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EFFECT OF PHYSIOLOGICAL STATUS ON SOME MACRO MINERALS PROFILE IN THE SERUM OF FEMALE CAMELS

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ABSTRACT

The aim of this study was to determine the effect of age and physiological status on some mineral concentrations in the serum of female camels namely calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na) and potassium (K). Animals used were an indigenous ecotype of nomad (Rashiada) inhabiting a semi-arid region (Butana) in eastern part of Sudan. A total of 32 female camels from approximately 3 to 12 years of age were divided into different groups; young (3-4 years old) and pregnant camels within three months to parturition were grouped according to number of gestations; first (4-5 years old), second (6-7 years old), third (8-9 years old) and fourth gestation (10-12 years old). Lactating camels (all in their mid-lactation) were classified according to yield; high, medium and low. Each group or subgroup consisted of four animals. The data analysis revealed that age, pregnancy or lactation had no significant effect on the concentration of minerals investigated. However, there was a tendency for Na level to increase with age, while Ca levels were observed to increase progressively through low, medium and high yielder.

Key words: Female camels, macrominerals, physiological state

Macro mineral profiles such as Ca, P, Mg, Na and K underlining changes in the physiological states of female camels is rarely studied, especially under natural habitat of these animals. The present study was thus initiated with the objective to investigate the above-mentioned mineral concentrations in the serum of female camels in their different physiological status.

Materials and Methods

The present study was conducted in Butana area of Sudan, a geographical zone that lies approximately between latitude 14 - 16° N and longitude 33 - 36° E. The area is bound by Atbara River to the East, River Nile to the west and Blue Nile to the south and south west. Rainfall is moderate to low (250 - 400 mm). Vegetation is of the semi desert grassland mainly *Aristida funiculate* on clay in the north and an area of rich Savanna on cracking clay, alternating with grass area to the south (Abu-Sin, 1970).

This study utilised female camels in their natural habitat during the winter season (maximum temperature 30°C and minimum 19°C). Camels are the only domestic animal that could exploit this precarious ecological niche, which has been artificially created by mechanised agriculture. Sorghum stalks appear to be a nutritionally adequate type of fodder, thus ensuring a degree of security for the pastoral system during winter time. The type of camel used in this study was the Rashaidi type, a sturdy camel with superior drought resistance.

Blood sampling

A total of 32 sera were collected from camels at different physiological states as follow:

1) Young animals at 2-3 years of age.

2) Pregnant animals within their three months to parturition were divided into subgroups as follows:

(a) First gestation (4-5 years old).

(b) Second gestation (6-7 years old).

(c) Third gestation (8-9 years old).

(d) Fourth gestation (10-12 years old).

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3) Lactating animals, all in their mid-lactation at 7-8 years of age, classified according to yield into:

(a) High (b) medium (c) low yielders.

Each group or subgroup consisted of four animals. Blood was collected by veni-puncture into non-heparinised vacutainers. The separated serum was stored at -20°C pending the analysis of calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na) and potassium (K). Calorimetric determination of plasma levels of Ca, P and Mg was carried out according to the methods of Trinder (1960), Varley (1967) and Norbert (1982), respectively. Na and K determinations followed the methods outlined by Wooton (1974).

Statistical Analysis : For the purpose of this study, randomised complete block design was used as a sampling technique, using the analysis of variance procedure (ANOVA) to test the overall significance of the model. Mean separations were examined by Duncan's multiple range test to detect statistical significance between the different groups with different physiological status (Thomas *et al*, 1987).

Results and Discussion

Mineral concentrations in the serum of young and pregnant camels : Mineral concentrations in the serum of young and pregnant camels at different gestations are shown in tables 1 and 2. Almost all values seemed to fall within the normal range quoted for cattle and sheep. However, the maximum ranges for Ca and Mg were highest than the normal range. Also the maximum range of K for the young animals and those in their first and third gestations were slightly higher than the normal range. The minimum ranges of Ca for the young animals and those in their first gestation were slightly lower than the normal range.

Table 1. The concentration of calcium (Ca), sodium (Na), potassium (K), phosphorus (P) and magnesium (Mg) in the serum of young female camels (n=4).

Parameter	Mean ± SD (range)
Ca (mg/100 ml)	12.6 ± 4.1 (6.2-17.5)
Na (mEq/l)	147.8 ± 10.9 (134-162)
K (mEq/l)	6.0 ± 1.5 (3.5-7.3)
P (mg/100 ml)	6.0 ± 1.6 (5.0-8.1)
Mg (mg/100 ml)	3.4 ± 7 (2.38-4.4)

n = number of animals n = number of animals

Mineral concentrations in the serum of lactating camels with different yields : Mineral concentration in the serum of different yielding lactating camels are shown in table 3. All values seemed to fall within the normal range quoted for cattle and sheep. However, for all groups, the maximum and minimum ranges for Ca and Mg were higher than the normal range. When comparing mineral concentrations (mean values only) in all animals at different physiological states, it could be seen that, there was a slight tendency for both Na and K levels to decrease with age, while those of Ca, P and Mg did not show a steady pattern (Table 2 and 3).

Discussion

In this study calcium (Ca) serum levels did not change significantly in response to change in physiological states. This would be expected because homeostatic levels of serum Ca are maintained through endocrine regulation of Ca absorption, excretion and bone metabolism (Marr *et al*, 1955; Moodie *et al*, 1955; Littledike and Goff, 1987). Furthermore, the excretion of Ca in urine and faeces appeared to be not affected by dietary Ca intake (Ramberg *et al*, 1976), as the rate of feedback of Ca from bone is sensitive to the level of Ca in the diet (Cohn *et al*, 1986). However, in goats, plasma Ca level was found to be significantly higher in early than in late pregnancy and in late than in early lactation (Uddin and Ahmed, 1984). The higher Ca level obtained in the high producing camels could be related to the high Ca drain which was found to exceed 50gm/day in high producing dairy cattle (Tucker *et al*, 1991).

