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Trace-elements Status in Camels, Cattle and Sheep in Saudi Arabia

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Abstract: Serum and hepatic concentrations of Cu, Zn, Fe and Mn of dromedary camels were determined and compared with respective values of cattle and sheep. Serum Cu and Mn concentrations were significantly higher for camels than for cattle and sheep. Serum Fe concentration was significantly lower for camels than for cattle and sheep. Liver Cu concentration was significantly higher for camels than for cattle and sheep. The differences in serum Zn, liver Zn, Fe and Mn between the three species were not statistically significant.

Key words: Copper, zinc, iron, manganese, serum, liver, camel, ruminants

INTRODUCTION

The world population of the dromedary and bacterianus camels is estimated to be 17 millions. Dromedary camels constitute about 91% of this figure and are concentrated mainly in the Arab world particularly the Arabian countries of Africa. There are about 415 thousands camels in Saudi Arabia, most of which are used to provide meat and milk for a growing number of human population.

The essential trace-elements are copper, zinc, iron, manganese, selenium, cobalt and iodine. These trace-elements are generally included in enzymes molecules, for example copper in cytochrome oxidase, alkaline phosphatase, cystyloxidase, DNA and RNA polymerase and dehydrogenases, manganese in pyruvate carboxylase and selenium in gluthione peroxidase. Some are included in hormones (iodine in thyroid hormones), vitamins (cobalt in vitamin B_{12}) and metalloprotein (iron in haemoglobin and myoglobin.

Indicators of trace-elements status of camels and ruminants are plasma and liver contents. Copper plasma level may be considered as a good reflection of Cu intake in ruminants, normal levels lie between 70-120 μg 100 ml^{-1} (Auza *et al.*, 1999; Dargatz *et al.*, 1999, Engle *et al.*, 2000; Engle *et al.*, 2001). Most of the observed values in camels fluctuate between these two values. However, some interspecies comparisons show that the Cu plasma values are, on average, slightly higher than other ruminants (Tartour, 1975; Faye and Grillet, 1984). Like other ruminants, camels store Cu mainly in the liver (Abu Damir, 1998). Liver Cu values ranging between 6.5-543 ppm were found in Sudani camels (Tartour, 1969, 1975; Abu Damir *el al.*, 1983). Khalifa *et al.* (1983) reported a range of 20-286 ppm in adult Egyptian camels. Lower values have been reported in deficient young camels (19-88 ppm) at Djibouti (Faye *et al.*, 1992).

In camels plasma Zn levels fluctuate between 70-120 μg 100 ml^{-1} (Abdel-Moty *et al.*, 1968; El Tohamy *et al.*, 1986; Faye *et al.*, 1986). However, lower values were observed in Djibouti (Faye *et al.*, 1990) and in the United Arab Emirates (Abdalla *et al.*, 1988). Hepatic Zn concentrations of 143±4.8 ppm were reported in camels by Awad and Berschneider (1977). Abu Damir *et al.* (1983) found that Zn concentrations in the liver (39.6±17.6 ppm wet weight; multiply by 3.5 = dry weight) of the camel were not different from that of sheep, goats and cattle. Zn deficiency is comparatively rare under field conditions and is manifested by parakeratosis, anorexia, growth failure, defected cell-mediated immunity and impaired reproductive functions (Underwood, 1977).

The concentrations of serum iron reported by Tartour and ldris (1970), Wahbi *et al.* (1984), Higgins and Kock (1986) and Abu Damir *et al.* (1983) are comparable and within normal ranges reported for cattle, horses and dogs (Kaneko, 1980). However, slightly higher serum levels were reported by Abdel-Moty *el* al. (1968) and Hussein *et al.* (1982). Reported liver iron values in camels ranged between 260-580 ppm (Tartour, 1969; Awad and Berschneider, 1977). Iron content of liver was found to be higher in young camels and in the foetus (Tartour, 1969).

Few reports could be traced in the literature concerning Mn concentration in the plasma of camels. El-Kasmi (1989) observed a mean value of 174 μg 100 ml^{-1} with no age or sex differences. However, El-Tohamy *et al.* (1986) reported lower plasma Mn (33.6 μg 100 ml^{-1}) in non-pregnant camels. In ruminants plasma Mn values were generally lower than 10 μg 100 ml^{-1} (Lamand, 1987). Low hepatic Mn values, as for other ruminants, were reported in the camel (Abu Damir *et al.*, 1983; Awad and Berschneider, 1977). The present study was therefore

undertaken to establish normal concentrations of Cu, Zn, Fe and Mn in she-camels, cows and ewes and to compare our results with those reported in the literature.

