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Concentrations of Sodium, Potassium, Copper, Zinc and Heavy Metals in Camel Milk Reared Under Pasture and Farm Conditions in South Egypt

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ABSTRACT

The present study aimed to determine concentration of sodium, potassium, copper, zinc, lead and cadmium in camel's milk. The camels was divided into two groups, the first group reared under the traditional farms and the second reared under pasture system. The elements were determined by using atomic absorption (AA) flame spectrometry techniques. The results indicated that the overall mean of sodium and potassium contents in camel milk was 1848.54±571.2 and 3749.90±328.9 mg/l, respectively. While, the overall mean of copper and zinc contents in camel milk was 0.065±0.02 and 0.20±0.06 mg/l, respectively. The overall mean of lead and cadmium contents in milk camel was 1.56±0.85 and 0.008 ± 0.001 mg/l, respectively. Sodium content in pasture camel milk was lower (1823.59±572.7 mg/l) than farm (1873.49±578.03 mg/l), but the content of potassium was higher (3868.49±162 .75 mg/l) in farm than pasture milk (3631.32±411.52 mg/l). Content of copper in pasture milk was higher (0.07±0.02 mg/l) than the farm milk (0.06 ± 0.02 mg/l). Similar trend was observed in zinc content in pasture milk was higher **(**0.21±0.07 mg/l) than the farm milk (0.19 ± 0.03 mg/l). Lead content was equal in pasture and the farm milk (1.54±1.1 and 1.58 ± 0.45 mg/l, respectively). Cadmium content in pasture milk was higher (0.016± 0.001 mg/l) than the farm milk (0.0005 ± 0.0001 mg/l). The present results of this study indicated that marked differences in concentration of K and Cd between pasture of milk and farm milk.

Keywords: Na, K, Cu, Zn, heavy metals, milk, camels

INTRODUCTION

Camel milk is used in hot and arid regions as an essential nutritional source, for high energy and vitamins contents (Gorakh *et al*., 2000 and Al-Awadi and Srikumar, 2001). Camel milk, use as medicinal, dietary properties and used as a fresh milk in some countries (Faye *et al*., 2008 and Meldebekova *et al*., 2008). These properties are widely exploited for human health (Kenzhebulat *et al*. 2000). Camel milk is considered as anti-cancer (Magjeed, 2005) and anti-diabetic properties (Agrawal *et al*., 2003 and Agrawal *et al*., 2005). Camel milk content of vitamin C lactoferrin, and immunoglobulin (El-Agamy *et al*., 1996 and Konuspayeva *et al*., 2007) can act as nutritional supplement in tuberculosis patients (Mal *et al*., 2000). EL-Fakharany *et al*. (2012) reported direct interaction between hepatitis C virus (HCV) and camel IgGs and camel lactoferrin (cLf), in addition to previous camels milk is well tolerated by lactase-deficient children who are allergic to cow milk (El- Agamy *et al*., 2009) and viral and bacterial infections (El- Agamy *et al*., 1992). In the light of the previous facts till now some recently investigations estimate the content of minerals in camel milk (Al-Wabel, 2008, Konuspayeva *et al*., 2009 and El-bagermi *et al*., 2014). Little investigations about the content of minerals in milk of camels reared in farms and pasture under conditions of south Egypt, therefore, the present study aimed to quantify of sodium, potassium, copper, zinc, lead and cadmium in camel's milk reared in farms and pasture under conditions of south Egypt.

MATERIALS AND METHODS

Location

This study was carried out in Aswan governorate south Egypt. The farm camels located in Kom Ombou city (32, 31' 23" East and 22, 28' 09" North) near by industrial district (sugar factory) and the pasture camels was located in Shalateen area near by Mines search of the gold (contamination resources). The experimental period was continued for three months from September to December, 2015.

Management and feeding system:

Females camels were divided into two comparable groups. The first group (n=60) was kept in traditional semi shading farm and fed on concentrate mixture (corn grain and wheat bran), wheat straw, fresh alfa-alfa and alfa-alfa hay. Whereas, the second group (n=60) was raised under pasture conditions. All females camels fed ad-libitum and reared under traditional conditions.

