

# Observations on serum trace elements levels (zinc, copper and iron) in camel (*Camelus dromedarius*) in the arid tracts of Thar Desert in India

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GHOSAL (A.K.), SHEKHAWAT (V.S.). Observations sur la concentration sérique de quelques oligo-éléments (zinc, cuivre et fer) chez le dromadaire (*Camelus dromedarius*) sur les parcours arides du désert de Thar (Inde). *Revue Elev. Méd. vét. Pays trop.*, 1992, 45 (1) : 43-48

Les concentrations sériques en zinc, cuivre et fer ont été recherchées sur 122 échantillons de sang de chameau (82 provenant d'une ferme universitaire, et 40 de 23 élevages privés). Les animaux étaient répartis sur toute la région du désert du Thar dans le Rajasthan-Ouest, en Inde. Les niveaux moyen globaux en zinc, cuivre et fer étaient respectivement les suivants :  $85,4 \pm 2,5$   $\mu\text{g}/100$  ml (33,3-100,0),  $94,3 \pm 3,2$   $\mu\text{g}/100$  ml (39,9-160,0) et  $107,4 \pm 3,0$   $\mu\text{g}/100$  ml (40,0-182,0). En même temps, les concentrations en oligo-éléments de quelques aliments locaux couramment consommés (herbes et buissons) par les dromadaires, ont été évaluées. Les plantes de la zone aride ont montré des taux tout à fait satisfaisants en zinc, fer et manganèse mais la concentration cuprique était trop basse. Cependant, si les fourrages grossiers sont disponibles en quantité suffisante, les besoins des animaux peuvent être satisfaits. Les teneurs en oligo-éléments des dromadaires de la ferme universitaire ont toujours été plus élevées que celles des dromadaires des élevages privés. L'analyse statistique a montré des teneurs significatives pour le fer, mais non pour le zinc et le cuivre. De plus, les jeunes mâles avaient une concentration légèrement inférieure comparée à celle des adultes. D'une manière générale, les valeurs sériques du zinc, du cuivre et du fer des dromadaires indiens étaient inférieures aux valeurs normales citées ailleurs. Elles étaient également inférieures à celles des ruminants (bovins et ovins) dans la même région. Enfin, nombre d'animaux ont montré des signes sub-cliniques de concentrations déficitaires. *Mots clés* : Dromadaire - Carence - Oligo-élément - Cuivre - Zinc - Fer - Besoin traditionnel - Zone aride - Désert de Thar - Inde.

## INTRODUCTION

### Environment

The vast Thar desert in the Bikaner District (Western Rajasthan) harbours large stocks of animals producing meat, milk, skins, hides and wool for millions. In addition, it is the home tract for 70 % of India's camel population. The hostile environment in this arid region, the scanty vegetation and the restricted water resources give rise to almost unsurmountable difficulties for the survival of most of the animals except the dromedary. Ninety-six percent of the 458 mm total rainfall occurs between June and September (120 days). Furthermore, the very high mineral content of the brackish well water, the phytates and tan-

nic acid of the leaves, interfere with the utilization of the available minerals and even more with the trace elements.

### Trace elements

Copper (Cu), zinc (Zn), iron (Fe) and cobalt are essential for the health and productivity. As clinical deficiencies without manifestation of specific symptoms, were liable to occur in this milieu, an exploration was necessary as no local information was available about the trace elements in the camel. With the aim of determining their level, serum samples from the university farm and from the breeders' stocks, distributed throughout the area were analysed for Zn, Cu and Fe together with the same levels of locally common feed.