Blood phosphorus (P) homeostasis is more complicated than it is for blood Ca because blood P is in equilibrium not only with bone but also with several organic P compounds. Nevertheless, kidney excretion of P is sufficiently controlled by parathyroid hormone secretion and 1, 25-dihydroxy vitamin D to result in relatively stable serum P concentration even with severe dietary P deficiency (Church and Pond, 1988). In the present study serum P levels were within the normal range and were not significantly affected by pregnancy or lactation. Similar results were obtained in dairy cows (Paynne and Leech, 1964) and Carabaos (Obsioma *et al*, 1994). However, other studies with black Bengal goats observed

Table 2. The concentrations of calcium (Ca), sodium (Na), potassium (K), phosphorus (P) and magnesium (Mg) in the serum of pregnant camels at their first, second, third and fourth gestation.

Physiological state	Mineral concentration				
	Ca (mq/100ml)	Na (mEq/l)	K (mEq/l)	P (mg/100ml)	Mg (mg/100ml)
First gestation	10.0 ± 2.9 (5.8-13.5)	146.5 ± 10.6 (131-160)	5.2 ± 0.9 (4.3-6.5)	5.8 ± 0.2 (5.5-6.1)	3.7 ± 0.7 (2.9-4.8)
Second gestation	12.0 ± 2.3 (8.4-14.5)	143.5 ± 7.2 (132-152)	4.4 ± 1.1 (3.2-5.6)	6.0 ± 0.4 (5.4-6.3)	3.6 ± 0.5 (2.9-4.3)
Third gestation	8.6 ± 1.8 (6.9-11.6)	158.5 ± 10.2 (146-169)	5.7 ± 0.1 (5.3-6.6)	6.0 ± 0.3 (5.5-6.5)	3.6 ± 0.2 (3.4-3.9)
Fourth gestation	12.0 ± 1.8 (5.5-17.1)	143.8 ± 3.2 (139-148)	4.4 ± 0.8 (3.6-5.6)	5.8 ± 0.7 (5.5-6.1)	3.7 ± 0.1 (3.6-3.9)

Data represents means of 4 animals (n=4); Values between parentheses represent ranges.

Table 3. The concentrations of calcium (Ca), sodium (Na), potassium (K), phosphorus (P) and magnesium (Mg) in the serum of high, medium and low yielder lactating camels.

Yielder capacity	Mineral concentration				
	Ca (mq/100ml)	Na (mEq/l)	K (mEq/l)	P (mg/100ml)	Mg (mg/100ml
High yielder	12.6 ± 0.5 (11.6-14.2)	143.7 ± 9.5 (125-156)	5.3 ± 0.4 (4.9-6.0)	- -	- -
Medium yielder	14.3±1.3 (8.7-15.3)	148.0 ± 7.6 (124-164)	4.9 ± 0.3 (4.2-5.8)	6.5 ± 0.6 (5.6-8.1)	3.9 ± 0.4 (3.7-6.9)
Low yielder	16.9±1.2 (14.6-17.1)	151.4 ± 5.9 (137-171)	5.1 ± 0.5 (3.7-6.9)	6.0 ± 0.3 (5.6-7.0)	3.7 ± 0.2 (4.0-5.7)

Data represents means of 4 animals (n=4); Values between parentheses represent ranges.

significantly higher plasma P levels in pregnant than in lactating animals (Uddin and Ahmed, 1984) which could be related to rate of P transfer to the foetus (Tawrdock *et al*, 1973).

About 75% of magnesium (Mg) is found in red blood cells (6 mEq/l) and about 25% in serum (1.1 to 2.0 mEq/l) and with variable concentrations in different species (Wacker and Vallee, 1964). In this study Mg serum concentration did not change significantly between the different physiological states. Similarly, it has been reported that pregnancy had no effect on serum Mg in ruminants (Dishington, 1965). Also, similar values of Mg levels were obtained for both pregnant and nonpregnant Carabaos (Obsioma *et al*, 1994). In the present study high yielding camels tended to have high Mg serum levels. Other studies have shown that high-producing cows had lower Mg level (Bakker, 1961). However, it has been pointed out that homeostasis of blood and tissue Mg is not understood clearly (Church and Pond, 1988). No carrier is known for Mg absorption nor has vitamin D been shown to enhance its absorption (Wacker and Vallee, 1964). Sodium (Na) and potassium (K) play a vital role in maintaining osmotic pressure in the extra cellular and intra cellular fluids and in maintaining acid-base balance. Thus large variation in intake has a relatively small effect on the total load of fluids and electrolytes entering the gastrointestinal tract (Wilson, 1962). In this study no significant changes could be detected in Na and K serum levels in response to the different physiological status. However, there was a tendency for both minerals to decrease with age. Similar results were obtained by Vrzgula (1963) in bovine blood. Also bone marrow was found to have more Na and K in young cows compared to old ones (Nowakowski, 1989). In this study, the insignificant differences observed between the animals at different physiological states were comparable to those obtained by Sellers and Roepke (1951) and Rahman and Baji (1985) in dairy cows at parturition, lactating and non-lactating cows which might be related to both electrolytes stable homeostasis.

It could be concluded that camels in their natural habitat have their macro mineral serum levels well adapted to physiological changes as long as these minerals are obtained from pasture in adequate amounts.

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