Determination of elements:

According to AOAC (2000) as a chemical method, milk samples (n=120) were analyzed quantitatively for determination sodium (Na), potassium (K), copper (Cu), zinc (Zn), lead (Pb) and cadmium (Cd) using atomic absorption (AA) flame spectrometry techniques. Spectrometer: (ICE 3000C113500040 v1.30, England) was used at wave length 589.0 nm for (Na), 766.5 nm (K), 324.8nm (Cu), 213.9 (Zn), 217.0 (Pb) and 228.8 (Cd). Measurement mode: Absorbance, Band pass: of Na, K, Cu, Pb and Cd was (0.5nm), but for Zn was (0.2). Fuel Flow: 1.1 L/min for Na, K, Cu and Pb while Cd and Zn was 1.2 L/min. Analysis of copper, zinc, lead and cadmium metals in animal's diet (mg/kg) and drinking water (mg/l) are shown in Table (1).

Procedures of analysis:

The milk samples (5 ml) were analyzed in Unit of Environmental Studies and Development, Aswan University, according to the procedures descript by AOAC (2000) for protein digestion and extraction. 1.0 ml of the milk sample was measured into a clean 250 ml dry Pyrex digestion flask. 3.0 ml of 65% nitric acid was added, followed by the addition of 3.0 ml of 30% hydrogen peroxide. The digestion flask was heated gently until frothing subsided. The sample was then

heated to dryness, dissolved in 30 ml deionized distilled water and filtered with Whatman filter paper 102, 12.5cm. The solution was made up to volume in a 50 ml flask and stored in a special container ready for analysis.

Table 1. Concentrations (X ± SE) of copper, zinc, lead and cadmium elements in the experimental animal diet (mg/kg) and drinking water (mg/l)

Minerals	NRC* requirement	Pasture	Farms
	Mineral in animal diet		
Copper	7-11	3.6± 0.3	4.5± 0.6
Zinc	32.0	65.4±1.4	73.7±2.1
Lead	0.2	0.5±0.1	0.3±0.03
Cadmium	0.5	0.8±0.02	0.6±0.04
	Mineral in drinking water		
Copper	0.5	0.5±0.1	0.3±0.1
Zinc	25.0	0.7±0.1	0.5±0.1
Lead	0.015	0.15±0.02	0.08±0.04
Cadmium	0.005	0.009±0.001	0.007±0.002

***Source: NRC, 2001**
Number of samples for each group was 4.

Statistical analysis:

The model included one fixed factor, system of feeding. The significance among the means was checked using T. test (SAS, 2002). The used model was:

$Y_{ij} = \mu + F_i + e_{ij}$

Where:

Y_{ij} = the observations trait

μ = overall mean

F_i=effect of rearing conditions(the farm =1, the pasture = 2)

e_{ij}= experimental error assumed to be randomly distributed $(0, \partial^2)$

RESULTS AND DISCUSSION

Concentrations of sodium and potassium in pasture and farm camel milks:

The overall mean of sodium and potassium in camel milk of pasture and farms was 1848.54 ± 571.2 and 3749.90 ± 328.9 mg/l, respectively (Table 1). These results were higher than that reported by Soliman (2005); Amin *et al*. (2008) and Shamsia (2009) who found that concentrations of sodium and potassium in camel milk were ranged (570- 748 mg/kg) and (972-1790 mg/kg) respectively. Higher concentrations of sodium and potassium in camel milk that observed in the present study may be due to nutrition. The results indicated that concentration of sodium in milk farm was higher (1873.49 ± 578.03 mg/l) than pasture camels (1823.59 ± 572.7 mg/l), but the difference was not significant (P <0.05)**,** while the content of potassium in farm milk was significantly (P <0.05) higher (3868.49 ± 162.75 mg/l) than pasture milk (3631.32 ± 411.52 mg/l). The significant difference of potassium in pasture and farm milk may be due to the difference of nutrition and grazing may be lead to lost a lot of minerals during sweating. The present results agree with that reported by Alwan *et al*. (2014), who found that concentration of sodium and potassium in Farm-reared and Desert-reared Libyan Maghrebi Camels' Milk was 43.14±9.77, 148.1±8.8 and 69.26±1.1, 154.57±5.5 mg/kg, respectively. However, the obtained concentration of sodium and potassium in camel milk was higher (1848.54 ± 571.2 and 3749.90 ± 328.9 mg/l) than that reported by Nnadozie *et al*. (2014) who found concentration of sodium and potassium in camel milk was 110.0±2.5 and 1133.77±5.64 mg/kg in Nigeria. Also, lower concentration were reported by Al-Wabel (2008), who found that the concentration of sodium and potassium in camel milk was 115.87±4.99 and 133.77±5.64 mg/kg in the central region of Saudi Arabia. Finally, lower concentration of potassium in camel milk (571.0± 0.81 mg/l) was reported by El-Bagermi *et al*. (2014).

