



RESEARCH ARTICLE

Serum concentrations of some ions in clinically healthy camels (*Camelus dromedarius*)

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Öz

Tajik J, Sazmand A, Hekmatimoghaddam S, Rasooli A, Mohammadzadeh YA. Klinik olarak sağlıklı develerde (*Camelus dromedarius*) bazı serum iyon konsantrasyonları.

Amaç: Tek hörgüçlü develerde serum kalsiyum, fosfor, magnezyum, sodyum ve potasyum düzeylerine yaş, cinsiyet ve mevsimin etkilerini değerlendirmektir.

Gereç ve Yöntem: Serum kalsiyum, fosfor, magnezyum, sodyum ve potasyum düzeyleri 180 sağlıklı deveden elde edilen örneklerden belirlendi.

Bulgular: Cinsiyetler arasında serum potasyum konsantrasyonlarında istatistiki fark belirlendi ($P<0.05$). Ayrıca serum potasyum ($P<0.007$) ve kalsiyum ($P<0.001$) düzeyleri farklı yaş gruplarında istatistiki olarak farklı belirlendi ve hayvanların yaşları arasında potasyum ($r=0.216$, $P<0.004$) ve kalsiyumda ($r=-0.205$, $P<0.006$) önemli korelasyon belirlendi. Yaz ve kış mevsimleri arasında serum kalsiyum ($P<0.012$), fosfor ($P<0.001$), potasyum ($P<0.001$) ve magnezyum ($P<0.004$) fark belirlendi.

Öneri: Tek hörgüçlü develerde serum kalsiyum, fosfor, magnezyum, sodyum ve potasyum düzeylerine mevsim, cinsiyet ve yaşın etkili olabileceği ifade edilebilir.

Anahtar kelimeler: Serum iyonları, yaş, cinsiyet, mevsim, *Camelus dromedarius*

Abstract

Tajik J, Sazmand A, Hekmatimoghaddam S, Rasooli A, Mohammadzadeh YA. Serum concentrations of some ions in clinically healthy camels (*Camelus dromedarius*).

Aim: Evaluation of the effects of season, sex and age on serum concentrations of calcium, phosphorus, magnesium, sodium and potassium in dromedarian camels.

Material and Method: Serum calcium, phosphorus, magnesium, sodium and potassium values were obtained from 180 clinically healthy animals.

Results: Serum concentration of potassium showed a significant difference between the two sexes ($P<0.049$). Also, serum potassium and calcium levels had significant difference between the different age groups of camels ($P<0.007$ and $P<0.001$, respectively) and had significant correlation with the age of the animals ($r=0.216$, $P<0.004$ and $r=-0.205$, $P<0.006$, respectively). There were significant differences between summer and winter seasons in the serum concentrations of calcium ($P<0.012$), phosphorus ($P<0.001$), potassium ($P<0.001$) and magnesium ($P<0.004$).

Conclusion: It may be stated that season, sex and age effect the serum concentrations of calcium, phosphorus, magnesium, sodium and potassium in dromedarian camels.

Keywords: Serum ions, age, sex, season, *Camelus dromedarius*





Introduction

Evaluation of serum biochemical parameters is an essential and reliable part in evaluation of health and nutrition status and in the differential diagnosis of diseases in animals. As a result, knowledge of reference values of healthy animals is a fundamental requirement (Waziri et al 2010).

Dromedary camel has a unique place among all domesticated animals due to its tolerance of heat stress and has a high economic value by providing meat, milk and labor for local farmers in many tropical countries. Although serum biochemical indices and their correlation together in one-humped camels have been evaluated in some previous studies, there is high variation and even some controversial findings in their results (Bogin 2000). Some factors such as season, sex and age may affect the general body metabolism and serum biochemical parameters in domestic animals (Yagil et al 1978, Prakash and Rathore 1991, Tuckova et al 1995). However, their effects on different species is not completely known (Nazifi et al 1999). In some previous studies, seasonal variation in some serum biochemical parameters has been reported in one humped camel (Nazifi et al 1999, Zia-ur-Rahman et al 2007), however, the season, age and sex related changes in serum biochemical parameters are not completely known.

This study was undertaken to investigate the effects of season, age and sex on the serum concentrations of calcium, phosphorus, magnesium, sodium and potassium in dromedarian camels.

Materials and Methods

The research was carried out in Yazd province, a semi-arid region in the center of Iran, from July to September 2011 (summer months) and January to February 2012 (winter months). In each sampling period, 90 clinically healthy ca-

mels, which were kept by local farmers, were selected randomly. Camels were of both sexes, with different ages and fed low quality diets containing mainly straw, barley and wilted grass, and no food complement. The age of the animals was estimated using dental characteristics (Hillson 2005). After clinical examination, jugular blood samples in plane tubes, free from anticoagulant, were collected. All samples were drawn in the morning. The blood serum was separated after centrifugation at 750 g for 15 min and the serum samples were stored at -20°C until analysis. The samples with haemolysis were thrown away. The concentration of total protein in serum samples was measured by Biuret method (Lati-mer et al 2003), and spectrophotometer (AA200, Shimadzu, Japan, kits available from Pars Azmoon Inc, Tehran, Iran) was used to measure serum concentrations of calcium (Ca), phosphorus (P) and magnesium (Mg). Additionally, the concentrations of serum potassium (K) and sodium (Na) were measured by flame photometry method (2655-00, Cole-Pulmer Instrument, Chicago, IL, USA).

