Comparative Study of Concentration of Some Minerals in Milk and Blood Plasma of Sheep and Goats Native and Foreign During Post-Partum Period under Climatic Conditions of Upper Egypt

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ABSTRACT

The present study aimed to determine concentrations of sodium, potassium, copper and zinc in milk and blood plasma of Awassi, Baladi ewes and Boer, Baladi goats during the winter and summer seasons. Used in this experiment number of 180 ewes and goats. The blood and milk samples were taken after one month post partum. The samples were stored at -18 °C till time of analysis. The minerals were determined by Atomic Absorption Spectrophotometer used to estimate copper and zinc and Flame Emission Photometry was used for estimation of sodium and potassium. The overall concentrations of (sodium, potassium, copper and zinc) in milk of Awassi and Baladi ewes were (533.8 ± 13.3, 493.9 ± 13.0, 1475.0 ± 20.4, 1372.6 ± 26.3, 0.740 ± 0.15, 0.442 ± 0.20, 6.8 ± 0.7 and 5.4 ± 0.6 mg/l), while in blood plasma were (2321.5 ± 10.8, 2034.3 ± 8.8, 186.2 ± 1.1, 142.5 ± 2.3, 0.87 ± 0.01, 0.51 ± 0.02, 1.72 ± 0.01 and 0.56 ± 0.02 mg/l) respectively. Meanwhile, concentrations of sodium, potassium, copper and zinc in milk of Boer and Baladi goats were (541.0 ± 15.6, 455.6 ± 14.3, 1660.3 ± 19.5, 1511.5 ± 13.9, 0.718 ± 0.25, 0.426 ± 0.30, 3.2 ± 0.3 and 2.7 ± 0.3 mg/l), while in blood plasma were (3263.7 ± 11.3, 1885.8 ± 11.3, 203.05 ± 1.7, 161.6 ± 1.6, 0.89 ± 0.01, 0.55 ± 0.01, 1.1 ± 0.01 and 0.51 ± 0.01 mg/l) respectively. The present results display that concentrations of sodium, potassium, copper and zinc in milk and blood plasma were higher in Awassi ewes and Boer goats compared with Baladi ewes and goats. Concentrations of studied elements in milk and blood plasma during the summer season recorded lower levels than winter season in ewes and goats. Thus, the study recommended supplementation of mixture of salts to diet of animals during the summer season in order to conservation of the minerals concentration in the normal levels in milk or blood. In addition, the assay of the studied minerals (sodium, potassium, copper and zinc) in milk compared with blood plasma is more easy and also accurate in ewes and goats.

Keywords: Minerals, milk, blood plasma, ewes, goats, winter, summer season

INTRODUCTION

Awassi sheep and Boer goat's considered as meat breeds were entered to Upper Egypt recently in order to improve the local breed by the crossing between them. Awassi sheep is a local breed distribute in South-West Asia (Iraq, Jordan, Syria, Lebanon and Palestine) Talafha and Ababneh (2011). Boer goats evolved in Southern Africa from indigenous African goats Casey and Van Nierkerk (1988), this breeds are breeding as a meat breeds in addition to acclimation, adaptation, and low parasite infestation Erasmus (2000). Minerals are required for all biological process of animal body functions. Its apart of enzymes structure in addition to regulate many chemical reactions (Ahmed et al., 2000 and Krajnicakova et al., 2003). Milk composition of ewes and goats depends on the feed, breed, lactation stage, individual animal, status of udder health and other environmental factors Park et al. (2007) and Sanz Ceballos et al. (2009). Several studies assess the minerals in ewes milk (Gerchev and Mihaylova, 2012; Catarino et al., 2014; El3bagermi et al., 2013; Ojoawo and Akinsoyinu, 2014 and Hernandz and Park, 2014). Recently some researchers determined the minerals in plasma of ewes and goats (Hassabo et al., 2015; Ebrahim et al., 2016 and Samadieh et al., 2017). There is limited information about concentration of minerals in milk and blood in ewes and goats that rearing under Upper Egypt conditions. In the light of the previous fact, the present study planned to investigate the concentration of minerals in milk and plasma of (Awassi, Baladi ewes and Boer, Baladi goats) reared under climatic conditions of Upper Egypt.

MATERIALS AND METHODS

Location and Climate

This study was carried out in Aswan governorate; it's far 890 km south from Cairo. The experimental period was extended from (May to August) as summer months and from (November to February) as winter months. The Ambient temperature (°C) during the summer season was (Max (35.9 – 44.3), Min (20.8 – 26.2)) while (Max (22.9 - 35.0), Min (8.8 - 19.1)) during the winter season. Relative humidity (%) during the summer and winter season was (16 – 26) and (18-40) respectively. The climatic data was collected from The Meteorological Authority, Aswan.

