ESTIMATION OF GENETIC DISTANCE USING PHENOTYPIC TRAITS IN DONKEYS

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ABSTRACT
Donkey breeds represent a fascinating model of domesticated biodiversity. This study was conducted in the Sahel agro-ecological zone of North Eastern part of Nigeria in Borno and Yobe State. Two hundred matured (200) donkeys were sampled from donkey owners in parts of Borno and Yobe States and were used for the study. The animals were maintained under the traditional system of management. The body measurements evaluated include: Face length (FL), Distance between the ears (DBE), Ear length (EL), Neck length (NL), Height at withers (HW), Body length (BL), Tail length (TL) and Body weight (BW). Body weight and body measurements were measured using a specially designed tape (WE-BO MALEBAND®) graduated from 0 meters to 2.26 meters (0 - 226cm). Body weight was estimated by taking readings round the circumference of the chest girth. The estimation of genetic distance using phenotypic data were analyzed using Multivariate analysis (Quadratic discriminants analysis) using MINI TAB statistical package version 16. The percent classification of donkeys investigated that the Grey (Idabari) donkey had the highest categorization rate of 94.4% while the others had lower classification percent. The highest classification percent may have indicated that the Grey breed varied significantly in the study areas while the lower percent classification may have indicated that the populations of donkeys in these groups are more comparable. The donkeys in the study area were categorized into four breeds on the basis of coat colour as Grey (Idabari), Red/rust (Auraki), Black (Duni) and White (Fari) with the grey breed being more significant varies than the other ecotypes as revealed by the genetic distances. The white (Fari) donkey had the shortest genetic distance as compared to the other breeds, suggesting that this breed is more unified.
Keywords: Genetic distance, Breed, Donkey and Phenotypic data

INTRODUCTION

Donkeys play a major role in the economy of developing countries by being the main source in transport and traction, particularly in areas with difficult reliefs (Labbaci *et al.*, 2018). The capacity performance of donkeys could be assessed by the description of the morphological characteristics, such as chest girths, body length and height (Nengomasha, 1999). Donkey, during domestication, some morphological and genetic changes have taken place in order to survive better in given conditions (Rossel *et al., 2*008). The power available for draught animals is related to its body weight. The maximum draught available for donkey 32% of body weight up to 6 h and 36% up to 4 h in two shifts. The draught power can be measure in terms of the following conditions. Under good condition larger animals can perform more work than smaller animal considering the body size of the animal. Animal that should be used for draught purpose should have wide chest girth, medium body length and should have good body weight as its body conformation (Blench, 2000). Genetic diversity refers to the variety of genes within a species. In order to preserve genetic diversity within a species, different populations must be sustained. Genetic diversity allows livestock species for adaptation to changes in the environmental conditions over time and is, consequently, essential to species survival (Koyuni *et al.,* 2016). One of the important reasons to preserve genetic diversity within animal as a source of food is that, different populations must be sustained since species of birds and mammals that have been domesticated allows livestock species for adaptation to changes for

use in agriculture and food production, and there are environmental conditions over time and is, consequently, more than 8000 recognized breeds (Diamond, 2002: FAO, 2011). Genetic diversity improves a species chance of survival (Neaves *et al*., 2015). Variations in phenotypic measurements are the basic parameters in the genetic diversity study of a species (Rosa *et al.,* 2007). The aim of this study was to estimate the genetic distances of donkeys using phenotypic measurements.

MATERIALS AND METHODS

Experimental Animals

A total number of 200 donkeys of different breeds comprising of grey, red, black and white donkeys were sampled through stratified random sampling from donkey owners in Borno and Yobe state and were used for the phenotypic measurements. The temperature ranges from 33°C to 40°C and humidity percent ranging from 4 - 12% with annual average rainfall of 400 – 600mm (FAO,1991). Borno / Yobe State are located between latitude 10 and 14°E and Longitude 11 and14° N and an altitude of 354 m above sea level. It covers an area of 61,435 km^2 which is about 12% of the total area of the country.

