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**BODY MEASUREMENTS OF SOME SUDANESE
CAMEL ECOTYPES (*CAMELUS DROMEDARIUS*)
IN BUTANA AREA-SUDAN**
(With 2 Tables)

By

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SUMMARY

The aim of the study was to phenotypic characterize the two Sudanese ecotypes according to their phenotypic measurements. Body measurements data were obtained on 256 camels from two Sudanese ecotypes (Arabi and Anaffi type). The data collected from central of Butana area-Sudan. The results revealed that the breed of camel had significant ($P<0.05$) effect on barrel circumference, heart circumference, body weight and neck length. The Arabi camel was observed had significantly ($P<0.05$) higher values of barrel circumference, heart circumference, body weight and neck length compared to the Anafi camel. Moreover, the results revealed that sex of camel was significantly ($P<0.05$) affected the most studied traits. The male camels had significantly ($P<0.05$) higher values of heart circumference, height at wither, body weight, face length and fore head length than those of female camels; but females had significantly ($P<0.05$) longer neck than that of males. The age group had significantly ($P<0.05$) influence on all studied measurements except height at hump was insignificantly ($P>0.05$) affected. The all tested measurements had increasing trend from 1st age group (3-4 years) to 4th age group (9-10 years), after which some measurements were slightly increased and others were slightly declined.

Key words: Camels, phenotypic measurements, breed, Sudan

INTRODUCTION

The world camel number estimates count for 19.4 million heads (FAO, 2003). Sudan camels were estimated to be 3.908 millions contributing to about 11% of country animal biomass. These figures also represent about 20% of the world's and also classes Sudan owner ship to be the second after Somalia (30%), who together owns more than half of the world's- camels. (Ministry of Animal Resources, 2005). In eastern Sudan, camels (*Camelus dromedarius*) are raised mainly in Butana region and Red Sea coast. In the former, the camel population was estimated around 750.000 head representing more than 25% of total Sudan camel herd population (Darosa, 2005). The main camel keeping tribes in Butana region are the *Lahawiyin*, *Kawahla*, *Shukriya*, *Rashaida*, *Bija* and *Bawadra*. There are two distinguished types of camels in Sudan, the slow heavy pack or baggage type and the fast light riding or racing camels. The former or baggage type is much heavily built with a balanced appearance of face and hind quarters. The hump is pronounced in well fed animals, shoulder and rump are relatively short and sloping steeply. The hair is often longer and coarse. The legs appear shorter and sturdier with large feet. Live weight of 650 kg in females and over 800 kg in males are not uncommon (Schwartz and Dioli, 1992).

Al-Arabi: Which is referred to most pack camels in Sudan. However, Al-Arabi is subdivided into three breed types, the Light Pack which is found west of the Nile and in the area of the Red Sea, where the Hedndiwea, Beni Amer and AL-Omarab tribes keep it, and the big Arabi in the area of Butana where the three tribes of Shokreya, Battahin, and Lahaween exist. The third is the Heavy Arabi camel which is characterized by its heavy weight (over 500 kg), big hump, long neck, big head, Roman nose, heavy bones, and sandy grey or fawn color, usually with long hair on the hump and the shoulders (Khoury, 2000).

Al Anaffi: Are characterized by long legs; slender and light body; short back; small, long head; small narrow, upright ears; large, sharp eyes; fine, thin skin; and white color. They are bred by Juhayneya, AL Refaa, Kenana, Shukreya and Kawahla tribes east of Atbara River in eastern Sudan. AL Anafi camels are race and ride camels which are famous for speed (7-12 km/h), especially for the first 10 km (Wardeh, 1989).

The objective of this study is to characterize the two Sudanese ecotypes according to their phenotypic measurements.

MATERIALS and METHODS

Body measurements data were obtained on 256 camels from two Sudanese ecotypes (Arabi breed) which characterized as pack or baggage type and (Anaffi breed) which identified as racing or riding type. The study area was central of Butana.

A measuring tap (cm) was used for all measures with the exception of height at withers and height at hump tip which were measured with a calibrated stick. The body weights of animals were estimated according to (Boue, 1949) formula. Basic information such as sex, age and breed were recorded for each camel. The age of animals was classified into five groups. The external body measurements recorded was: height at hump: tip from the ground level to the highest point of the hump, height at wither: tip from the ground level to the highest point of the wither, barrel circumference: taken around the abdomen at the last rib, girth circumference: measured around the chest at the fourth ribs, body length: from shoulder point to pin bone, neck length: taken from the point of the shoulder to the base of the neck, face length: measured from tip of the poll to the muzzle, fore head length: measured between the bases of the two ears.

