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Effect of Breed, Sex and Age on Body Measurements of Sudanese Camels (*Camelus dromedarius*)

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Abstract: Data on body measurements and weight were obtained on 274 camels (different ecotypes). The purpose of this study was to determine factors affecting body measurements of Sudanese camel breeds and re-grade those camels according to their morphological traits. The results of this study showed that average barrel girth, heart girth, height at shoulders and body weight were 2.45 ± 0.02 m; 2.02 ± 0.01 m; 1.90 ± 0.01 m and 463.25 ± 4.90 kg respectively. The results also revealed that phenotypic measurements were significantly influenced by type of camel and age group. The Shanbali camel recorded the highest values of barrel girth, heart girth and body weight, followed by those of the Kenani camel. Rashaidi, Anafi and Bishari camel breeds recorded the lowest values. Regarding to the age groups the camels in the second group 7 to 9 years had significantly the highest values of phenotypic measurements, followed by those of the third group 10 to 12 years, while the animals in the first group 4 to 6 years recorded the lowest values. Moreover, the results showed that the sex of camel significantly affected the heart girth, height at shoulders and body weight; and the males had significantly higher ($P < 0.5$) values than those of females. The study concluded that the Shanbali and Kenani camels are the largest Sudanese camel breed followed by Maalia and Maganeen camels.

Key words: barrel and heart girth, shoulder height, body weight, camel breeds, Sudan

INTRODUCTION

Sudan ranks second in respect to the size of the camel population in the world. Camels constitute 22% of the animal biomass in Sudan and 26.3% of the number of camels in the Arab world (Sakr and Majid, 1990). The last estimation of camels' population in the Sudan was about 3908 thousands head (Ministry of Animal Resources, 2005). Camels in Sudan are concentrated in two main regions; the Eastern region, where camels are found in the Butana plain and the Red Sea hills, and Western regions (Darfur and Kordofan) (Agab, 1993).

Camels in the Sudan are classified as pack (heavy) and riding (light) types according to the function they perform and probably as a result of selection applied for these traits by the various camel-owning tribes. The Sudanese heavy type constitutes the majority of the camels kept by nomads in Sudan. In this group two types can be identified on the basis of conformation and tribal ownership: The Arab and Rashaidi camels. On the other hand, the riding camels are restricted to the north-east of the country between the Nile and Red Sea. Two main types are recognized, namely Anafi and Red Sea Hills (Bishari) camels (El-Fadil, 1986). Dromedary camels were classified into four major classes: beef, dairy, dual purpose and race camel (Wardeh, 2004). This classification is based on the fact that the camel is a major component of the agro-pastoral systems in Asia and Africa. The purpose of this study was to determine factors affecting body measurements of some Sudanese camel breeds and re-grade those camels according to their morphological traits.

MATERIALS AND METHODS

Study areas:

The study was covered all camel areas in Sudan (except Darfur states) in a belt that extends between latitudes 12°N - 16°N (Figure 1).

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Fig. 1: Distribution of camel breeds in Sudan

Study Animal:

Kenani camel breed homeland is Sinnar state, while Rashaidi, Lahwee, Anafi and Bishari breeds are located in Gedaref state. Butana camel is raised and bred in the Butana plains (Gezira state). Kabbashi, Maalia, Magareen and Shanabli camels are found in North Kordofan state.

Data collections:

Body measurements data were obtained from 274 mature and unrelated camels represented different breeds. Sex and age of each animal were recorded. The studied body measurements were:

Heart girth: taken by metric tape immediately behind the breast pad (Plate 1)

Barrel girth: taken over the highest part of the hump and

height at shoulders:

Body weights: of animals were estimated according to the Boue (1949) formula as follows:

$$P = 53 \text{ TAH}$$

- Where: **P** = body weight (kg)
- T** = heart girth or chest (m).
- A** = barrel or abdominal girth (m).
- H** = shoulder height (m).