## MATERIALS AND METHODS

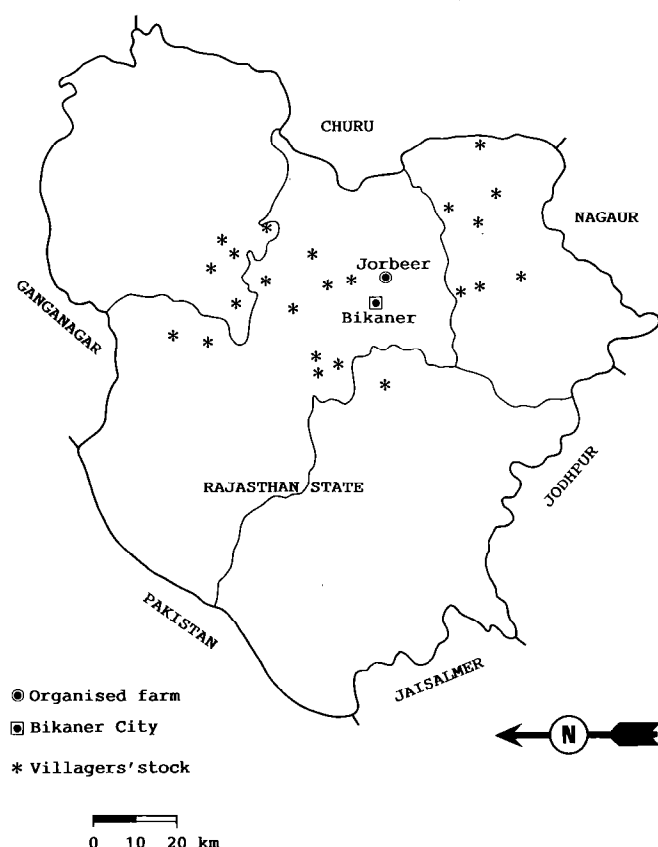
In the present investigation, the selection was made randomly according to age and sex, young males and young females up to 4 years of age in each of the two different experimental groups. In the first group, 82 serum samples were taken from the University Camel Breeding Farm at Jorbeer (map 1) near Bikaner (16 young males, 22 young females, 15 adult males and 29 adult females) (table I).

The second group comprised 40 serum samples from farmers' stocks with 10 animals in each of the four categories distributed in 23 villages of the Bikaner District. A collection of forage samples was also carried out in the same region. About 20 serum samples and 5 feed samples were normally taken in a single trip to Jorbeer's farm or from the different villages, depending upon transport facilities (map 1).

Serum samples were collected in the morning before feeding and watering from the jugular vein under sterile conditions. After clotting clear serum was obtained at the top and some was collected in screw cup-tubes and transported back to the laboratory. The samples were analysed for zinc and copper by the atomic absorption spectrophotometric method of PINTS (12) and the determination of iron levels was made using the calorimetric method of Peters, as given by OSER (11).

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Map 1 : Bikaner district showing the University farm and the different villages from where serum and fodder samples were taken for trace element study.

Feed samples were taken so as to include particular portions of trees (leaf, stem, root) normally consumed by the camel in this region, according to author's observations.

Seven different species of forage were identified and five samples of each variety were collected for analysis of Cu, Zn, Fe and Mn levels by the atomic spectrophotometric

method of PINTS (12). In this study no seasonal effect was taken into consideration, but during a given period of sampling, both serum and forage samples were taken simultaneously.

## RESULTS

**Table I**

The values for overall mean serum level of Zn, Cu and Fe were  $85.4 \pm 2.5$ ,  $94.3 \pm 3.2$  and  $107.4 \pm 3.0$   $\mu\text{g}/100$  ml, respectively.

The mean values of animals of group 1 were  $87.7 \pm 3.1$ ,  $95.5 \pm 2.8$  and  $111.5 \pm 4.2$   $\mu\text{g}/100$  ml respectively. The corresponding values for Zn, Cu and Fe of group 2 were  $80.6 \pm 4.3$ ,  $91.8 \pm 3.9$  and  $99.1 \pm 3.1$   $\mu\text{g}/100$  ml, respectively.

**Table II**

All values for Zn and Cu values from the University farm were not significantly higher than those of the farmers' stock. They were higher in adults in comparison to young animals and in females in comparison to males.

