
Chest circumference	75.98	7.27	1.24	78.58	7.18	1.63	0.920
Head length	22.00[a]	15.95	0.78	19.58[b]	5.53	0.31	0.003
Head wide	13.05[a]	27.85	0.81	10.25[b]	10.30	0.31	0.001
Ear length	19.00	8.87	0.38	16.58	8.89	0.43	0.087
Tail length	47.45	11.55	1.23	42.83	20.78	2.57	0.196
Rump length	20.95	20.10	0.94	20.75	15.80	0.95	0.139
Rump wide	17.70	15.99	0.63	17.00	15.99	0.63	0.140
Height at rump	69.60	10.34	1.61	69.42	6.93	1.39	0.145
Foreleg	53.65	9.08	1.09	48.08	21.60	3.00	0.173
Hind leg	60.60	11.94	1.62	59.00	12.97	2.21	0.902
Neck length	31.45	16.87	1.19	34.17	25.42	2.51	0.272

SEM=Standard Error of Mean; CV= Coefficient of variation; a,b = Means with different superscripts on the same row differ significantly (P<0.05)

Table 3: Summary statistics on morphometric traits of Yankasa breed of sheep

Traits	Mean	Minimum	Maximum	CV	SEM
Body weight	51.09	37.00	70.00	16.58	1.50
Body length	50.69	42.00	62.00	10.10	0.91
Height at wither	76.84	66.00	90.00	8.88	1.21
Chest circumference	76.96	68.00	88.00	7.31	0.99
Head length	21.09	17.00	28.00	14.52	0.54
Head wide	12.00	8.00	19.00	26.86	0.57
Ear length	18.09	14.00	22.00	10.95	0.35
Tail length	45.72	29.00	64.00	15.73	1.27
Rump length	20.88	12.00	27.00	18.36	0.68
Rump wide	17.44	14.00	23.00	14.49	0.45
Height at rump	69.53	60.00	82.00	9.10	1.12
Foreleg	51.56	20.00	61.00	15.06	1.37
Hind leg	60.00	45.00	74.00	12.19	1.29
Neck length	32.47	22.00	57.00	20.84	1.20

CV=Coefficient of Variation, SEM=Standard error of mean

These were higher than those of Yankasa breed of sheep reported by Muhammad *et al*. (2014); Tesfay *et al*. (2016); Taye *et al*. (2017). The value of coefficient of variation (CV) from this study ranges from 7.31 – 26.86. The highest CV value is from HDW (26.86) and the least is CC (7.31). The coefficient of variation indicated moderate to low variation within the body traits. The variations that exist in the body traits of Yankasa breed showed possibility of respond to selection and improvement.

The Pearson′s correlation of linear body measurements with body weight and other morphometric traits is presented in Table 4. The result showed that there was low, moderate, high, negative, positive and significant ($P<0.05$) correlation between weight and other morphometric traits of Yankasa sheep. The highest correlation coefficient obtained was between ear length and tail length ($r = 0.90$) which was followed by hind leg with height at rump ($r = 0.73$). The positive correlation signifies that they are controlled by same gene and the similarity is an indication that any of these body dimensions could serve as a predictor of body weight. The observed positive ($P<0.05$) correlations between weight and other body measurements is in agreement with literature (Afolayan *et al*., 2006; Khan *et al*., 2006; Sowande and Sobola, 2008; Yakubu and Ayoade, 2009; Melesse *et al*., 2013b). This means that an improvement in one trait will lead to improvement in the other while the negative correlation between traits implies that improvement in one trait will lead to decrease in the other trait. This also implies that the traits are controlled by more than one gene (pleiotropy) (Fayeye, 2014).

Prediction equations to estimate body weight from quantitative traits are presented in Table 5. Regression coefficients (R^2) for the quantitative traits measured were highly significant ($P<0.001$). The value of R^2 increased as more independent variables were added to the regression equation, showing that estimating body weight using a single body measurement is not the only suitable criterion for predicting body weight. The variation in body weight was explained to a large extent by the combination of all the traits with the highest R^2. The results of this study confirmed that body weight of Yankasa breed of sheep can be predicted with confidence from most of the quantitative traits measurements.