Data analysis:

The SPSS statistical computer software (SPSS for windows, release 15, 2006) was used to analyze the data. Body measurements data were subjected to analysis of variance (ANOVA) using the general linear model (GLM). The statistical model used was:

$$Y_{ijkl} = \mu + B_i + S_j + A_k + e_{ijkl}$$

- Where: Y_{ijkl} is the observation for each trait of the $ijkl$ th animal.
- μ is the general mean of each trait.
- B_i is the fixed effect of i th breed.

S_j is the fixed effect of j th sex.

A_k is the fixed effect of the k th age group.

e_{ijkl} is the random error effect associated to the $ijkl$ th observation.

The separation of the means was made according to Duncan's multiple range test (DMRT).



Plate. 1: Measurement of Heart girth.

RESULTS AND DISCUSSION

Table 1 shows body measurements of Sudanese camels in respect to breed, age group and sex. The results of this study revealed that averages of barrel girth, heart girth, height at shoulders and body weight were 2.45 ± 0.02 m; 2.02 ± 0.01 m; 1.90 ± 0.01 m and 463.25 ± 4.90 kg, respectively (Table 1). The results also showed that the breed of camel had a very high significant ($P < 0.001$) effect on the studied phenotypic measurements. The Shanbali and Kenani camels had significantly ($P < 0.05$) higher values of barrel girth, heart girth and body weight, followed by those of the Maganeen and Maalia camels. However, the Rashaidi, Anafi and Bishari camel breeds recorded the lowest values of the above traits and were significantly ($P < 0.05$) different from those of other breeds. It was observed that Maalia camel breed was significantly ($P < 0.05$) taller at shoulders (1.98 ± 0.02 m) than other breeds. The sex of camel had a very high significant ($P < 0.001$) influence on heart girth, height at shoulders and a high significant ($P < 0.01$) on body weight; while the barrel girth was insignificantly ($P > 0.05$) affected by sex. The data also showed that the male camels scored greater heart girth, height at shoulders; and had heavier body weights than those of the females. The results also showed that the age of camel had a very high significant ($P < 0.001$) effect on each of barrel girth, heart girth and body weight, and had a significant ($P < 0.05$) influence on height at shoulders. The age group 7 to 9 years had a significantly ($P < 0.05$) higher values of the above traits, followed by those of the age group 10 to 12 years, then those of the age group ≥ 13 years. However, the age group 4 to 6 years had significantly ($P < 0.05$) low values of all measured traits.

Table 1: Phenotypic measurements of Sudanese camel with respect to breed, sex and age group.

Item	No.	Barrel girth (m)	Heart girth (m)	Height at shoulder (m)	Body weight (kg)
Breed:		***	***	***	***
Kenani	31	2.51 ± 0.04^{abc}	2.08 ± 0.02^a	1.96 ± 0.01^b	501.75 ± 12.08^a
Rashaidi	30	2.54 ± 0.04^a	1.95 ± 0.02^b	1.78 ± 0.02^c	427.59 ± 12.82^c
Lahwee	30	2.49 ± 0.04^{ab}	1.99 ± 0.02^b	1.87 ± 0.01^d	450.00 ± 12.37^{bc}
Anafi	30	2.41 ± 0.04^{bcd}	1.97 ± 0.02^b	1.86 ± 0.01^d	426.90 ± 12.20^c
Bishari	30	2.40 ± 0.04^{cde}	1.97 ± 0.02^b	1.86 ± 0.01^d	427.37 ± 12.46^c
Kabbashi	34	2.26 ± 0.04^e	1.98 ± 0.02^a	1.92 ± 0.01^{bc}	453.19 ± 11.31^{bc}
Maganeen	16	2.50 ± 0.05^{bc}	2.11 ± 0.03^a	1.93 ± 0.02^{bc}	499.07 ± 16.91^{ab}
Shanbali	29	2.64 ± 0.04^a	2.08 ± 0.02^a	1.91 ± 0.01^c	516.69 ± 12.48^a
Maalia	12	2.37 ± 0.06^{de}	2.13 ± 0.03^a	1.98 ± 0.02^a	491.11 ± 19.52^{ab}
Butana	32	2.37 ± 0.04^{bcd}	1.93 ± 0.02^b	1.89 ± 0.01^{bc}	438.82 ± 11.69^{bc}