Body Measurements

Body biometric indices evaluated include: face length (FL), distance between the eyes (DE), ear length (EL), neck length (NL), height at withers (HW), body length (BL) tail length (TL) and body weight. Donkeys were measured in a standing position. Body weight and body measurements were measured using a specially designed tape (WE-BO MALEBAND®) graduated from 0 meters to 2.26 meters (0 - 226cm). Body weight was estimated by taking readings round the circumference of the chest girth. Body biometrical indices were evaluated include: face length (FL), distance between the eyes (DE), ear length (EL), neck length (NL), height at withers (HW), body length (BL) and tail length (TL). All morphometric measurement was measured according to FAO (2012) phenotypic characterization guide lines.

1. Body length (BL): This was measured as the distance between the anterior part of the shoulder to the junction between the hip and the tail that is, the pin bone (ischium).
2. Height at withers (HW): This was measured from the highest point at the withers to the ground.
3. Heart Girth (HG): This was measured as the circumference around the chest, just behind the front leg.
4. Back Length (BkL): This was measured from the base of the withers to the base of the tail.
5. Neck Length (NL): This was measured as the distance between the cranial edge of the atlas wings and the apex of the scapula.
6. Face length (FH): This was measured from the midline between the top of the occipital region and the tip of the nose.
7. Tail length: This was measured from the base of the tail to the end of the tail.

Data Analysis

The estimation of genetic distance using phenotypic data was done using Multivariate discriminate analysis using MINI TAB statistical package version 16.

RESULTS AND DISCUSSION

The percent classification of donkeys into its original groups and error rate is shown in Table 1. Genetic distance based on phenotypic data is used to discriminant species into distinct phenotypic class and this done to establish genetic diversity within the population for breed improvement and genetic conservation. According to the results the Grey (*idabari*), Red/rust (*Auraki)*, Black (*Duni)* and the white donkey (*Fari)* donkeys were classified respectively as 94.4%, 55.89%, 40.67% and 41.8%. The Grey donkey had the highest error rate of 0.788% while the white donkey (*Fari)* had the lowest error rate of 0.115%. The proportional correct

classification the white donkey had the highest value of 0.885% while the Grey donkey had the lowest value of 0.212%. The highest classification percent may have indicated that the Grey breeds are very diversified in the study areas while lower percent classification may have indicated that the populations of donkeys in these groups are more comparable. The high error rate of the classification was obtained in Grey donkey, which indicates that the sampled population of donkeys were phenotypically Grey but genetically were not grey donkey they are from crosses with other ecotype/genotypes from the study areas. The lower error rate observed in white *(Fari)* donkey may indicated that these ecotypes had been classified into its genetic group very well in the study area. The present study agreed with the findings of Getachew *et al*. (2023) who classified donkeys based on recognized districts within his study area (Selolo *et al*., 2015).

Table 1: The classification of donkeys into its original group and error rate

Breeds	Grey	Red/rust	Predicted Black	Groups White	Membership Total
Grey	17 (94.4%)	00 (0%)	01 (5.6%)	00 (0 %)	18
Red/rust	23 (33.82)	38(55.89%)	06(8.82%)	01(1.47%)	68
Black	25(42.37%)	08(13.56%)	24(40.7%)	02(3.38%)	59
White	15(27.29%)	07(12.73)	10(18.18%)	23(41.8)	55
Total (N)	80	53	41	26	200
Proportional correct %	0.212 %	0.717	0.585	0.885	0.510
Error rate	0.788%	0.283	0.415	0.115	0.490

The estimated genetic distance to group relationship of donkeys in Sahel agro ecological zone of Nigeria

The estimated genetic distance to group relationship of donkeys in Sahel agro ecological zone of Nigeria is shown in Table 2. From the results it was recorded that the Grey (*Idabari*) had close relationship with Red/rust donkey with the values of 50.64% and 47.33% respectively. While the red/rust, the black and white donkeys are related with the values of 47.73%, 47.61% and 47.04% respectively. These followed the same trend with the other relationships. Based on the results the Grey donkey were ranked into group one followed by the red /rust and Black donkey as group two while the white donkey as group three. This present study agreed with Getachew *et al.* (2023) who established genetic diversity within population based on phenotypic data.