Statistical analysis was performed using SPSS12 (Illinois, Chicago). Two sample t-tests were used to detect differences in the parameters between the two sexes and between the two seasons. Correlations were analyzed by Pearson's correlation test. Analysis of variance (ANOVA) tests with a post hoc Bonferroni test were used to compare the serum concentrations of the measured factors between the different age groups of camels. Because of the unequal variances, the Kruskal-Wallis test and Mann-Whitney U tests were used to compare Ca between the three age groups. Differences were considered significant at $P < 0.05$.

Results

Overall, 146 male camels and 34 female camels were sampled. The average age (mean±SEM) of the male and female camels was 7.26 ± 0.24 and 8.32 ± 0.84 years, respectively. The

Table 1. The concentrations of serum calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na), potassium (K) and total protein (TP) in clinically healthy camels in different genders and age groups (mean± SEM).

		Ca ^a	Mg	P	Na	K ^{a,b}	TP
	Number	mmol/L	mmol/L	mmol/L	mEq/L	mEq/L	g/dL
Male camels	146	2.57±0.02	2.05±0.02	2.97±0.06	170±6.60	5.88±0.08	7.41±0.05
Female camels	34	2.47±0.05	2.04±0.05	2.87±0.20	161±1.30	5.45±0.18	7.25±0.17
G1(≤5 years)	48	2.55±0.03	2.06±0.04	2.98±0.14	162±1.50	5.54±0.15	7.30±0.11
G2 (5-0 years)	109	2.59±0.02	2.05±0.03	2.90±0.06	172±9.30	5.83±0.09	7.48±0.06
G3 (>10 years)	23	2.38±0.06	2.05±0.05	3.17±0.14	166±1.20	6.36±0.24	7.15±0.15
Total	180	2.55±0.02	2.05±0.02	2.96±0.80	169±5.60	5.82±1.04	7.39±0.05
Normal ranges	--	1.99-2.57	0.75-1.55	1.00-3.50	148-155	4.60-7.10	5.80-7.50

^aSignificant differences between two sexes ($P < 0.05$), ^bSignificant differences between different age groups ($P < 0.05$).



Table 2. The concentrations of serum calcium (Ca), phosphorus (P), magnesium (Mg), sodium (Na), potassium (K) and total protein (TP) in clinically healthy camels in different seasons and gender (Mean± SEM).

	Number	Ca* mmol/L	Mg* mmol/L	P* mmol/L	Na mEq/L	K* mEq/L	TP g/dL
Summer months	90	2.51±0.03	2.00±0.03	3.23±0.09	166±1.30	6.35±0.12	7.32±0.08
Winter months	90	2.60±0.02	2.10±0.02	2.67±0.06	172±11.0	5.29±0.05	7.46±0.06
Total	180	2.55±0.02	2.05±0.02	2.96±0.80	169±5.60	5.82±1.04	7.39±0.05

*Significant differences between two seasons (P<0.05)

average age of both sexes had no significant difference. The average temperatures of summer and winter in the sampling region were 30.76 and 8.63°C, respectively.

The results of the measurement of the serum concentrations of Ca, P, Mg, Na and K in different genders and age groups of dromedary camels are shown in Table 1. There was no significant difference between the male and female camels in the measured parameters, except K values (P<0.049). There was also a marginally significant difference between the two sexes in serum Ca (P<0.069). Age had a significant correlation with serum concentrations of K (r=0.216, P<0.004) and Ca (r=-0.205, P<0.006).

The results of the measured serum parameters in different seasons are shown in Table 2. The camels were divided into three groups, according to their age as G1: ≤5 years, G2: 5-10 years and, G3 >10 years. The serum concentrations of Ca and K had significant difference between the three age groups (P<0.001 and P<0.007, respectively). Serum concentration of K in G3 was significantly higher than G1 (P<0.005) and marginally significantly higher than G2 (P<0.07). This group also had less serum Ca in comparison with G2 (P=0.001) and G1 (P=0.025). There were significant differences between summer and winter seasons in the serum concentrations of Ca (P<0.012), P (P<0.001), K (P<0.001) and Mg (P<0.004).

When sampling seasons were evaluated separately, the same results were obtained. However, in summer, Ca was the only measured parameter with significant difference between the two sexes (P<0.007), and between the three age groups (P<0.03), and with significant correlation with age (r=-0.245, P<0.02). In winter, higher serum K in male camels in comparison with females was marginally statistically significant (P<0.07), and serum Ca showed no significant difference between both sexes. None of the measured parameters showed significant correlation with the age of the sampled camels, and no significant difference between different age groups was seen.

