MORPHOMETRIC AND MORPHOLOGICAL EVALUATIONS OF NIGERIAN DONKEY (*EQUUS ASINUS*)

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ABSTRACT
The aim of this study was to evaluate the morphometric variation in Nigerian donkeys. The study was carried out at the Equine and Camel Research Programme NAPRI/ A. B. U, Shika Zaria. Forty (40) donkeys consisting of young and adult, male and female, divided into 4 groups of 10 donkeys each, were used for this study. Fourteen (14) body parameters measured include: Height withers, height rump, body length, chest depth, front leg length, heart girth circumference, tail length, cannon circumference fore limb, cannon circumference hind limb, neck length, neck circumference, head width, head length and ear length. The morphometric indexes determined include; Body Profile Index, Pectoral height index, Dactyl thoracic index, Front-back height, massive index, Relative Body Index. Values were subjected to one-way ANOVA. The findings in this study showed that young and adult donkeys do not have the same body parameter and this increases with age. There were significant differences (P < 0.05) in; HDW, NL, FLL, BL, CD, HGC, CCH and HW between the males and females adult donkeys, with the adult males having higher values than the females. There were significant differences (P < 0.05) in, NL, BL, HGC, HR, CCH and CD between the young males and female donkey, with the young males having higher values than the females. In conclusion, this study provided insight into morphological and morphometric measurements of donkeys and highlighted the variability that exists between the genders and age group based on the morphological parameters. Also, the morphometric indices revealed that the donkeys in this study are short legged (PHI > 0.56) with a slant back FBH > 1, indicating overload.

KEYWORD: Adult, Young, male, Female, Donkeys, Morphology, Morphometrics

INTRODUCTION

Donkeys originate from the semi-arid parts of the world, but are now kept in a variety of different environments, although they are rarely found in the humid tropics. Obesity (overweight) is the biggest problem facing donkeys kept in temperate areas of the world where food is relatively abundant, and of good quality (Zaitoun *et al*., 2005). These donkeys do relatively little work, often being kept as companion animals. Emaciation (underweight) is the biggest problem facing donkeys kept in the hotter tropical areas where food is in short supply, and of poor quality for many months of the year. These donkeys often work for at least part of each day in transport or tillage activities (Crepaldi *et al*., 2001). In places where donkeys are used for work, good management generally involves trying to ensure the animals eat enough to meet their daily requirements for food (Salako and Ngere, 2002). Morphometric measurement or body condition scoring is a useful indicator of a donkey's nutritional status and its reproductive wellbeing. It can be used to compare donkeys of different sizes and on different management systems where individuals cannot be reliably identified (Pearson and Ouassat, 1996). The capacity performance of donkeys could be assessed by the description of the morphological characteristics, such as umbilical girths, body length and height. This has been suggested, as donkey draft power is directly proportional to size parameters (Nengomasha, 1999). The aim of this study was to evaluate the morphometric variation and some biometric indexes in the young and adult male and female Nigerian donkeys.

MATERIALS AND METHODS

Study Location

The study was carried out at the Equine and Camel Research Programme, National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Shika - Zaria.

Experimental Design and Management

Forty (40) donkeys consisting of young and adult, male and female, divided into 4 groups of 10 donkeys each, were used for this stud. Young (≤ 5 years), Adult (≥ 5≤ 10 years). (Ayad *et al.,* 2019). The donkeys were housed in the donkey pen and were identified by means of plastic ear tags. They were aged based on the farm records. They were kept outdoors in the experimental Groups and fed *Digitaria smutsii* hay (wooly finger grass), concentrate rations at 1.2 kg/donkey/day as basal diet and water was provided *ad libitum*.

1. Group 1: Ten (10) young female, weighing 63 ± 2.5 kg with body condition score of 3.0 ± 0.5 aged 2.5 ± 1.0 years were used.
2. Group 2: Ten (10) young male, weighing 65 ± 2.5 kg with body condition score of 3.0 ± 0.5 aged 2.5 ± 1.0 years were used.
3. Group 3: Ten (10) adult female, weighing 100 ± 2.0 kg with body condition score of 3.5 ± 0.5 aged 9.5 ± 1.0 years were used.
4. Group 4: Ten (10) adult male, weighing 102 ± 2.5 kg with body condition score of 3.5 ± 0.5 aged 9.5 ± 1.0 years were used.

Measurements

All morphometric measurements were taken using measuring tape and recorded in centimetres (cm) as described by Salako, (2006a). The body parameters measured include; height withers (HW), height at rump (HR), body length (BL), chest depth (CD), fore arm length (FARL), heart girth circumference (HGC), tail length (TL), cannon circumference of the fore limb, (CCF), cannon circumference of the hind limb (CCH), neck length (NL), neck circumference (NC), head width (HeW), head length (HeL) and ear length (EL) were measured using a specially graduated metal measuring tape (Sönmez, 1973). From some measured morphologic donkeys, morphometric indexes were calculated according to the following formulas (Ayad *et al.,* 2019). Body Profile Index/Body frame (BPI), Pectoral height index (PHI), Dactyl thoracic index (DTI), Front-back height in (FBH), Massive index (MI), Relative Body Index (RBI)

Statistical analysis

Data collected were expressed as mean ± SEM. Values were subjected to one-way analysis of variance (ANOVA) followed by Tukey's post hoc test to compare differences between means. The student t-test was used to determine the difference between the two groups of male and female. Values of P where significantly not different when $P > 0.05$. The values were statistically different when the P-value was < 0.05. Statistical analysis was carried out using Graph pad prism.