Serum iron level revealed a significant difference due to management conditions, age and sex. The mean Fe serum level in group 1 was significantly higher than in group 2 ( $111.5 \pm 4.2$  vs  $99.1 \pm 3.1$   $\mu\text{g}/100$  ml). The mean serum level of Fe in adults was significantly higher than in young animals ( $116.0 \pm 3.9$  vs  $98.0 \pm 4.5$   $\mu\text{g}/100$  ml). Moreover, in females the Fe level was also significantly higher than that observed in males ( $112.7 \pm 4.3$  vs  $100.1 \pm 4.0$   $\mu\text{g}/100$  ml).

**Table III**

It refers to trace elements in local plants consumed by dromedaries.

**TABLE 1** Trace element level in serum ( $\mu\text{g}/100$  ml) of camel (*Camelus dromedarius*) from Thar desert of Rajasthan, India.

Trace element level	Stock from organised farm					Farmers stock					Overall mean level & range farmers stock & organised farms
	Young : 4 years and less		Adult : over 4 years		Total mean organised farm	Young : 4 years and less		Adult : over 4 years		Total mean farmers stock	
	Male n = 16	Female n = 22	Male n = 15	Female n = 29		Male n = 10	Female n = 10	Male n = 10	Female n = 10		
Zinc	77.9 $\pm 7.8$	86.0 $\pm 6.3$	85.7 $\pm 9.3$	95.4 $\pm 3.8$	87.7 $\pm 3.1$	77.3 $\pm 8.0$	83.9 $\pm 8.7$	82.6 $\pm 9.8$	78.6 $\pm 9.3$	80.6 $\pm 4.3$	$85.4 \pm 2.5$ (33.3 - 100.0)
Copper	91.6 $\pm 5.8$	95.4 $\pm 4.3$	95.9 $\pm 4.4$	98.8 $\pm 6.0$	95.5 $\pm 2.8$	88.6 $\pm 7.1$	86.6 $\pm 6.6$	97.9 $\pm 8.3$	93.9 $\pm 8.0$	91.8 $\pm 3.9$	$94.3 \pm 3.2$ (39.9 - 160.0)
Iron	99.5 $\pm 8.9$	99.7 $\pm 9.1$	105.9 $\pm 8.9$	130.0 $\pm 6.0$	111.5 $\pm 4.2$	92.7 $\pm 4.9$	97.0 $\pm 8.3$	99.9 $\pm 4.7$	107.0 $\pm 6.3$	99.1 $\pm 3.1$	$107.4 \pm 3.0$ (40.0 - 182.0)

**TABLE II** Effect of age, sex and management condition on trace element levels (Zn, Cu and Fe) in camel (*Camelus dromedarius*) from Thar Desert in India (unit :  $\mu\text{g}/100 \text{ ml}$ ).

Trace elements	Population	Effect of management condition			Effect of age			Effect of sex		
		Stock of organised farm	Farmers stock	't' value	Young	Adult	't' value	Male	Female	't' value
Zinc	122	87.7 $\pm 3.1$	80.6 $\pm 4.3$	1.8 NS	84.3 $\pm 4.3$	88.5 $\pm 3.5$	0.7 NS	81.0 $\pm 4.3$	88.5 $\pm 3.1$	1.4 NS
Copper	122	95.5 $\pm 2.8$	91.8 $\pm 3.9$	0.7 NS	91.0 $\pm 2.9$	97.2 $\pm 3.4$	1.3 NS	92.8 $\pm 3.2$	95.3 $\pm 3.2$	0.5 NS
Iron	122	111.5 $\pm 4.2$	99.1 $\pm 3.1$	2.3 *	98.0 $\pm 4.5$	116.0 $\pm 3.9$	3.0 *	100.1 $\pm 4.0$	112.7 $\pm 4.3$	2.1 *

\* significant at  $P < 0.05$  ; NS : non-significant.