Table 2: Estimated genetic distance to group relationship of donkeys in Sahel agro ecological zone of Nigeria.

Breeds of donkey	Generalized Grey (%)	Squared Red/rust (%)	Distance to Black (%)	Group White (%)	Relationships
Grey	50.64	47.73	47.61	47.04	
Red/rust	50.83	44.19	45.08	42.86	
Black	51.49	44.97	44.54	42.96	
White	51.66	45.14	45.60	41.23	

CONCLUSION

The donkeys in the study area were categorized into four breeds on the basis of coat colour as Grey (Idabari), Red/rust (Auraki), Black (Duni) and White (Fari) with the grey breed being more significant varies than the other ecotypes as revealed by the genetic distances. The white (Fari) donkey had the shortest genetic distance as compared to the other breeds, suggesting that this breed is more unified.

REFERENCES

Blench, R. M. (2000). A history of donkeys and mules in Africa. In: *The origin and development of African livestock.* R.M. Blench & K.C. MacDonald eds. 339-354. London: University College Press.

Dauda, A., Abbaya, H.Y. and Ebegbulem, V. N. (2018). Application of Multifactorial discriminant analysis of morphostructural differentiation of sheep. *Journal of Genetics and Genetic Engineering.* Vol 2(2) pp 11-16

Diamond, J. (2002). Evolution, consequences and future of plant and animal domestication. Nature, 418: 700707.

FAO. (2011). http://www.fao.org/docrep/013/i2050e/i2050e00.htm

FAO. (2012). Phenotypic characterization of animal genetic resources. FAO Animal Production and Health Guidelines, No. 11. Rome, 7—28.

Getachew, T. B., Kassa, A.H. and Megersa, A. G. (2023). Phenotypic characterization of donkey population in South Omo zone Southern Ethiopia. *Heliyou* 9 (2023) e18662

Koyuni, H., Koncagul, S. and Karakus , K . (2016). Significance of genetic diversity in farm animal production. *Turkish Journal of Scientific review* 9(1):82-83

Labbaci, M., Djaout, A., Benyarou, M., Ameur, A.and Gaouar, S. B. S.(2018).Morphometric characterization and typology of donkey farming (Equus Asinus) in the wilaya of Tlemcen. *Journal of Genetic Biodivsity* 1, 60—72.

Nengomasha, E.M., Pearson, R.A., and Smith, T. (1999). The donkey as a draught power resource in smallholder farming in semi-arid western Zimbabwe. 1. Live weight and food and water requirements. *Animal Science,* 69, 297-304

Rosa, A.R.D., Amato, C. and Zumbo, A. (2007). Morphological traits of the "Pantesco" donkey. *Italian Journal of Animal Science*, 6(sup1), 646-646.

Rossel, S., Marshall, F., Peters, J., Pilgram, T., Adams, M. D. and O'Connor, D. (2008). Domestication of the donkey: Timing, processes, and indicators. *Proceedings of the National Academy of Sciences*, 105, 3715–3720.

Selolo, Tiou,C., Majele, M.L., Norris,D., Ng ambi,W. and David,B.(2015).Morphological differenciation of indigenous goats in different agro ecological zones of Vhembe district, Limpopo province, *South Africa Journal of Animal Resource* 49(4):527-531.

Yakubu, A. and Ibrahim, A. I. (2010). Multivariate analysis of morphostructural characteristic of Nigerian indigenous sheep. *Italian Journal of Animal Science.*

Yunusa, A. J., Salako, A. E. and Oladejo, O. E. (2013). Morphometric characteristic of Nigerian Sheep using Multifactorial discriminant analysis. *International Journal of Biodiversity and Conservation* .5(10):173-182