Table 1. Mean ± SE of sodium and potassium (mg/l) in camel milk under pasture and farm conditions

Element	Pasture camels	Farm camels	Overall mean
Na (mg/l)	1823.59 ± 572.7	1873.49 ± 578.03	1848.54 ± 571.2
K (mg/l)	3631.32 ± 411.52[b]	3868.49 ± 162.75[a]	3749.90 ± 328.9

[a, b]: values within the same row having different superscripts are different at P <0.05.

Concentrations of copper and zinc in pasture and farms camel milks:

The overall mean of copper and zinc concentration in pasture and farm milk was 0.065 ± 0.02 and 0.20 ± 0.06 mg/l, respectively (Table 2). These results were lower than that reported by Soliman (2005); Amin *et al*. (2008) and Shamsia (2009) who found that concentrations of copper and zinc concentration in camel milk were ranged (0.6 - 1.9 mg/kg) and (1.9 - 9.2 mg/kg) respectively. Lower content of copper and zinc concentration in camel milk that showed in the present study may be due to low content in the forage and deficiency of eatable. These results indicated that no significant difference of copper concentration in farm (0.06 ± 0.02 mg/l) and pasture (0.07 ± 0.02 mg/l) milk. Similar trend was observed of zinc concentration in booth milk (Table 2). The present result is closed to that reported by Meldebekova *et al*. (2008) and El-Bagermi *et al*. (2014), who found that the concentration of copper in camel milk was 0.065±0.04 and 0.08 ± 0.05 mg/l, respectively. Similar trend was reported by Alwan *et al*. (2014), who found that concentration of copper and zinc in Farm-reared and Desert-reared Libyan Maghrebi Camels' Milk was 0.58±0.052, 0.24±0.27 and 0.42 ±0.02, 0.14±0.02 mg/kg, respectively. However, the obtained result was lower than that reported by Nnadozie et al. (2014) and Saini et al. (2007), who found the concentration of copper and zinc in camel milk was 0.161, 0.156 and 0.416 mg/kg, respectively, while the concentration of zinc was higher 0.20± 0.06 than that reported by Saini et al. (2007) who found that concentration of zinc in camel milk was 0.071±0.07 ppm.

Table 2. Mean ± SE of copper and zinc (mg/l) in camel milk under pasture and farm conditions

Element	Pasture camels	Farms camels	Overall mean
Cu (mg/l)	0.07 ± 0.02	0.06 ± 0.02	0.065 ± 0.02
Zn (mg/l)	0.21 ± 0.07	0.19 ± 0.03	0.20 ± 0.06

Concentrations of lead and cadmium in pasture and farm camel milks:

The overall mean of lead and cadmium concentration in pasture and farm milks was 1.56 ± 0.85 and 0.008 ± 0.001 mg/l, respectively (Table 3). The obtained results were agree with that reported by Amin *et al*. (2008) who found that concentration of lead and cadmium camel milk was 0.016 and 1.35 mg/kg respectively. These results indicated that no difference in content of lead in pasture and farms milks (Table 3), but the concentration of cadmium was higher (0.016 ± 0.001 mg/l) in pasture milk than in farms milk (0.0005 ± 0.0001 mg/l) (Table 3). The significant difference of cadmium in pasture and farm milk may be due to the concentration of element in the forges. Concentration of lead in camel milk was higher (1.56 ± 0.85 mg/l) than that reported by (Saini *et al*., 2007; Meldebekova *et al*., 2008 and El-Bagermi *et al*., 2014), who found content that of lead in camel milk ranged between 0.022 and 0.025 mg/l. The overall concentration of lead in camel milk was higher than that allowed (1.0 ppm) in Egyptian food according to E.E.A.A (1994). Concentration of cadmium in camel milk was lower (0.008 ± 0.001 mg/l) than that reported by Nnadozie *et al*. (2014) and El-Bagermi *et al*. (2014) (0.09 and 0.105 ppm). While concentration of cadmium in camel milk was lower than that allowed 0.5 ppm in Egyptian food according to E.E.A.A (1994). The World Health Organization (WHO, 1992) has established a provisional tolerable weekly intake (PTWI) of cadmium was 0.007 mg/kg body weight of human. Provisional tolerable weekly intake (PTW) value correspond to a daily tolerable intake level was 0.07 mg/kg of cadmium for the average 70-kg man and 0.060 mg/kg of cadmium per day for the average 60-kg woman. However, provisional tolerable weekly intake (PTWI) of lead was 0.025 mg/kg body weight of human (WHO, 2004).