Phenotypic measurements data were subjected to analysis of variance (ANOVA) using the general linear model (GLM). The statistical model used was: $Y_{ijkl} = \mu + B_i + S_j + A_k + (B \times S)_{ij} + (B \times A)_{ik} + (S \times A)_{jk} + e_{ijkl}$

Where Y_{ijkl} is the individual observation for each trait of the animal; μ is the general mean of each trait; B_i is the fixed effect of the i th ecotype, S_j is the fixed effect of j the sex; A_k is the fixed effect of k the age group; $(B \times S)_{ij}$ is the effect of the interaction between sex and ecotype; $(B \times A)_{ik}$ is the effect of the interaction between ecotype and age group; $(S \times A)_{jk}$ is the effect of the interaction between sex and age group and e_{ijkl} is the random error effect associated to the $ijkl$ observations.

RESULTS

Influences of breed, sex and age group on the barrel circumference, heart circumference, height at wither and body weight of Butana plain camels were showed in Table 1. However; the effects of the above factors on body length, neck length, face length, fore head length and height at hump were showed in Table 2. The overall means of barrel circumference, heart circumference, height at wither, body weight, body length, neck length, face length, fore head length and height at hump were found to be 227.3 ± 1.7 cm, 172.9 ± 0.7 cm, 180.7 ± 0.7 cm, 376.4 ± 4.7 kg, 157.1 ± 0.8 cm, 118.5 ± 0.8 , 47.9 ± 0.2 cm, 19.3 ± 0.1 cm and 187.3 ± 1.2 cm, respectively. The analysis of variance results revealed that the breed of camel had significant ($P < 0.05$) effect on barrel circumference, heart circumference, body weight and neck length, while it had no significant ($P > 0.05$) influence on height at wither, body length, face length, Fore head length and height at hump. The Arabi camel was observed had significantly ($P < 0.05$) higher values of barrel circumference, heart circumference, body weight and neck length compared to the Anafi camel. Moreover, the results revealed that sex of camel was significantly ($P < 0.05$) affected heart circumference, height at wither, body weight, neck length, face length and fore head length; but it was insignificantly ($P > 0.05$) influenced barrel circumference, body length and height at hump. The male camels had significantly ($P < 0.05$) higher values of heart circumference, height at wither, body weight, face length and fore head length than those of female camels; but females had significantly ($P < 0.05$) longer neck than that of males. The age group had significantly ($P < 0.05$) influence on all studied measurements except height at hump was insignificantly ($P > 0.05$) affected. The all tested measurements had increasing trend from 1st age group (3-4 years) to 4th age group (9-10 years), after which some measurements were slightly increased and others were slightly declined. The interaction between breed and sex of camel had significant ($P < 0.05$) effect only height at wither; the males of Arabi camel were higher than females of same breed, while there was no difference observed between males and females of Anafi breed. Also, the interaction between breed and age group was significantly affected only body length. On other hand; the interaction between sex and age group had significant influence on barrel circumference, heart circumference and body weight. The results indicated that height at hump was not significantly ($P > 0.05$) influenced by any the studied factors.

Table 1: Means and standard errors of barrel circumference (BC), heart circumference (HC), height at wither (HW) and body weight (BW) for camel of Butana Plain.

Source of variation	N	BC (cm) mean \pm SE	HC (cm) mean \pm SE	HW (cm) mean \pm SE	BW (kg) mean \pm SE
Breed:		*	***	NS	**
Arabi	120	232.3 ^a \pm 2.4	175.6 ^a \pm 1.0	181.5 ^a \pm 1.0	390.1 ^a \pm 6.6
Anafi	136	222.3 ^b \pm 2.3	170.3 ^b \pm 0.9	179.1 ^a \pm 0.9	362.6 ^b \pm 6.4
Sex:		NS	*	*	*
Male	122	228.3 ^a \pm 2.5	174.7 ^a \pm 1.0	182.4 ^a \pm 1.0	385.5 ^a \pm 7.0
Female	134	226.2 ^a \pm 2.3	171.2 ^b \pm 0.9	178.9 ^b \pm 0.9	367.2 ^b \pm 6.3
Age groups:		***	***	**	***
1 st (3-4 years)	66	209.3 ^c \pm 3.5	165.6 ^c \pm 1.5	177.6 ^b \pm 1.4	321.9 ^d \pm 9.8
2 nd (5-6 years)	53	218.7 ^b \pm 3.4	168.1 ^c \pm 1.4	178.7 ^b \pm 1.4	350.2 ^c \pm 9.6
3 rd (7-8 years)	49	237.5 ^a \pm 4.2	175.6 ^b \pm 1.7	178.9 ^b \pm 1.7	397.4 ^b \pm 11.7
4 th (9-10 years)	36	238.5 ^a \pm 4.0	177.3 ^{ab} \pm 1.6	183.3 ^a \pm 1.6	409.1 ^a \pm 11.2
5 th (\geq 11 years)	49	232.3 ^a \pm 3.7	178.0 ^a \pm 1.5	184.5 ^a \pm 1.5	403.2 ^a \pm 10.3
Breed*Sex		NS	NS	*	NS
Breed*Age group		NS	NS	NS	NS
Sex*Age group		*	*	NS	*
Overall mean	256	227.3 \pm 1.7	172.9 \pm 0.7	180.7 \pm 0.7	376.4 \pm 4.7

Table 2: Means and standard errors of body length (BL), neck length (NL), face length (FC), fore head length (FHL) and height at hump (HH) for camel of Butana Plain.