RESULTS AND DISCUSSION

The findings in this study showed the young and adult donkeys do not have the same body parameter, which increases with age. This result corroborates the findings of Ayad *et al.,* (2019) who reported that young and adult, animals do not present the same body parameters and this increases concomitantly with age for certain parameters. The frame size of donkeys attained in Nigeria suggests that this population resembles donkeys in Morocco (Pearson and Ouassat, 1996). However, they differ from large donkey breeds like the Spanish Zamorano Leones donkeys (Kugler *et al* 2008; Rodrigues *et al.,* 2013). The height at withers was between the range of 81.28 cm to 105.79 cm in both male and female, young and adult donkeys in this study, this corroborates the findings of Wilson, 1981, who reported that there was little physical variation in donkeys found throughout Africa and that donkeys rarely exceed a height at the withers of 105 cm. This can be explained by the difficulty of living conditions such as food quantity and quality as well as intensity (Ayad *et al,.* 2019). There were also significant differences in some variables measured such as chest depth (CD), neck length (NL) and Canon circumference of the hind limb (CCH), between the male and females donkeys of adult and young donkeys, This corroborates the report of Ayad *et al.* (2019), who reported significant differences between the values of some variables such as chest width (CW), thoracic circumference (TC) and canon circumference (CC), according to the animals' age classes. The significant differences in body length (BL), height at withers (WH) and hearth girth circumference (HGC) observed in this study, between male and female young and adult donkeys, indicated that males tended to be taller than their female counterparts. This may be attributed to the fact that the physiological evolution according to animal age leads to an increase in weight and morphological growth. These findings corroborate the results obtained in previous reports (Kaboré, 2014; Roamba, 2014; Nininahazwe *et al*., 2017).

Table 1: Morphological measurements of donkeys for Group 1 and Group 2

PARAMETERS (cm)	GROUP 1 (n=10)	Range Grp 1	GROUP 2 (n=10)	Range Grp 2	LS
HDW	8.64 ± 1.02	10.16 - 5.08	9.14 ± 1.55	10.16 - 7.62	NS
HL	40.64 ± 3.13	45.70 - 35.56	42.93 ± 1.30	45.72 - 38.10	NS
EL	21.84 ± 0.61	22.86 - 20.32	22.45 ± 0.81	24.13 - 20.32	NS
NC	39.62 ± 1.30	43.18 - 35.56	40.89 ± 1.17	43.18 - 38.10	NS
NL	35.05 ± 3.15	43.18 - 30.48	38.10 ± 0.81	40.64 - 35.56	**
FLL	42.67 ± 2.03	45.72 - 35.56	42.16 ± 1.30	45.72 - 38.10	NS
CCF	10.16 ± 0.00	10.16 - 10.16	9.91 ± 0.25	10.16 - 8.89	NS
BL	68.58 ± 2.13	73.66 - 63.5	71.37 ± 2.49	76.2 - 64.77	*
CD	34.54 ± 2.21	40.64 - 27.94	38.10 ± 1.60	43.18 - 35.56	**
HGC	74.57 ± 3.66	83.31 - 63.50	80.67 ± 1.85	83.82 - 73.66	*
HW	81.28 ± 1.96	83.82 – 73.66	83.82 ± 1.80	88.9 - 78.74	*
HR	71.63 ± 2.19	78.74 – 66.04	78.23 ± 1.24	81.28 - 73.66	*
CCH	10.77 ± 0.48	12.70 - 10.16	10.16 ± 0.41	11.43 - 8.89	*
TL	26.92 ± 0.74	27.94 – 24.13	27.69 ± 1.02	30.48 - 24.13	NS

GROUP 1: Young females; GROUP 2: Young males; n: Number of Animals; LS: Level of significance; NS: Not significant (P > 0.05); *(P < 0.05) Significant; **(P < 0.01) Highly significant Head Width (HDW), Head Length (HL), Ear Length (EL), Neck Circumference (NC), Neck Length (NL), Front Leg Length (FLL), Cannon Circumference of the Forelimb (CCF), Body Length (BL), Chest Depth (CD), Heart Girth Circumference (HGC), Height at Withers (HW), Height at Rump (HR), Cannon Circumference of the Hind Limb (CCH), Tail Length (TL).