Table 4: Phenotypic correlation of morphometric traits of Yankasa br eed of sheep

	BW	BL	CC	EL	FLG	HDL	HDW	HAW	HLG	HAR	NL	RL	RW	TL
BW	1.00													
BL	0.35*	1.00												
CC	0.26	0.15	1.00											
EL	0.67**	0.35*	0.62**	1.00										
FLG	0.07	0.46*	0.14	0.06	1.00									
HDL	-0.25	-0.17	**-0.46***	0.54*	**-0.46***	1.00								
HDW	0.34*	0.40*	0.08	0.00	0.65**	0.42*	1.00							
HAW	0.69**	0.54**	0.00	0.63**	0.14	0.36*	0.00	1.00						
HLG	0.17	0.51**	0.37*	0.39*	0.27	-0.14	0.58**	0.12	1.00					
HAR	0.69**	0.05	0.27	-0.07	0.08	-0.10	0.54**	0.38*	0.73**	1.00				
NL	0.53**	0.42*	0.33*	0.69**	0.27	0.40*	0.15	0.63**	0.20	0.26	1.00			
RL	0.52**	0.41*	0.22	0.18	0.37*	-0.17	0.07	0.48*	0.06	0.41*	0.13	1.00		
RW	0.04	0.13	0.16	0.15	0.38*	-0.10	0.30*	0.01	0.13*	0.24	0.15	0.22	1.00	
TL	0.59**	0.47*	0.54*	**0.90*****	0.04	0.51*	0.04	0.63**	0.53**	0.04	0.64**	0.14	0.29	1.00

*Significant ($p<0.05$), ** Highly Significant ($p<0.01$) body weight (BW), body length (BL), height at wither (HAW), chest circum ference (CC), head length (HDL), head wide (HDW), ear length (EL), tail length (TL), rump wide (RW), rump length (RL), height at rump (HAR), foreleg (FLG), hind leg (HLG) and neck length (NL)

Table 5: Simple linear regression equations relating live body weight to body linear measurements

Linear body Measurement (X) (cm)	Prediction Equation	R^2	SEE	P Value
BW,BL	-6.0+1.13BL	0.446	6.310	<0.001
BW,BL,CC	-63.96-0.06BL+1.53CC	0.987	0.979	<0.001
BW,BL,CC,EL	-61.58-0.01BL+1.51CC-0.16EL	0.987	0.953	<0.001
BW,BL,CC,EL,FL	-61.39-0.02BL+1.53CC-0.10EL-0.04FL	0.988	0.920	<0.001
BW,BL,CC,EL,FL,HDL	-61.89-0.03BL+1.55CC-0.06EL-0.04FL-0.02HDL	0.988	0.929	<0.001
BW,BL,CC,EL,FL,HDL,HDW	-61.67+0.04BL+1.57CC-0.02EL+0.02FL+0.07HDL-0.20HDW	0.991	0.811	<0.001
BW,BL,CC,EL,FL,HDL,HDW,HAW	-61.69+0.04BL+1.58CC-0.02EL+0.02FL+0.07HDL-0.19HDW-0.02HAW	0.990	0.826	<0.001
BW,BL,CC,EL,FL,HDL,HDW,HAW,HLG	-62.27+0.22BL+1.55CC-0.04EL+0.06FL+0.12HDL-0.27HDW+0.002HAW-0.27HLG	0.993	0.714	<0.001
BW,BL,CC,EL,FL,HDL,HDW,HAW,HLG,HAR	-61.75+0.22BL+1.55CC-0.04EL+0.06FL+0.12HDL-0.28HDW+0.001HAW-0.29HLG+0.03HAR	0.993	0.729	<0.001
BW,BL,CC,EL,FL,HDL,HDW,HAW,HLG,HAR,NL	-63.67+0.26BL+1.56CC+0.05EL+0.02FL+0.12HDL-0.25HDW+0.05HAW-0.27HLG-0.18HAR-0.10NL	0.997	0.440	<0.001
BW,BL,CC,EL,FL,HDL,HDW,HAW,HLG,HAR,NL,RL	-62.89+0.25BL+1.56CC+0.04EL+0.02FL+0.12HDL-0.26HDW+0.04HAW-0.28HLG-0.15HAR-0.10NL+0.02RL	0.997	0.449	<0.001
BW,BL,CC,EL,FL,HDL,HDW,HAW,HLG,HAR,NL,RL,RW	-63.76+0.25BL+1.56CC+0.07EL+0.003FL+0.11HDL-0.23HDW+0.06HAW-0.21HLG-0.21HAR-0.11NL+0.03RL-0.01RW	0.997	0.431	<0.001
BW,BL,CC,EL,FL,HDL,HDW,HAW,HLG,HAR,NL,RL,RW,TL	-66.29+0.28BL+1.58CC+0.21EL+0.004FL+0.09HDL-0.23HDW+0.09HAW-0.30HLG-0.20HAR-0.13NL+0.03RL-0.08RW-0.06TL	0.997	0.427	<0.001