Animals and feeding

The total number of experimental animals 180 (45 Awassi and 45 Baladi ewes) and (45 Boer and 45 Baladi goats). Age and parity of animals ranged between 2 to 3 year and 2nd to 4th , respectively. Live body weights of the experimental animals were showed in table (1). The animals raised in a semi shaded open yards, and were fed on concentrate feed mixture (corn and wheat bran), Alfa-Alpha, and Barseem hay, the animals were fed adlibitum. Functions and symptoms of deficiency of (Sodium, Potassium, Copper and Zinc) on sheep and goats were showed in table (2).

Table 1. Means of live body weight of the experimental animals.

<table>
<thead>
<tr>
<th>Breeds</th>
<th>Range</th>
<th>Mean ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ewes</td>
<td>40 - 60</td>
<td>48.5 ± 5.97</td>
</tr>
<tr>
<td>Baladi</td>
<td>30 - 42</td>
<td>36.73 ± 3.85</td>
</tr>
<tr>
<td>Goats</td>
<td>35 - 43</td>
<td>39.46 ± 2.58</td>
</tr>
<tr>
<td>Baladi</td>
<td>22 - 35</td>
<td>29.06 ± 3.46</td>
</tr>
</tbody>
</table>
Blood, milk and diet samples collection and determination of minerals

Blood samples (10 ml) were collected from the jugular vein from all ewes and goats into heparinized tubes. Plasma collected upon centrifugation at 3000 rpm for 10 min, and stored at -18°C until analyzed. Milk samples (50 ml) were collected from all experimental animals (n=180) and stored till the analysis; all the blood and milk samples were taken at the morning, after one month post-partum. The diets of animals were analyzed Table (3). The minerals were determined by Atomic Absorption Spectrophotometer (AAS) (ICE 3000C113500040 v1.30, England) used to estimate copper and zinc and Flame Emission Photometry was used for estimation of sodium and potassium. Minerals were analyzed according to (AOAC, 2000).

Table 3. Analysis of sodium, potassium, copper and zinc elements in green and dry forages throughout the experimental period.

<table>
<thead>
<tr>
<th>Element</th>
<th>Alfa-Alfa</th>
<th>Barseem hay</th>
<th>Concentrate feed mixture</th>
<th>Critical level in Blood (ppm)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium meq/kg DM</td>
<td>130.5-152.3</td>
<td>261-304.5</td>
<td>226.2-243.6</td>
<td>-</td>
</tr>
<tr>
<td>Potassium meq/kg DM</td>
<td>409.6-435.2</td>
<td>281.6-332.8</td>
<td>163.8-171.5</td>
<td>-</td>
</tr>
<tr>
<td>Copper ( mg/kg)</td>
<td>15.3-21.2</td>
<td>8.7-16.4</td>
<td>11.1-16.3</td>
<td>0.6</td>
</tr>
<tr>
<td>Zinc ( mg/kg)</td>
<td>10.6-16.5</td>
<td>7.2-14.2</td>
<td>14.5-18.7</td>
<td>0.6</td>
</tr>
</tbody>
</table>


Statistical analysis:

Data were analyzed to the effect of season of the year on concentrations of minerals in milk and blood plasma of (Awassi and Baladi ewes, Boer and Baladi goats) using the general linear model procedure (SAS, 2002). Significance among the means was checked using T. test and Chi Squire was performed. The used model was:

\[ Y_{ij} = \mu + B_i + e_{ij} \]

Where:
- \( Y_{ij} \): The measured trait
- \( \mu \): Overall mean
- \( B_i \): Effect of season (summer =1, winter = 2)
- \( e_{ij} \): Experimental error assumed to be randomly distributed (0, \( \sigma^2 \)).

RESULTS AND DISCUSSION

I-Minerals concentrations in milk of ewes and goats

Sodium concentrations in milk of ewes

Sodium concentrations in milk of ewes are presented in Table (4). The mean of sodium concentrations in milk were higher of Awassi than Baladi ewes (\( P <0.05 \)). The obtained averages were agree with that reported by Moreno-Rojas et al. (2009), Goran et al. (2010) and Gerchev and Mihaylova (2012) they reported a concentrations of sodium in ewes milk ranged between (490 and 543 mg/l). While, concentrations of sodium in ewes milk were lower than those reported by (Sahan et al., 2005 and Catarino et al., 2013) found that sodium concentrations were ranged between 612.0 and 743.0 mg/l. This result may be due to different conditions around the study like (breed difference, nutrition, climate, season, lactation stag and heat tolerance). From table (4) concentrations of sodium in milk of ewes were higher (\( P <0.05 \)), during the winter than summer season. Similar trend was reported by Nantapo et al. (2013) who found concentration of sodium was higher in milk of ewes in the cold season than hot season.