**TABLE III** Trace element content of common desert plants consumed by camel (*Camelus dromedarius*) from Thar Desert in India.

Local name of feed	Botanical name	Zn mg/kg dry matter	Cu mg/kg dry matter	Fe mg/kg dry matter	Mn mg/kg dry matter
Pala	Leaf of <i>Zyzyphus nummularia</i>	22.6	10.7	224.0	48.9
Guar Falgati	Straw of <i>Cymopsis tetragonoloba</i>	16.0	12.9	144.0	18.3
Moth Chara	Straw & leaf of <i>Phaseolus aconitifolius</i>	18.5	15.1	176.0	44.0
Phog	<i>Calligonum Polygonoidus</i>	35.0	25.7	30.0	199.0
Senia	<i>Crotalaria buyhia</i> (leaf & stem)	23.0	15.0	143.3	106.0
Loong Khejri	<i>Prosopis cinceraria</i> (leaves)	25.0	26.0	49.9	39.8
Neem leaf	<i>Azadirachta indica</i>	20.0	18.8	135.0	46.6
Deficiency threshold		45.0	10.0	50.0	45.0

Each value is mean of 5 samples drawn from different regions of Thar Desert (see Map 1).

## COMPARATIVE DISCUSSION

### Zinc

In the present investigation, Zn values, in  $\mu\text{g}/100 \text{ ml}$ , seemed to be lower as compared to cattle and sheep from the same region. It might be due to the differences in the type of feed intake and management practices :

Cattle  $86.8 \pm 3.6$  (46.6 - 256.6) ; sheep  $94.8 \pm 6.4$  (44.1 - 153.3) and camel  $85.4 \pm 2.5$  (33.3 - 100.0) (mean values) (13).

Cattle and small ruminants are grazing animals whereas camel and to some extent goat, adopt a browsing behaviour. Their feed normally comprises tree leaves, shrub foliage and thorny bushes. Moreover, cattle is getting concentrate depending upon their milk yield in addition to grazing of arid land grasses. Sheep are kept in range management systems, but being a close ground grazer, may find some micronutrients from soil contaminated grasses.

Similar trends of very low serum levels of Zn in camel have been found in the United Arab Emirates by ABDALLA *et al.* (1), the mean value being  $41 \mu\text{g}/100 \text{ ml}$  with a range of 37-46  $\mu\text{g}/100 \text{ ml}$ .

The camel, due to its adaptation to extreme thermal and nutritional stresses, requires zinc dependent enzymes, as the synthesis or release of the leukocyte endogenous mediator (LEM), a Zn-binding ligand, is reported to be increased by stress causing an increase in intestinal absorption and in liver uptake of Zn, together with a decrease in the serum level (3). Such a phenomenon might account for low Zn concentration in the present investigation. However, concentration more studies on Zn

metabolism in this species are needed to support the above observation. Earlier, WAGNER *et al.* (15) and CORRIGAL *et al.* (4) observed a reduction in the serum rate of Zn in cattle subjected to hyperthermal and nutritional stresses.

However, MOTY *et al.* (10) in 17 Egyptian farm camels reported mean serum levels of Zn of  $135 \pm 4.1$   $\mu\text{g}/100$  ml which were higher in comparison with the data of the present investigation. The analysed Zn levels in the studied camel feed indicated the presence of sufficient Zinc, provided they were consumed in required quantities (table III). Occasional cases of skin parakeratosis and poor fertility have been observed in both farmers' stocks and University farm, and a further study is under way to determine the deficiencies levels.

## Copper

The serum level of copper ( $\mu\text{g}/100$  ml) showed a higher concentration in camel compared to the values reported in cattle and sheep in this region (13) (mean values) : Cattle =  $86.8 \pm 2.9$  (26.6 - 159.9) ; sheep =  $88.3 \pm 3.4$  (25.9 - 140.3) and camel =  $94.3 \pm 3.2$  (39.9 - 160.0).