MATERIALS AND METHODS

Animals: The camels used in the present study belonged to the Camel Research Centre, King Faisal University. The camels were kept under reasonable hygienic conditions and veterinary supervision. The animals were fed on hay and barley. Water was available ad libitum. The cows and ewes belonged to the Agriculture and Veterinary Training Station of King Faisal University. The cows and ewes were lactating and were fed on long hay and concentrates.

Blood sampling: Blood samples were collected by jugular venipuncture from 5 adult she-camels, 5 lactating cows and 5 lactating ewes into silicon-coated vacuum containers. The blood was allowed to clot and after centrifugation the serum was separated and stored at-20°C until analysed.

Collection of liver samples: Visits were paid to Al-Ahsa abbatoir. Liver samples from slaughtered camels, cattle and sheep were collected. To avoid contamination, first use stainless surgical blades were used to cut off the liver samples. The samples were transferred into clean sterile containers and immediately frozen at-20°C until analysed.

Biochemical analysis: Serum concentrations of Cu, Zn, Fe and Mn were measured by atomic absorption spectrophotometer (Shimadzu, Model 6601). Liver samples were digested in a mixture of 2 : I : 0.5 nitric acid (HNO_3, 65%), perchloric acid ($HCLO_4$, 60%) and sulphuric acid (H_2SO_4, 97%). The samples were further diluted and aspirated into an atomic absorption spectrophotometer (Shimadzu, Model 6601).

Statistical analysis: The data were analysed statistically using analysis of variance (ANOVA). The statistical differences between means were estimated by Duncon's Multiple Range Test. The computation was facilitated by statistical package SAS (SAS, 2000).

RESULTS

The mean ±SE concentrations of Cu, Zn, Fe are shown in Table 1. Mean serum Cu and Mn concentrations of she camels were significantly higher ($P < 0.05$) when compared with values obtained in cows and ewes. Conversely, mean serum Fe concentration of she-camels was significantly lower ($P < 0.05$) as compared with mean concentrations obtained in cows and ewes. The difference in mean serum Zn concentrations between the three species was not statistically significant.

Table 1: Mean ±S.E. concentrations of Cu, Zn, Fe and Mn in the serum of she-camels (n = 5), cows (n = 5) and ewes (n = 5)

Parameter	Unit	She camel	Cow	Ewe
Cu	µg/dl	113.5±15.1^a	70.2±11.5^b	95.6±10.3^b
Zn	µg/dl	103.4±12.6^a	98.5±8.6^a	110.7±13.1^a
Fe	µg/dl	80.2±16.0^b	168.4±13.9^a	178.6±23.7^a
Mn	µg/dl	30.0±4.5^a	8.3±2.5^b	7.5±1.8^b

Table 2: Mean ±S.E. concentrations of Cu, Zn, Fe and Mn in the liver (DM basis) of she camels (n = 5), cows (n = 5) and ewes (n = 5)

Parameter	Unit	She camel	Cow	Ewe
Cu	mg/kg	265.1±30.6^a	150.5±18.lb	154.6±11.2b
Zn	mg/kg	148.7+9.6^a	139.4±7.9^a	141.0±8.5^a
Fe	mg/kg	295.2^a+21.6	229.14+15.6^a	251.4±19.5^a
Mn	mg/kg	6.1±2.2^a	7.5±2.9^a	8.6±3.l^a

Note: Duncan's Multiple Range Test was performed at $P < 0.05$
Means with the same letter are not significantly different

Mean± SE liver concentrations of Cu, Zn, Fe and Mn are shown in Table 2. The mean liver Cu concentration of she-camels was significantly higher ($P < 0.05$) when compared with mean values obtained in either cows or ewes. However, the differences in mean liver concentrations of Zn, Fe and Mn, between the three species, were not statistically significant.

DISCUSSION

In the present study the concentrations of trace elements (Cu, Zn, Fe, Mn) obtained in sera of she camels were comparable to values recorded in Sudan (Tartour, 1975; Wahbi *et al.,* 1984; Abu Damir *et al.,* 1983), Egypt (Abdel-Moty *et al.,* 1968), Ethiopia (Faye *et al.,* 1986) and United Arab Emirates (Abdalla *et al.,* 1988). Low plasma Cu values have only been observed in the Horn of Africa (Faye and Mulato, 1991). It concerns secondary deficiencies (forages are rich in molybdenum and sulfur, which are well known antagonists of copper) particularly in the Rift Valley. Plasma Zn is a good and early reflection of the zinc status. However, little work has been done with respect to Zn in camels and the clinical deficiency is not known. Young camels have lower plasma Zn than adults but there is no sex difference (El-Kasmi, 1989).