Sodium concentrations in milk of goats

Concentrations of sodium in milk of goats are presented in Table (4). Concentrations of milk sodium were higher of Boer goats than Baladi goats (\( P <0.05 \)), Table (4). The results were close to that reported by Kedzierska -Matysek et al. (2013) and Hernandez and Park (2014) who found milk sodium in goats ranged between (464.0 and 545.2 mg/l). Meanwhile it was higher than that reported by Park et al. (2007) and Moreno-Rojas et al. (2009) (410 - 440.0 mg/kg) in goats milk. On the other hand, the present result was lower than that reported by Guzeler et al. (2010) and Ojoawo and Akinsoyinu (2014) (670.5 and 882.0 mg/l). The different between concentrations of sodium in milk of goats may be due to experimental conditions, Sanz Ceballos et al. (2009) reported that milk composition of goats depends on the feed, breed, lactation stage, individual animal, status of udder health and other environmental factors. There is a significant difference (\( P <0.05 \)) in concentrations of sodium in milk of goats during two seasons summer and winter Table (4). Nantapo et al. (2013) found that no difference in concentration of sodium in milk of goats during the seasons of the year.

Table 4. Mean ± SE (mg/l) of sodium in milk of ewes and goats during summer and winter season.

<table>
<thead>
<tr>
<th>Breed</th>
<th>Summer</th>
<th>Winter</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ewes</td>
<td>493.5 ± 15.3*</td>
<td>574.0 ± 11.3*</td>
<td>533.8 ± 13.3*</td>
</tr>
<tr>
<td>Awassi</td>
<td>455.6 ± 12.4*</td>
<td>532.2 ± 13.6*</td>
<td>493.9 ± 13.0*</td>
</tr>
<tr>
<td>Baladi</td>
<td>422.5 ± 12.1*</td>
<td>488.7 ± 16.4*</td>
<td>493.9 ± 13.0*</td>
</tr>
<tr>
<td>Goats</td>
<td>597.7 ± 12.9*</td>
<td>533.8 ± 13.3*</td>
<td></td>
</tr>
</tbody>
</table>

* values within the same row having different superscripts are significantly different at (\( P <0.05 \)).

Potassium concentrations in milk of ewes

Concentrations of potassium in milk of ewes are presented in Table (5). Concentrations of potassium in...
milk of Awassi ewes were higher (1475.0 ± 20.4 mg/l) compared with Baladi ewes (1372.6± 26.3 mg/l) (P <0.05). The result was agrees with that reported by Raynal-Ljutovac et al. (2008) who found that concentrations of potassium in milk of ewes were ranged between (1360 and 1400 mg/l). Lower concentrations of potassium in milk of ewes reported by Sahani et al. (2005), Catarino et al. (2013) and El-bagermi et al. (2014) (593.9 and 1199.0 mg/l). On contrary, higher concentrations of potassium in milk of ewes were reported by Moreno-Rojas et al. (2009), Goran et al. (2010) and Zamberlin et al (2012) (1570 to 2137.7 mg/l). The different in concentrations of potassium in milk of ewes compared to the previous works may be due to the different of breed, content of food from minerals and content of soil from minerals. Park et al. (2007) found that milk composition of ewes affected by the feed, lactation stage, breed, status of udder health, individual animal, and other environmental factors. Concentrations of potassium in milk of ewes during winter season were higher (1530± 18.4, 1390.7± 28.4 mg/l) than summer season (1420 ± 22.4, 1354.5 ± 24.2 mg/l) (P <0.05). There is a significant difference (P <0.05) in concentrations of potassium in milk of ewes during two season summer and winter table (5). Similar result reported by Nantapo et al. (2013) in the cold and hot seasons.

Potassium concentrations in milk of goats

Potassium concentrations in milk of goats are presented in Table (5). The present means of potassium concentrations in milk of Boer goats were higher (1660.3 ± 19.5 mg/l) compared with Baladi goats (1511.5 ± 13.9 mg/l) (P <0.05).The present mean of potassium concentrations in milk agrees with that reported by Moreno-Rojas et al. (2009), Guzelser et al. (2010) and Ojoawo and Akinsuyinu (2014) (1460.0 - 1630.0 mg/l). Higher concentrations of potassium in milk of goats were reported by Kedzierska-Matysek et al. (2013) and Hernandez and Park (2014) (1717.0 and 1968.0 mg/l) in goat milk. Lower concentrations of potassium concentrations in milk of goats compared with some authors may be due to different breed or the offered feed and the grazing. Sanz Ceballos et al. (2009) Milk composition of goats depends on the feed, breed, lactation stage, individual animal, status of udder health and other environmental factor. There is a significant difference (P <0.05) between winter and summer season of potassium concentrations in milk of Boer and Baladi goats Table (5). Guler (2007) reported that the difference in concentrations of milk mineral within winter and spring season is due to effect of dilution.

