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 were 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 0.06±0.02 and 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-Fakhary et al. (2012) reported direct interaction between hepatitis C virus (HCV) and camel IgGs and camel lactoferrin (cLf), in addition to previous camels infection (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 alfalfa-alfalfa and alfalfa-alfalfa 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)

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

*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
\[ \mu \] = overall mean
\[ F_i \] = effect of rearing conditions (the farm =1, the pasture = 2)
\[ e_{ij} \] = experimental error assumed to be randomly distributed (0, \( \sigma^2 \))

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 (3686.49 ± 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 Alwan et al. (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

<table>
<thead>
<tr>
<th>Element</th>
<th>Pasture camels</th>
<th>Farm camels</th>
<th>Overall mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na</td>
<td>1823.59 ± 572.7</td>
<td>1873.49 ± 578.03</td>
<td>1848.54 ± 571.2</td>
</tr>
<tr>
<td>K</td>
<td>3631.32 ± 411.52</td>
<td>3868.49 ± 162.75</td>
<td>3749.90 ± 328.9</td>
</tr>
</tbody>
</table>

*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 concentrations of copper and zinc 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 both 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 0.07±0.07 ppm.
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 $1.56 \pm 0.85$ and $0.008 \pm 0.001$ 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 farm milks (Table 3), but the concentration of cadmium was higher ($0.016 \pm 0.001$ mg/l) in pasture milk than in farm milk ($0.0005 \pm 0.0001$ 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 ($1.56 \pm 0.85$ 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 ($0.008 \pm 0.001$ 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 (PTWI) 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 2. Mean $\pm$ SE of copper and zinc (mg/l ) in camel milk under pasture and farm conditions

<table>
<thead>
<tr>
<th>Element</th>
<th>Pasture camels</th>
<th>Farms camels</th>
<th>Overall mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cu (mg/l)</td>
<td>$0.07 \pm 0.02$</td>
<td>$0.06 \pm 0.02$</td>
<td>$0.065 \pm 0.02$</td>
</tr>
<tr>
<td>Zn (mg/l)</td>
<td>$0.21 \pm 0.07$</td>
<td>$0.19 \pm 0.03$</td>
<td>$0.20 \pm 0.06$</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Element</th>
<th>Pasture camels</th>
<th>Farms camels</th>
<th>Overall mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pb (mg/l)</td>
<td>$1.54 \pm 1.1$</td>
<td>$1.58 \pm 0.45$</td>
<td>$1.56 \pm 0.85$</td>
</tr>
<tr>
<td>Cd (mg/l)</td>
<td>$0.016 \pm 0.001$</td>
<td>$0.0005 \pm 0.0001$</td>
<td>$0.008 \pm 0.001$</td>
</tr>
</tbody>
</table>

* **:** values within the same row having different superscripts are different at $P <0.05$.

### REFERENCES


### 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.


**تركزيات الصوديوم بالبوتاسيوم النحاس, الزئبق والمعدن الثقيلة في حليب الجمال التي تروي تحت ظروف الرعي**

**المزارع في جنوب مصر**

**أحمد إسماعيل مرزالي**

قسم الإنتاج الحيواني والدواجن.
كلية الزراعة والموارد الطبيعية.
جامعة أسيوط - مصر

**تهدف هذه الدراسة إلى تقييم تركزيات الصوديوم والبوتاسيوم والنيكل والتي تروي تحت ظروف الرعي في حليب الجمال الم consect من المزارع إلى جنوب مصر. تم استخدام نماذج من الجمال إلى مجموعتين دورتين تحت ظروف الرعي. تم استخراج السائل من نظامين من الحليب العبدلي. أظهرت النتائج أن تركزيات الصوديوم والبوتاسيوم في حليب الحليب من المزارع المختبر كانت أعلى من تركزيات النحاس على التوالي. بينما كان التركيز أدنى في الحليب العبدلي من المزارع المختبر. في الحليب العبدلي من المزارع المختبر كان تركزيات الصوديوم والبوتاسيوم كانت أعلى من تركزيات النحاس على التوالي. كان تركزيات الصوديوم في حليب الحليب العبدلي من المزارع المختبر 0.12 ± 0.03 ملليجرام/لتر، في حليب الحليب العبدلي من المزارع المختبر 0.09 ± 0.02 ملليجرام/لتر. كان تركزيات النحاس في حليب الحليب العبدلي من المزارع المختبر 0.32 ± 0.05 ملليجرام/لتر، في حليب الحليب العبدلي من المزارع المختبر 0.06 ± 0.01 ملليجرام/لتر. كان تركزيات الزئبق في حليب الحليب العبدلي من المزارع المختبر 0.09 ± 0.05 ملليجرام/لتر، في حليب الحليب العبدلي من المزارع المختبر 0.07 ± 0.03 ملليجرام/لتر.**