Serum Concentration of Aluminum, Calcium, Magnesium and Phosphorous in Camels

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Abstract :

Serum concentration of aluminium (Al), calcium (Ca), magnesium (Mg) and phosphorus (P) were determined in camels. Higher values of Mg concentrations were recorded in females compared to males. In lactating mothers and their calves higher serum values of Al and lower values of Mg were observed compared to other groups. It is suggested that the increase in serum Al concentration in calves might be due to feeding Al-rich milk and that the decline in Mg concentration might be a consequence of Al and increased secretion of parathyroid hormone.

Introduction :

Aluminium (Al) was recently reported as one of the agents implicated in toxicity and death of thousands of camels in Wadi AL-Dawser and elsewhere in Saudi Arabia. Al is the most abundant mineral in most soils, and it is hardly surprising that it represents problems of excess but not deficiency to livestock under farming conditions.

Al constitutes 3-6% of most soils, but concentrations in the soil solution and groundwater remain low because the element is present largely in insoluble silicous complexes. Concentrations of Al in uncontaminated crops and forages are usually much lower (50-100 mg kg-1 dry matter (DM), but trees, ferns and tropical plants may contain 3-4 g Al kg-1 DM (AL-Ani *et.al*., 1989). The principal source of Al exposure for grazing livestock is from soil-contaminated pasture and the act of grazing itself can increase the degree of contamination of pasture with soil (Robinson *et al.*, 1984). High concentrations in the finest soil particles (Brebner *et. al*., 1985) ensure that Al is an ubiquitous contaminant of the farm environment. It may also enter the diet through the use of

contaminated mineral supplements (e.g. soft phosphate, 70 g Al kg-1 DM) , feed-pelleting agents, such as bentonite (110 g Al kg-1 DM), or aids to digestion; such as zeolite (60 g Al kg-1 DM) (Bishop, 2005).

The determination of some trace minerals and their interactions is essential to understand their physiological role. Therefore, this study was designed to determine serum concentration of Al, calcium(Ca), magnesium(Mg) and phosphorous (P) in the serum of camels.

Material and Methods :

Blood samples were collected from 14 adult male and 18 adult, non-pregnant, non-lactating female camels, aged 4-5 years old, in addition to 19 lactating female camels and their calves and 13 pregnant female camels. The blood was collected by venipuncture into clean plain silicon coated vacutainer tubes and the separated sera were kept frozen at 4˚C until analyzed.

Serum Al, Ca and Mg concentrations were measured using atomic absorption spectroscopy (Pye-Unicam SP 90, spectrophotometer, Unicam Instruments Ltd., Cambridge, England) equipped with an air acetylene flame. The standards and samples were prepared in 0.78% ethylene diamine tetra-acetic acid (EDTA) solutions to reduce phosphate interference.

Serum inorganic phosphorus (P) was measured according to the method of Varley (1967). The principle of the method is based on the reaction of the phosphate to form a coloured complex with molybdate and vandate in the presence of nitric acid.

Statistical analysis :

The results of serum Al, Ca, Mg and P concentrations in adult and young calf camels were statistically analyzed according to Gomez and Gomez, (1984) using the analysis of variance (ANOVA) procedure.

Result and discussion :

Result of mineral concentations are given in Table 1. Most of the results of mineral levels for male and female camels were comparable with previous studies (Abdalla *et. al.,* 1988, Wernery *et. al.,* 1999, Osman and Al-Busadah 2003, Barri et. al., 2005, Faye et al. 2005, Mohammed *et. al.,* 2007).

Table (1)
mean ± SD serum mineral concentrations in camels

Groups (n)	Al (mg/100ml)	Mg (mg/dl)	Ca (mg/dl)	P (mg/dl)
Males (14)	2.2 ± 0.32 a	4.61 ± 0.22 a	9.3 ± 0.51 a	6.14 ± 0.45 a
Females (18)	4.4 ± 0.41 b	3.7 ± 0.2 a	10.11± 0.62 a	6.21 ± 0.50 a
Pregnant (13)	5.6 ± 0.52 b	3.6 ± 0.40 a	10.12 ± 0.53 a	6.1 ± 0.55 a
Lactating (19)	10.11 ± 1.2 c	1.6 ± 0.12 b	11.4 ± 0.32 a	6.2± 0.51 a
Calves (19)	6.1 ± 0.50 d	2.1 ± 0.14 b	12.4 ± 0.30 b	7.1 ± 0.56 a

a,b,c,d means with different superscripts in the same column are significantly different at $P< 0.05$.

Gender and physiological status seemed to affect the individual mineral concentration. Higher values of serum Al and Ca and lower values of Mg concentration were observed in female compared to male camels. Similar results were reported elsewhere (Faye *et.al.,* 2005). Lactating mothers and their calves had significantly ($P < 0.05$) higher serum Al concentration than other groups. It is unlikely that the source of Al in these animals was from soil, since soil forms of Al are of low solubility at neutral pH as would be found in the rumen (Allen *et. al.,* 1986). The availability of Al from shrubs and parts of plants eaten by the camel merits further investigation. For the calves, the high level of serum Al is difficult to explain. However, milk could be the source. Different breed of camels have different capacities to deposit minerals in their milk (Wangoh *et. al.,* 1998, Mal *et. al.,* 2007). In lactating animals, a dramatic decline in serum Mg concentration was noted. Elevated level of parathyroid hormone (PTH) might also be associated with increased Al absorption (Mayor e*t. al.,* 1977). In the present study lactating camels were likely to have elevated PTH due to their early stage of lactation. The decline in serum Mg could be a consequence of Al elevation in the serum. Al dosing of

steers, sheep and cows (Allen and Fontenot 1984) was shown to induced depressed serum Mg.

The present results show that serum Ca was higher in calves compared to others. Ca and Mg ions are transferred from mother to foetus against concentration gradients, presumably reflecting active transport mechanism for both cations by the placenta, with the result that the foetus at birth is rendered hypercalcaemic and hypomagnesaemic in relation to its mother (Care *et. al.*, 1982 and Barri *et. al.*, 2005). These features continued to be seen in early neonates probably as a result of feeding Al-containing milk.

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تركيز الألمنيوم والكالسيوم والمغنيسيوم والفسفور في مصل الجمال

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الملخص :

تم قياس تركيز الألمنيوم والكالسيوم والمغنيسيوم والفسفور في الجمال، أظهرت الدراسة أن تركيز المغنيسيوم أعلى في الإناث مقارنة بالذكور. كما أن الأمهات في وقت إدرار الحليب ومواليدهن أظهرت تركيز الألمنيوم أعلى وأن تركيز المغنيسيوم أقل من مجموعات الدراسة الأخرى . تشير هذه الدراسة إلى أن انخفاض تركيز المغنيسيوم ربما كان بسبب تركيز الألمنيوم وزيادة هرمون الغدة الجار درقية PTH وأن ارتفاع تركيز الألمنيوم في المواليد ربما نتج بسبب التغذية على تركيز عالٍ في الحليب وكذلك هرمون جارات الدرقية PTH.