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Mineral Contents of Milk of Cattle, Camels, Goats and Sheep in the Central Region of Saudi Arabia

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Abstract: Milk samples were obtained during the second month of lactation from cattle, camels, sheep and goats for analysis of their essential mineral content. The Mean±SD concentrations of Zn, Mn, Cu, Fe, Ca, Na and K in the milk of cattle were calculated as mg kg^{-1} on dry matter basis and were as follows: 2.0±0.28, 1.291±2.43, 1.80±1.10, 4.214±1.78, 661.0±41.95, 91.6±3.45 and 113.7±5.84, respectively; for camels: 1.48±0.76, 1.299±0.11, 1.61±0.90, 2.981±2.24, 699.3±96.65, 115.87±4.99 and 133.77±5.64, respectively; for goats: 1.129±0.04, 0.57±0.20, 4.908±2.66, 751.72±72.78, 101.3±10.71 and 123.85±9.94, respectively; for sheep: 3.09±0.91, 1.144±0.05, 0.62±0.22, 5.011±3.24, 822.5±113.36, 95.4±5.47 and 127.4±11.10, respectively. Milk obtained from the species of animals investigated above was free from lead and cadmium.

Key words: Milk minerals, cattle, camel, goats, sheep

INTRODUCTION

The concentration of minerals in milk varies in different countries and is affected mainly by factors such as the growing conditions of feed (soil, type of fertilizer and irrigation water) as well as the type of processing used which affects the pH and use of metal containers (Muller *et al*., 1996). Minerals at nutritional standard concentrations in foodstuffs are necessary for human health; however, when these nutritional values are low or exceeded they are likely to cause disease (Oehme, 1979). The consumption of foodstuffs with high mineral contents can cause gastric irritation and diarrhoea (Goyer, 1986; Blunden and Wallace, 2003) and might affect other organ systems. The target for toxicity are specific biochemical processes (enzymes) and/or membranes of cells and organelles. In addition, some useful metals such as calcium and magnesium are competitive with respect to their absorption sites and calcium may partially inhibit the absorption of magnesium (Goyer, 1986). The contribution of milk and milk products to the diet in western countries is significant for sodium, potassium, chloride, calcium, phosphorus, zinc and iodine (Flynn, 1992).

The mineral content of milk of animals raised under hot and dry desert conditions, such as Saudi Arabia, is poorly documented in the literature. In this study the mineral contents of milk obtained from cattle camels, goats and sheep raised at the central region of Saudi Arabia is reported.

MATERIALS AND METHODS

This study was carried out in Qasim Region, Central Saudi Arabia from September 2006 to August 2007. Fifteen milk samples were collected from each species of cattle, camels, goats and sheep that were during their second month of lactation. All animals were stall-fed on dried Lucerne and commercially formulated rations. Milk was collected fresh and transferred to the laboratory in cold containers for analysis.

Milk samples were prepared according to the method described by Vidovic *et al*. (2005) with minor modifications. Ten milliliters of milk were used. Five milliliters of concentrated nitric acid were added and the suspension was evaporated to dryness. The dish was then transferred to muffle furnace and heated to white ash at 450°C for 12 h. After mineralization, 5 mL of 10% HCl were added. The mixture was heated and the solution was filtered to 25 mL in a volumetric flask and made up to volume using deionized water. Analysis of trace elements in the samples were carried out by atomic absorption spectrophotometer (Shimatdzu Model AA 6200, Japan). Sodium and potassium concentrations were determined by flame photometry (Digital Flame Analyser Model 2655-00, Cole-Palmer. Instrument Company, Chicago, IL, USA).

Statistical Analysis

Statistical analysis were carried out by SigmaStat for Windows version 2.0 (Jandel Scientific, USA). Data were expressed as Mean±SEM. Statistical analysis was performed using one way analysis of variance followed by Tukey post hoc test. The criterion for statistical significance was $p<0.05$.

RESULTS AND DISCUSSION

Sheep milk had the highest content of the most minerals investigated. Camels had the lowest concentration of zinc in their milk ($p<0.05$). There were no significant differences ($p>0.05$) in the concentrations of manganese and iron between cattle, camels, sheep and goats (Table 1). Cattle and camels have significantly higher concentration of copper in milk compared to goats and sheep. The lowest concentration of iron in milk was recorded for goats. There were significant differences in the concentration of calcium in milk ($p<0.05$) between the four species. Camels have the highest concentration ($p<0.05$) of sodium and potassium compared to other species.

The availability of minerals in milk is essential to its nutritional quality to the developing newborn. Phosphorus and calcium are the major constituents of milk and required by the growing neonate for bone growth and development. The concentration of iron in milk is, naturally, low and it is bound to lactoferrin, transferrin xanthine oxidase and is essential in some other caseins. It is essential for transport of oxygen by hemoglobin. Zinc, manganese and copper are core components in many tissue enzymes needed by the body (Underwood, 1981).

There are many factors that determine the concentration of minerals in milk. Coni *et al*. (1999) reported that concentration ranges of certain health-related elements in milk were closely dependent upon animal species and feeding, time of year of sample collection, environmental conditions and manufacturing processes. Of importance is the quantity of the minerals in the feed. Calcium and zinc were specially affected by the diet. Dell'Orto *et al*. (2000) showed that the concentration of calcium and zinc were significantly higher in milk of cows receiving diets high in both minerals. Toxic minerals in milk, such as cadmium, are as well affected by the polluted environment. These generated negative impact and accumulate in milk and other human foods (Vidovic *et al*., 2005).

Table 1: Mineral contents of milk (Mean±SD) in cattle, camels, goats and sheep (n = 15)

Mineral content (mg kg^{-1})	Cattle	Camels	Goats	Sheep
Zn	2.000±0.28^{a}	1.480±0.76^{a}	2.320±0.22^{b}	3.090±0.91^{c}
Mn	1.291±2.43^{a}	1.299±0.11^{a}	1.129±0.04^{a}	1.144±0.05^{a}
Cu	1.800±1.10^{a}	1.610±0.90^{a}	0.570±0.20^{b}	0.620±0.22^{b}
Fe	4.214±1.78^{a}	2.981±2.24^{a}	4.908±2.66^{a}	5.011±3.24^{a}
Ca	661.000±41.95^{ab}	699.300±96.65^{ab}	751.700±72.78^{b}	822.500±113.36^{bc}
Na	91.600±3.45^{a}	115.870±4.99^{b}	101.300±10.71^{c}	95.400±5.47^{c}
K	113.700±5.84^{a}	133.770±5.64^{b}	123.850±9.94^{c}	127.410±1.10^{bc}

$^{a-c}$Means that have no superscript in common are significantly different from each other ($p<0.05$)

Results obtained showed that most of the mineral contents of milk in the studied animals were comparable to those reported previously. However, The results of the present study came at variance the results obtained by Al-Awadi and Srikumar (2001), who studied the mineral content of Kuwaiti camels and reported that it contained 7 to 20 fold manganese and 4 to 10 fold iron than human and cows milk.

Cattle and camels have significantly higher concentration of copper in milk compared to goats and sheep. However, the concentration of calcium in milk of cattle and camels were significantly lower than those of sheep and goats. As expected, the current study showed that camels had the highest concentration of sodium and potassium.

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