Both sexes were evaluated separately. In the male camels, serum P also had significant difference between three age groups (P<0.029), and only serum K had a significant correlation with the age (r=0.23, P<0.004). In the female camels, serum Na had significant difference (P<0.05) between summer and winter seasons, and none of the measured parameters had a

significant difference between the different age groups. Separate evaluation of different age groups showed the same results, however, in the G1 group, none of the measured serum parameters showed significant difference between the male and female camels, and significant correlation with the age. In G3 group, serum P had also a significant difference between the two sexes (P>0.042).

Discussion

The measured serum concentrations of Ca, P, K and total protein were within the reported normal ranges for dromedary camel (Table 1), while the serum concentrations of Na and Mg were slightly higher than the previously reported ranges (Bogin 2000). Nazifi et al (1999) measured the serum concentrations of Ca, P, Mg, Na, K and total protein in forty male Iranian one-humped camels, aged 2-3 years old, in summer and winter months, in which the serum concentrations of Ca were rather equal to the results of this study (Table 2). However, serum concentration of P, Mg, Na, K and total protein in the current study was higher than that of reported by Nazifi et al (1999). The results of the previous studies regarding the serum biochemical parameters in dromedary camels are partially different (Bogin 2000, Mohammed et al 2007). Besides the probable effects of season, age and sex of the sampled animals, breed, geography, physiological status and diet may be responsible for the different results.

There is little information regarding the effects of season, sex and age on the serum biochemical parameters in dromedary camel. The current study showed that higher serum Ca, Mg and less P and K in winter than in summer in one-humped camel. Also, higher serum Na was found in female camels in summer than in winter. The same results regarding the Ca and K and the reverse regarding the Na have been reported by Zia-ur-Rahman et al (2007) in male camels. In another study, 100 male and 100 female camels, the same results regarding Ca and P, and no significant seasonal change in serum Mg have been reported (Barakat and Abdel-Fattah 1971). The result of the Nazifi et al study (1999) on forty male one-humped camels was in contrast to our results, except serum Ca. They found higher serum Na, K, Ca and P, and less total protein and Mg in winter months than in summer months. On the other hand, Mohammed et al (2007) found no significant difference between dry and wet seasons in the serum





concentrations of total protein, Ca, P, Na and K. Bogin (2000) reported that hemoconcentration caused by water loss may be the cause of some controversial findings regarding serum parameters in dromedarian camels. Since serum total protein increases in dehydrated animals, has been evaluated in the current study as an indicator for hydration status. Insignificant difference of serum total protein between two sampling seasons in this study besides significant difference in some previous studies suggest the dehydration of sampled camels as a probable reason for these controversial findings. It seems that the hydration status of animals should be considered in evaluation of seasonal changes of serum electrolytes in camel. On the other hand, some authors believed that despite camel adaptation to arid condition, nutritional status and different concentrations of these elements in diet and water may change the physiological responses and affect their serum concentrations (Nazifi et al 1999). According to our results, sex of the evaluated camels may affect the seasonal variation in serum electrolytes. Camel is known to be a seasonal breeder and the period of maximum breeding activity for the males is winter and the spring seasons. Zia-ur-Rahman et al (2007) reported that change in androgens during the rutting season in male camels contributed to changes in serum minerals.

The current study showed only a higher serum K in male animals than in females, and serum concentration of Ca had a marginally significant difference, which was significant in summer season. No significant difference in serum Ca, P, and Na, and higher serum K in males besides higher total protein in females were found in Mohammed et al's study (2007) during wet and dry seasons. In other study, no significant difference between the two sexes in the serum concentrations of Ca, P, Mg, Na and K was found (Hussein et al 1992). According to our results, no significant difference was found in camels up to 5 years old, and in G3 group, the serum P also showed a significant difference between the two sexes. Additionally, the results were partially different in the two evaluated seasons. As a result, the age of the camels and the season can be proposed as probable causes of controversial findings in previous studies.

The current study showed that serum K had a positive relationship with the age and showed a negative correlation between serum Ca and the age. Their serum concentrations had significant differences between three age groups of camels. Negative relationship of age with serum concentration of P in one-humped camel and llamas (Rezakhani et al 1997, Smith and Van Saun 2001), and with serum Ca and P in different breeds of dairy cattle and sheep (Schaffer et al 1981) has been reported. In different breeds of sheep, an age related decrease in serum Ca, P and K, and an increase in serum Mg have been reported (Lane et al 1968). In the current study, separate evaluation of both sexes and different seasons showed that the sex of evaluated animals and the season may af-

fect the results of comparison of serum electrolyte between different age groups of camels.

Conclusions

The results of the current study proposed the age, sex and season as the probable causes of the controversial findings in the previous studies regarding the serum concentration of Ca, P, Mg, Na and K in dromedarian camels. However, the effect of some factors such as breed, geography and diet on serum profiles of the sampled animals may be the cause of these findings and some contradictory findings regarding the measured serum parameters.

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