Body weight (BW), body length (BL), height at wither (HAW), chest circumference (CC), head length (HDL), head wide (HDW), earlength (EL), tail length (TL), rump wide (RW), rump length (RL), height at rump (HAR), foreleg (FL), hind leg (HLG) and neck length (NL)

This is in agreement with earlier research (Taye *et al*., 2012; Melesse *et al*., 2013b) that multiple regression models estimated weight with better accuracy; and accuracy of prediction increased with the increased number of variables. Therefore, choice of the equations according to Taye *et al*. (2016) should be based on the accuracy needed and level of difficulty at field conditions. The author further stated that regression equations with a number of variables can be used in breeding programs while those simpler ones can be used for marketing and medication purposes.

Conclusion

The findings from this study showed that age and sex had significant effect on phenotypic traits of Yankasa sheep while the coefficient of variation (CV) showed that there could be more room for improvement of such traits in these breeds. There was positive correlation among most phenotypic parameters and thus these could be used for livestock improvement, since improvement in one phenotypic parameter will lead to improvement in others. The results of this study will help breeders in selection and improvement of sheep in Nigeria.

References

Adejoro, F. A. and Salako, A. E. 2012. Morphobiometric characterization of the Balami sheep of Nigeria. *African Journal of General Agriculture*, 8(4): 169 173.

Adu, I. F. and Ngere, L. O. 1979. The indigenous sheep of Nigeria. *World Review of Animal Production*, 15 (3):51–62.

Afolayan, R. A., Adeyinka, I. A. and Lakpini, C. A. M. 2006. The estimation of live weight from body measurements in Yankasa sheep. *Czech Journal of Animal Science*, 51: 343-348.

Borno State Ministry of Land and Survey (BMLS) 2016. Annual Report 15-58.

Dauda, A., Abbaya, H. Y., Shettima, S. M. and Saul, S. 2018b. Phenotypic differentiation of Koroji sheep in Maiduguri. *Nigerian Journal of Animal Science*, 20 (2): 33-41.

Dauda, A., Okon, B., Ibom, L. A. and Abbaya, H. Y. 2018a. Phenotypic characterization of Balami breed of sheep in Maiduguri, North-Eastern Nigeria. *Nigerian Journal of Animal Science*, 20 (2): 26-32.

FAO (Food and Agricultural Organization of the United Nations) 2015. The Second Report on the State of the World's Animal Genetic Resources for Food and Agriculture, edited by B.D. Scherf & D. Pilling. FAO Commission on Genetic Resources for Food and Agriculture Assessments. Rome (available at http://www.fao.org/3/a-i4787e/index.html).

Fasae, O.A., Chineke, A.C. and Alokan, J.A. 2005. Relationship between some physical parameters of grazing Yankasa ewes in the humid zone of Nigeria. *Archivos de Zootecnia*, 54, 639-642.

Fayeye, T. R. 2014. Genetic principles and animal breeding. Happy Printing Enterprises, Ilorin, Nigeria.

Gilbert R. P., Bailey D. R. C., Shannon N. H. 1993. Body dimensions and carcass measurements of cattle selected for post-weaning gain fed two different diets. *Journal Animal Science*, 71:1688–1698.