Source of variation	N	BL (cm) mean \pm SE	NL (cm) mean \pm SE	FL (cm) mean \pm SE	FHL (cm) mean \pm SE	HH (cm) mean \pm SE
Breed:		NS	*	NS	NS	NS
Arabi	120	158.3 ^a \pm 1.2	120.1 ^a \pm 1.1	48.2 ^a \pm 0.3	19.5 ^a \pm 0.2	188.2 ^a \pm 1.7
Anafi	136	155.8 ^a \pm 1.2	117.0 ^b \pm 1.1	47.5 ^a \pm 0.3	19.2 ^a \pm 0.2	186.5 ^a \pm 1.6
Sex:		NS	*	***	*	NS
Male	122	158.5 ^a \pm 1.3	116.7 ^b \pm 1.2	48.8 ^a \pm 0.3	19.7 ^b \pm 0.2	188.2 ^a \pm 1.8
Female	134	155.6 ^a \pm 1.1	120.3 ^a \pm 1.1	46.9 ^b \pm 0.2	19.0 ^a \pm 0.2	186.5 ^a \pm 1.6
Age groups:		***	*	**	**	NS
1 st (3-4 years)	66	150.0 ^c \pm 1.8	115.7 ^c \pm 1.6	46.9 ^c \pm 0.4	18.5 ^a \pm 0.3	186.2 ^{ab} \pm 2.5
2 nd (5-6 years)	53	157.3 ^b \pm 1.7	116.3 ^{bc} \pm 1.6	47.6 ^{bc} \pm 0.4	19.3 ^b \pm 0.3	185.8 ^{ab} \pm 2.4
3 rd (7-8 years)	49	157.3 ^b \pm 2.1	116.6 ^{ab} \pm 1.9	47.7 ^{bc} \pm 0.5	19.7 ^{ab} \pm 0.3	185.4 ^b \pm 3.0
4 th (9-10 years)	36	159.2 ^{ab} \pm 2.0	122.3 ^a \pm 1.9	48.1 ^b \pm 0.4	19.4 ^{ab} \pm 0.3	191.3 ^a \pm 2.9
5 th (\geq 11 years)	49	161.4 ^a \pm 1.9	121.8 ^a \pm 1.7	49.0 ^a \pm 0.4	19.9 ^a \pm 0.3	188.1 ^{ab} \pm 2.6
Breed*Sex		NS	NS	NS	NS	NS
Breed*Age group		*	NS	NS	NS	NS
Sex*Age group		NS	*	*	*	NS
Overall mean		157.1 \pm 0.8	118.5 \pm 0.8	47.9 \pm 0.2	19.3 ^a \pm 0.1	187.3 \pm 1.2

DISCUSSION

The results showed significant differences between Arabi and Anafi type in the phenotypic measurements, that is attributed to the classification of Anafi as light ridding camels while, Arabi type classified as heavy pack or baggage one (Schwartz and Dioli, 1992). This finding is also in agreement with that reported by Gillespie, (1962) who explained that the Anafi is a slender animal with smallish hump, a marked tucked in abdomen and small feet. These differences between two breeds in body measurements due to pronounced hump of the Arabi type in addition to the much heavily build of the body. The body measurements obtained in this study for Arabi and Anafi breed were lower than that reported by (Ishag *et al.*, 2010; Ishag *et al.*, 2011^a; Ishag *et al.*, 2011^b). The study showed the sex of camel had significant influence on the most studied traits; and the male camels had higher body measurements than the females, this results which was similar to that reported by (Dioli *et al.*, 1992; Mehari *et al.*, 2007; Ishag *et al.*, 2010; Ishag *et al.*, 2011^b); they stated that there is quite distinctive sexual dimorphism in camels, i.e. the male camels is usually taller and of heavier weight than the female. These differences between males and females may reflect differences in the hormonal secretions and their activities in the two sexes. On the other; female camels recorded higher values of neck length compared to the male camels; this could be also attributed to the physiological, anatomical and morphological changes between the two sexes. The age of animal had significantly effect on the all studied traits except height at hump. The all tested measurements had increasing trend from 1st age group (3-4 years) to 4th age group (9-10 years), after which some measurements were slightly increased and other were slightly declined. This results was somewhat is agree with findings of (Ishag *et al.*, 2010; Ishag *et al.*, 2011^b); who mentioned that the camels of Sudan reach maturity (growth peak) within 7 to 9 years; after which the different measurements decline. This trend is probably attributed to the increases of the body measurements with the gradually increases in age of the animal till reach the maturity. The height at hump was only body measurement that not significantly affected by breed, sex and age of animal. This is means that the size of hump is influenced by level of feeding; when the level of feeding is good the hump is well developed and gives highest values when take measurement from ground level to the highest point of the hump.

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