A similar trend was observed in Egyptian camels compared with other ruminants from the region by MOTY *et al.* (10). In Ethiopia a serum Cu value was reported to be higher in camel than in cattle, sheep and goat living in the same area by FAYE *et al.* (5). A difference in the feeding behaviour and consequently a change in the nature and quality of the feed intake could partly explain such a consistent difference along with a better adaptability of the camel to the hot arid desert. Last, a higher liver copper store in comparison to other ruminants in camels from Eastern Sudan has been also reported by ABUDAMIR *et al.* (2).

The present values are well in agreement with the reported data of  $93.6$   $\mu\text{g}/100$  ml by IDRIS *et al.* (7) and the values of  $90.4 \pm 14.5$ ,  $93.3 \pm 22.1$   $\mu\text{g}/100$  ml and  $109.2 \pm 53.8$   $\mu\text{g}/100$  ml respectively from three different regions of Sudan by TARTOUR (14). KHALIFA *et al.* (8) on the other hand reported higher a serum level of  $126.5 \pm 26.9$   $\mu\text{g}/100$  ml in camel from South Somalia. In the present study the serum copper level varied considerably (39.9 - 160.0  $\mu\text{g}/100$  ml) with no specific clinical syndroms which could be attributed to a copper deficiency again suggestive of some better adaptive mechanisms in camels to effectively handle the copper status.

## Iron

The serum iron values obtained in the present investigation were slightly higher than those reported by GHOSAL *et al.* (6), WHABI *et al.* (16) and ABDALLA *et al.* (2) :  $101.3 \pm 4.6$ ,  $98.5 \pm 19.0$  and  $113$   $\mu\text{g}/100$  ml, respectively. However, MOTY *et al.*, (10) indicated a higher value for

iron in camel :  $186.0 \pm 39$   $\mu\text{g}/100$  ml. Later on, MARX and ABDI (9) reported a value ranging from 30.0 to 175.0  $\mu\text{g}/100$  ml in camels from Africa. Comparatively, a higher serum iron value from the African continent might be due to a higher feed iron value reported from Ethiopia by FAYE *et al.* (5). The plant iron contents from the Thar Desert in the present investigation were always lower (table III) a fact which might account for a low serum iron level in India camel.

Parasitism in the serum and the gastrointestinal tract which might affect serum iron level did not seem to have any influence except, to a limited extent, in the farmers' stock where no serum and faecal samples were examined prior to sampling and where serum was only taken for analyses from apparently healthy animals. However, in the University farm, the animals were regularly subjected to screening for parasitism and during the study, the animals were in fact free of any parasitic load. The trace element levels in the desert adapted plants were quite adequate in comparison to values reported from other regions in India. Among different forages, the lowest values were observed for Cu followed by Zn, manganese (Mn) and Fe (table III).

## CONCLUSION

Occasional cases of skin parakeratosis followed by a poor growth rate and infertility problems were reported in the two types of farms. Only a supplementation trial with these trace elements along with the monitoring of production data will enable to determine the possibility of any micronutrient deficiency in the camel. Project is under way to initiate such investigations. At present, this region has been experiencing serious problems, like overgrazing, poor rainfalls, increase in animal population and new irrigational projects resulting in an imbalance in the desert ecology, thus adversely affecting the overall camel management and productions.

A definite strategy needs to be adopted in order to provide alternative measures to generate forage resources. Adoption of new agro-sylvo-pastoral development techniques with the help of irrigation facilities, is the only way to improve resources for these animals and thus save them from malnutrition. The camel is already at the cross road in this continent and needs an urgent attention for increasing its productivity rather than for its survival which is no longer a problem.