Table 1: Continue

Sex:		NS	***	***	**
Male	97	2.45±0.02 ^a	2.05±0.01 ^a	1.93±0.01 ^a	477.57±5.69 ^a
Female	177	2.45±0.02 ^a	1.99±0.01 ^b	1.86±0.01 ^b	448.92±7.60 ^b
Age group:		***	***	*	***
4-6 years	94	2.31±0.02 ^b	1.96±0.01 ^b	1.87±0.01 ^a	416.37±6.86 ^c
7-9 years	89	2.51±0.02 ^a	2.05±0.01 ^a	1.91±0.01 ^a	489.34±7.23 ^a
0-12 years	62	2.50±0.03 ^a	2.04±0.01 ^{ab}	1.90±0.01 ^a	477.05±8.97 ^{ab}
≥13 years	29	2.48±0.04 ^a	2.03±0.02 ^b	1.90±0.02 ^a	470.22±12.82 ^{bc}
Overall	274	2.45±0.02	2.02±0.01	1.90±0.01	463.25±4.90

^{a,b,c} means with the same letters are significantly not different $P > 0.05$.

NS, *, ** and ***: significant at $P > 0.05$, $P < 0.05$, $P < 0.01$ and $P < 0.001$.

Discussion:

The results showed significant differences in phenotypic measurements among breeds. Shanbali and Kenani camels recorded the highest values of phenotypic measurements followed by those of the Maganeen and Maalia breeds. These large breeds have long distances to cover during their seasonal north-south movements in search of water and pasture. Shanbali, Maganeen and Maalia camels spend the wet season in North Kordofan state (Um-bader area), and move to South Kordofan state (near Kadugli city) in the dry season. Kenani camels on the other hand are found in the White Nile state (Dueim town) during the wet season and in the dry season they move to southern Sinnar state and Blue Nile state. The long movement route of these camels tread offers them the best and most diverse types of feeds (trees, shrubs, grasses and crop residues). Other ecotypes such as Butana (Gezira state), Lahawee, Rashaidi (Gedaref state) and Kabbashi (North Kordofan state) camels have short movement routes and usually suffer from shortage of feeds in the dry season. These camels graze mainly shrubs and grasses in the wet season; and crop residues in the dry season. On the other hand, Anafi and Bishari camels recorded the lowest values of body measurements and are described as riding camels. This is probably as a result of good selection applied to the light weight over a long period of time (Al-Khoury and Majid, 2000).

The sex of camel had a significant influence on heart girth, height at shoulders and body weight. Male camels had higher values of heart girth, height at shoulders and body weight compared to those of the females. This result is in agreement with findings of (Mehari *et al.*, 2007) and (Dioli *et al.*, 1990) who stated that there is quite distinctive sexual dimorphism in camels, i.e. the male camel is usually taller and of heavier in weight than those of the female. The higher values of the measured traits of male camels might be attributed to physiological inducers (hormonal secretions) and activities in the different sexes. The results of this study showed that the age of camel had a significant effect on the studied phenotypic measurements. The age group 7 to 9 years had significantly higher values of the above traits, followed by those of the age group 10 to 12 years, then those of the age group ≥13 years. However, the age group 4 to 6 years had significantly lower values of tested traits than those of the other age groups. This indicates that the camels reach maturity (growth peak) within 7 to 9 years; after which the different measurements decline. This trend is reflected in the growth curve of the Sudanese camels.

Conclusion:

Generally this study concludes that the Shanbali camel is the largest camel breed in North and South Kordofan states (western Sudan) followed by Maalia and Maganeen camels. While Kenani camel is the largest camel breed in central and eastern Sudan. More studies in the morphological measurements with large number of animals for camels in Sudan include Darfur states were recommended.

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