Table 3: Mean ± SE of lead and cadmium (mg/l) in camel milk under pasture and farm conditions

Element	Pasture camels	Farms camels	Overall mean
Pb (mg/l)	1.54 ± 1.1	1.58 ± 0.45	1.56 ± 0.85
Cd (mg/l)	0.016 ± 0.001[a]	0.0005 ± 0.0001[b]	0.008 ± 0.001

[a, b]: values within the same row having different superscripts are different at P <0.05.

CONCLUSION

The present results of this study indicated that marked differences in content of K (macro-element) and Cd (micro-element) between pasture of milk and farm milk.

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تركيزات الصوديوم ،البوتاسيوم، النحاس ، الزنك والمعادن الثقيلة في حليب الجمال التي تربى تحت ظروف الرعي و المزارع فى جنوب مصر

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تهدف هذه الدراسة الى تقدير تركيزات الصوديوم ، البوتاسيوم ، النحاس ، الزنك ، الرصاص والكادميوم في حليب الجمال . قسمت الجمال إلى مجموعتين الأولى مراباة تحت ظروف المزارع التقليدية والثانية تحت ظروف الرعي. تم استخدام جهاز الامتصاص الذرى في تقدير المعادن. أظهرت أهم النتائج أن المتوسط العام لمحتوى الحليب من الصوديوم والبوتاسيوم كان كالتالي: ٨٤٨.٥٤ ± ٥٧١.٢ و ٣٧٤٩.٩ ±٣٢٨.٩ ملليجرام / لتر على التوالي. بينما كان المتوسط العام لمحتوى الحليب من النحاس والزنك ٠.٠٦٥ ± ٠.٠٢ و ٠.٠٢ ± ٠.٠٦ ملليجرام / لتر على التوالي. كان المتوسط العام لمحتوى الحليب من الرصاص والكادميوم كان ١.٥٦ ± ٠.٨٥ و ٠.٠٠٨ ± ٠.٠٠١ مليجرام / لتر على التوالي. كان محتوى الصوديوم في حليب جمال الرعي اقل (١٨٢٣.٥٩ ± ٥٧٢.٧ ملليجرام /لتر) منه فى جمال المزارع (١٨٧٣.٤٩ ± ٥٧٨.٠٣ ملليجرام /لتر).كان محتوى البوتاسيوم أعلى في حليب جمال المزارع (٣٨٦٨.٤٩ ± ١٦٢.٧٥ ملليجرام /لتر) منه فى جمال الرعى (٣٦٣١.٣٢ ± ٤١١.٥٢ ملليجرام /لتر). كان محتوى النحاس فى حليب جمال الرعي أعلى (٠.٠٧ ± ٠.٠٢ ملليجرام /لتر) منه فى جمال المزارع (٠.٠٦ ± ٠.٠٢ ملليجرام /لتر). كان محتوى الزنك في حليب جمال الرعي أعلى (٠.٢١ ± ٠.٠٧ ملليجرام /لتر) منه فى جمال المزارع (٠.١٩ ± ٠.٠٣ ملليجرام /لتر). كان محتوى الرصاص فى الحليب في جمال المزارع أعلى (١.٥٨ ±٠.٠٤٥ ملليجرام /لتر) منه فى جمال الرعي (١.٥٤± ١.١ ملليجرام /لتر).كان محتوى الكادميوم فى الحليب أعلى في حليب جمال الرعي (٠.٠١٦ ± ٠.٠٠١ ملليجرام /لتر) منه في جمال المزارع (٠.٠٠٠٥ ± ٠.٠٠٠١ ملليجرام /لتر). أظهرت الدراسة أن هناك اختلافات واضحة بين محتوى البوتاسيوم والكادميوم بين البان جمال الرعي وجمال المزارع.