GHOSAL (A.K.), SHEKHAWAT (V.S.). Observations on serum trace elements levels (zinc, copper and iron) in camel (*Camelus dromedarius*) in the arid tracts of Thar Desert in India. *Revue Élev. Méd. vét. Pays trop.*, 1992, **45** (1) : 43-48

Hundred and twenty-two camel serum samples (82 from a University farm, 40 from 23 farmers' stocks) were screened for the serum levels of zinc, copper and iron. Animals were distributed all over the region of the Thar desert of Western Rajasthan (India). The overall mean serum levels in zinc, copper and iron were  $85.4 \pm 2.5 \mu\text{g}/100 \text{ ml}$  (33.3-100.0),  $94.3 \pm 3.2 \mu\text{g}/100 \text{ ml}$  (39.9-160.0) and  $107.4 \pm 3.0 \mu\text{g}/100 \text{ ml}$  (40.0-182.0), respectively. Simultaneously, trace element levels from locally grown common camel feeds (plants and shrubs) consumed by these animals were also analysed. The desert plants concentrations were quite adequate in zinc, iron and manganese, but the value for copper seemed too low. However, if a sufficient quantity of roughage is available the animals can meet requirements. Trace element values from the University farm camels were always higher than those of the farmers' stocks. The statistical analysis showed significant values in the case of iron, but non-significant ones for zinc and copper. Furthermore, young males showed a slightly lower level in comparison to adults. Generally, the status of zinc, copper and iron in Indian camels were lower than the normal values reported elsewhere. Similarly they were lower in comparison to ruminants (cattle and sheep) from the same region. Some animals showed sub-clinical deficiency levels. *Key words* : Dromedary - Deficiency - Trace elements - Copper - Zinc - Iron - Nutrient requirement - Arid area - Thar desert - India.

GHOSAL (A.K.), SHEKHAWAT (V.S.). Observaciones sobre la concentración sérica de algunos oligo elementos (zinc, cobre y hierro) en el camello (*Camelus dromedarius*) en las zonas áridas del desierto de Thar, India. *Revue Élev. Méd. vét. Pays trop.*, 1992, **45** (1) : 43-48

Se obtuvieron muestras de suero de 122 camellos (82 provenientes de la estación universitaria y 40 de otros establecimientos), para determinar los niveles de zinc, cobre y hierro. Los animales se encontraban distribuidos a lo largo de la región del desierto de Thar, en la zona oeste de Rajasthan (India). Los niveles promedio de zinc, cobre y hierro fueron de  $85,4 \pm 2,5 \mu\text{g}/100 \text{ ml}$  (33,3-100,0),  $94,3 \pm 3,2 \mu\text{g}/100 \text{ ml}$  (39,9-160,0) y  $107,4 \pm 3,0 \mu\text{g}/100 \text{ ml}$  (40,0-182,0) respectivamente. Paralelamente se determinaron y analizaron los niveles de oligo elementos en los alimentos locales más comunes en la nutrición de los camellos (plantas y arbustos). Las concentraciones de zinc, hierro y manganeso fueron relativamente adecuadas en las plantas desérticas, sin embargo los valores de cobre fueron bastante bajos. Sin embargo, los animales pueden obtener los requerimientos nutricionales adecuados si se les alimenta con una cantidad suficiente de forraje. Los valores de oligo elementos en los animales provenientes de la estación universitaria, fueron siempre más elevados que aquellos de animales provenientes de fincas de la región. El análisis estadístico mostró resultados significativos para el hierro, pero no significativos para el zinc y el cobre. Los machos jóvenes mostraron un nivel inferior en comparación con los adultos. En general, los niveles de zinc, cobre y hierro en los camellos indios fueron inferiores a los valores normales reportados en otros lugares. Estos valores fueron también inferiores a los encontrados en los rumiantes (bovinos y ovinos) en la misma región. En algunos animales se encontraron niveles sub-clínicos de deficiencia. *Palabras claves* : Dromedario - Deficiencia - Oligo elementos - Cobre - Zinc - Hierro - Necesidad nutritiva - Zonas árida - Desierto de Thar - India.

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