Gizaw, S., Komen, H., Hannote, O., Van, A. J. A. M., Kemp, S., Haile, A., Mwai, O. and Dessie, T. 2011. Characterization and conservation of indigenous sheep genetic resources: A practical framework for developing countries. ILRI Research Report No 27. Nairobi, Kenya.

Khan, H., Muhammad, F., Ahmad, R., Nawaz, G. and Zubair, M. 2006. Relationship of body weight with linear body measurements in goats. *Journal Agriculture and Biological Science*, 1(3):51-54.

Maria, S. F., Castelli, L., Bogani, D. and Panella, F. 2003. The measurement of chest girth as an alternative to weight determination in the performance recording ofmeat sheep. *Italian Journal of Animal Science*, 2:123-129.

Melesse, A., Banerjee, S., Lakew, A., Mersha, F., Hailemariam, F., Tsegaye, S. and Makebo,T. 2013a. Morphological characterization of indigenous sheep in Southern Regional State, *Ethiopian Animal Genetic Resources*, 5239-5250.

Melesse, A., Banerjee, S., Lakew, A., Mersha, F., Hailemariam, F., Tsegaye, S. and Makebo, T. 2013b. Variations in linear body measurements and establishing prediction equations for live weight of indigenous sheep populations of southern. *Ethiopian Science Journal Animal Science*, 2 (1): 15-25.

Muhammad, A. M., Peter, S., Wosilat, A., Helen, Y. Y., James, G., Silas, N. and Ruth, N. 2014. Live body weight estimation using cannon bone length and other body linear measurements in Nigerian breeds of sheep. *Journal of Advanced Veterinary Animal Research*, 1 (4): 169-176.

Musa, H. H., Amin, E.l., Suleiman, F.M., Chen, A.H., Olowofeso, G.H. and Mekki, D.M. 2006. Body measurements in West African sheep in Sudan. *Journal of Animal and Veterinary Advances*, 5(4): 289-300.

Payne, R. W., Harding, S. A., Murray, D. A., Soutar, D. M., Baird, D. B., Glaser, A. I., Channing, I. C., Welham, S. J., Gilmour, A. R., Thompson, R. and Webster, R. 2010. The guide to GenStat release 13. VSN International, Hemel Hempstead.

Sölkner, J., Nakimbugwe, H. and Zarate, A. V. 1998. Analysis of determinants for success and failure of breeding programmes. pp. 273-280. *In: Proceedings of the Six World Congress on Genetics Applied to Livestock Production*, 11-16 January, 1998, Armidale, Australia.

Sowande, O. S. and Sobola, O. S. 2008. Body measurement of West African Dwarf sheep as parameters for estimation of live weight. *Tropical Animal Health Production*, 40:433-439.

Taye, M., Bimerow, T., Yitayew, A., Mekuriaw, S. and Mekuriaw,

G. 2012. Estimation of live body weight from linear body measurements for Farta sheep. *Online Journal Animal Feed Research*, 2 (1): 98-103.

Taye, M., Yilma, M., Rischkowsky, B., Dessie, T., Okeyo, M., Mekuriaw, G. and Haile, A. 2016. Morphological characteristics and linear body measurements of Doyogena sheep in Doyogena district of SNNPR, Ethiopia. *African Journal of Agricultural Research*, 11 (48): 4873-4885.

Tesfay, H. H., Banerjee, A. K. and Mummed, Y. Y. 2017. Live body weight and linear body measurements of indigenous sheep population in their production system for developing suitables election criteria in Central Zone of Tigray, Northern Ethiopia. *African Journal of Agricultural Research*, 12 (13): 1087 - 1095.

Yakubu, A. and Akinyemi, M. O. 2010. An evaluation of sexual size dimorphism in Uda sheep using multifactorial discriminant analysis. *Acta Agric Scand Sect Animal Science*, 60:74–78.

Yakubu, A. and Ayoade, J. A. 2009. Application of principal component factor analysis in quantifying size and morphological indices of domestic rabbit. *International Journal of Morphology*, 27 (4): 1013-1017

Yakubu, A. and Ibrahim, A. I. 2011. Multivariate analysis of morphostructural characteristics in Nigerian indigenous sheep. *Italian Journal of Animal Science* 10 (2):46-52.

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