Plasma Zn level significantly increases in haemolytic blood or in blood contamination during the collection, storage or processing. The Fe content of serum decreases during pregnancy (El-Tohamy *et al.,* 1986) from 68.0 µg 100 ml^{-1} at the beginning to 64.0 by the end of gestation. El Kasmi (1989) did not observe significant differences with age or sex, but Barakat and Abdel-Fattah (1970) reported higher values for whole blood Fe in she camel during the rainy season and lower values during the dry season compared to males. Tartour and Idris (1970) found

that racing camels have higher serum Fe levels than pack camels.

The concentrations of Cu, Zn, Fe and Mn found in sera of cows and ewes of the present study fall within the normal range reported for ruminants (Sanson *et al.,* 1994; Kirk *et al.,* 1985; Black *et al.,* 1985; Stoszek *et al.,* 1986; Kaneko, 1980; Engle *et al.,* 2001). Serum Cu concentration of she camels was significantly higher than values found in cows and ewes. This is in agreement with previous reports that serum Cu values are higher in camels than in ruminants (Tartour, 1975; Faye and Grillet, 1984, 1990). This may be attributed to the fact that camels graze more forage trees than grasses (Rutagwenda *et al*., 1990). Forage-trees are generally richer in copper (Tartour, 1966; Faye *et al*., 1986). No differences were found in serum Zn concentrations between she camels, cows and ewes of the present study. These levels fall within the general range reported for other animals (Underwood, 1977). On the other hand, serum Fe concentration was significantly lower in she camels as compared to cows and ewes. This is in accordance with previous studies which revealed lower blood iron values in the camel compared to other ruminants (Faye *et al*., 1986; Tartour and Idris, 1970; Ghosal *et al*., 1976), but this is not the case for transferrin (Tartour and Idris, 1970) which possesses a lower iron-binding capacity (30%) than other ruminants. Serum Mn concentrations of she camels was significantly higher than mean values found in cows and ewes. Only two references are available concerning Mn level in camel plasma, El Kasmi (1989) observed a mean value of 174 μg 100 ml^{-1} with no age or sex differences. These values are higher than the values recorded in the present study and higher than those observed by El-Tohamy *et al.* (1986). No variation owing to pregnancy has been observed, contrary to other trace-elements, These values should be reconsidered since the observed values on other ruminants are generally lower than 10 μg 100 ml^{-1}. Concerning liver trace elements, little data are available. In the present study the mean hepatic concentrations of Cu, Zn, Fe and Mn found in she camels agree with previous reports (Tartour, 1969, 1975; Awad and Berschneider, 1977; Khalifa *et al*., 1983; Abu Damir *et al*., 1983; Wensvoort, 1992). More recently, lower hepatic Cu concentrations have been reported in deficient young camels by liver biopsy (19-88 ppm) at Djibouti (Faye *et al*., 1992). The status was improved with mineral supplementation.

In the present study, liver concentrations of Cu, Zn, Fe and Mn obtained on cows and ewes fall within the general range recorded for ruminants (Kirk *et* at 1985; Black *et al*., 1985; Stoszek *et al*., 1986; Hatfield *et al*., 2001; Bailey *et al*., 2001; Arthington and Pate, 2002). With the exception of Cu, no significant differences were found in hepatic trace elements between she camels and cows or ewes. This may be due to accumulation of Cu in the liver by camels owing to the fact that the camels graze more forage trees which are generally richer in copper (Tartour, 1966; Faye *et al*., 1986). As for other ruminants, hepatic Mn is generally low in camels compared to other trace-elements: from 2.6±1.5 ppm to 10.3±8.8 ppm according to different authors (Awad and Berscheider, 1977; Abu Damir *et* at, 1983; Wensvoort, 1992). These values compare well with Mn status in other ruminants. Abu Damir *et al*. (1983) found lower hepatic Zn values (39.6±17.7 ppm) in Sudani camels. On the other hand, higher hepatic Fe (558.1±266.4 were recorded in camels in the Sudan (Tartour, 1969) and values of 460.0±85 ppm in Egyptian camels (Awad and Berschneider, 1977). However, in natural conditions, iron deficiency is not observed in ruminants (Underwood, 1977).

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