Table 2: Morphological measurements of donkeys for Group 3 and Group 4

PARAMETERS (cm)	GROUP 3 (n=10)	Range Grp 3	GROUP 4 (n=10)	Range Grp 4	LS
HDW	11.05 ± 1.93	11.43 – 10.16	14.35 ± 0.71	17.78 - 11.43	**
HL	50.55 ± 2.82	51.88 – 49.80	53.85 ± 0.66	55.88 – 50.80	NS
EL	24.38 ± 0.38	25.4 – 22.86	24.89 ± 0.33	25.4 – 22.86	NS
NC	52.02 ± 0.89	55.88 – 48.26	53.21 ± 0.94	58.42 – 48.26	NS
NL	45.09 ± 0.74	48.26 - 43.18	47.75 ± 1.30	50.80 - 43.18	*
FLL	47.75 ± 1.19	53.34 - 40.64	51.82 ± 1.32	60.96 – 45.72	**
CCF	12.19 ± 0.20	12.70 - 11.43	12.45 ± 0.25	12.70 – 10.60	NS
BL	100.58 ± 1.09	104.14 - 93.95	105.67 ± 2.26	120.65 – 83.82	**
CD	51.01 ± 0.41	53.34 - 48.26	51.31 ± 0.84	55.88 – 48.26	*
HGC	103.00 ± 0.89	105.41 - 96.52	111.84 ± 2.11	115.57 – 105.41	**
HW	99.57 ± 1.40	104.14 - 93.98	105.79 ± 0.66	109.22 – 101.60	**
HR	85.09 ± 3.58	106.68 - 78.74	88.90 ± 2.82	106.68 – 81.28	NS
CCH	12.70 ± 0.18	13.97 – 29.03	13.01 ± 0.41	15.24 – 12.70	*
TL	36.83 ± 0.43	38.1 – 35.56	36.58 ± 0.86	40.64 – 33.02	NS

GROUP 3: Adult females; GROUP 4: Adult males; n: Number of Animals; LS: Level of significance; NS: Not significant (P > 0.05), * (P < 0.05) Significant, ** (P < 0.01) Highly significant) Highly significant Head Width (HDW), Head Length (HL), Ear Length (EL), Neck Circumference (NC), Neck Length (NL), Front Leg Length (FLL), Cannon Circumference of the Forelimb (CCF), Body Length (BL), Chest Depth (CD), Heart Girth Circumference (HGC), Height at Withers (HW), Height at Rump (HR), Cannon Circumference of the Hind Limb (CCH), Tail Length (TL).

In order to study the donkeys' conformation, some indexes were assessed from the morphological measurements. The morphometric parameters established were used for determination of body indexes that reflect the development of animal and allow description of the shape, size and volume of body. The result in this study has shown statistical differences of morphometric indexes between the different age groups. The Body profile index (BPI) in this study across the groups were between 0.99 cm to 1.00 cm, according to the stRudy of Mariante *et al.,* 2002, who reported that animals with BPI > 0.90 were long

and good animal for speed (longilineal), meaning its total length is equal to its height . This corroborates the findings of Ayad *et al* (2019), who reported a body profile index of 0.97 and stated that the value allows to classify the animal population as a longilinear breed. These results also corroborate the findings of Daloum *et al*., (2015) and Folch and Jordana, (1997) in donkeys. The Massive index (MI) in this study was reported, that the young group had 1.00 cm to 1.06 cm while adult donkeys had 1.03 cm to 1.06 cm, with MI > 1 indicating overload for both male and female donkeys across both age group. And as reported by Mariante *et al.,* (2002), donkeys with MI ≤ 1 could support well its weight and MI > 1 indicates donkeys that were massive overload. This also corroborates the finding of Ayad *et al.,* (2019), who reported that, the donkeys sampled in Kabylie showed massive overload (1.34 ± 0.2 kg/cm). This also corroborates with those reported by Daloum *et al.* (2015) and Defeu *et al*. (2015).

Table 3. Morphometric Indices of donkeys for all groups

PARAMETERS(cm) Group (n=10)	BPI	PHI	FBH	RBI	DTI	MI
GROUP 1	0.99±0.06[a]	0.97±0.08[a]	1.19±0.07[a]	1.00±0.04[a]	11.79 ±0.05[a]	1.00±0.01[a]
GROUP 2	0.96±0.04[b]	1.20±0.1[b]	1.19± 0.08[a]	0.98±0.02[a]	12.62 ±0.02[b]	1.06±0.06[b]
GROUP 3	0.99±0.08[a]	1.07±0.03[a]	1.17±0.04[a]	0.98±0.01[a]	11.84±0.02[a]	1.03±0.06[a]
GROUP 4	1.00±0.09[a]	0.99±0.06[a]	1.19±0.23[a]	0.94±0.01[b]	11.13±0.01[c]	1.06±0.03[b]

[abc]Mean with different superscripts down the column are significantly different (P < 0.05). Body Profile Index/Body frame (BPI); Pectoral height index (PHI); Front-back height in (FBH); Relative Body Index (RBI) Dactyl thoracic index (DTI); Massive index (MI)

CONCLUSION AND RECOMMENDATION

In conclusion, this study has shown that the young and adult donkeys have different morphological and morphometric parameters, which increased with age. The morphological and morphometric measurements of donkeys highlighted the variability that exists between the genders and age groups. Also, the morphometric indices revealed that the donkeys in this study are short legged (PHI > 0.56) with a slant back FBH > 1, indicating overload. It is recommended that parameters should also be taken for aged donkeys to see if there will be changes in the parameters as the animal change and also if aged animals can be used for work as draft animals.

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