Table 5. Mean ± SE (mg/l) of potassium in milk of ewes and goats during summer and winter season.

<table>
<thead>
<tr>
<th>Breed</th>
<th>Summer</th>
<th>Winter</th>
<th>Overall mean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ewes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awassi</td>
<td>1420 ± 22.4 &amp; 1530± 18.4 &amp; 1475.0 ± 20.4 mg/l</td>
<td>1354.5 ± 24.2 &amp; 1390.7± 28.4 &amp; 1372.6± 26.3 mg/l</td>
<td></td>
</tr>
<tr>
<td>Baladi</td>
<td>1560.6 ± 17.9 &amp; 1760 ± 21.2 &amp; 1660.3 ± 19.5 mg/l</td>
<td>1432.3 ± 11.8 &amp; 1590.6 ± 13.9 &amp; 1511.5 ± 13.9 mg/l</td>
<td></td>
</tr>
<tr>
<td><strong>Goats</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boer</td>
<td>1560.6 ± 22.4 &amp; 1760 ± 21.2 &amp; 1660.3 ± 19.5 mg/l</td>
<td>1432.3 ± 11.8 &amp; 1590.6 ± 13.9 &amp; 1511.5 ± 13.9 mg/l</td>
<td></td>
</tr>
<tr>
<td>Baladi</td>
<td>1560.6 ± 22.4 &amp; 1760 ± 21.2 &amp; 1660.3 ± 19.5 mg/l</td>
<td>1432.3 ± 11.8 &amp; 1590.6 ± 13.9 &amp; 1511.5 ± 13.9 mg/l</td>
<td></td>
</tr>
</tbody>
</table>

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

Copper concentrations in milk of ewes

Copper concentrations in milk of ewes were shown in Table (6). Concentrations of copper in milk of Awassi ewes were higher (0.740 ± 0.15mg/l) compared with Baladi ewes (0.442 ± 0.20 mg/l) (P <0.05). The present means of copper concentrations are closed to that reported by Raynal-Ljutovac et al. (2008), Etonihu and Alicho (2010) and Zamberlin et al. (2012) (0.40- 0.89 mg/l) in milk of ewes. Higher concentrations of copper were reported by Gerchev and Mihaaylova (2012) (1.2 and 1.8 mg/l) in milk of ewes. On contrast, lower concentrations of copper were reported by Abdalla et al. (2013) and El- bagermi et al. (2014) (0.09 -0.2 mg/l) in milk of ewes. Copper concentrations in milk of ewes are significantly (P <0.05) higher in winter (0.760 ±0.1 mg/l) than in summer season (0.720 ± 0.2 mg/l), respectively (Table, 6). Nantapo et al. (2013) reported higher concentration of copper in milk during cold months (0.20 mg/l) than hot months (0.17 mg/l). Park et al. (2007) and Sanz Ceballos et al. (2009) reported that milk composition of ewes and goats depends on the breed, feeding, lactation stage, individual variations, status of udder health and environmental factors.

Copper concentrations in milk of goats

Copper concentrations in milk of goats are shown in Table (6). Concentrations of copper in milk of Boer goats were higher (0.718 ± 0.25 mg/l) compared with Baladi goats (0.426± 0.30mg/l) (P <0.05). The present means are closed to that reported by Kondyli et al. (2007), Abed Al-Helaly et al. (2013) and El-bagermi et al. (2014) (0.37- 0.8 mg/l) in milk of goats. On the contrary, lower concentrations of copper were reported by Zamberlin et al. (2012) and Abdalla et al. (2013) (0.1mg/l) in goats of milk. Higher concentrations of copper in goats milk were reported by Hernandez and Park (2014) (9.8 -10.5 mg/l). Concentrations of copper during winter season were significantly (P <0.05) higher (0.74± 0.2, 0.43± 0.3 mg/l) than summer (0.70± 0.3, 0.42± 0.3 mg/l) season in two breed Boer and Baladi goats respectively. Concentration of copper in milk of goat during winter season was higher (P <0.05) than summer season Table (6). Similar results were reported by Khan et al. (2003) and Kedzierska-Matysek et al. (2013). Michlova et al. (2016) found that the variation in concentrations of goat's milk minerals might be due to feed and pasture quality, throughout the different grazing seasons.

Table 6. Mean ± SE (mg/l) of copper in milk of ewes and goats during summer and winter season.

<table>
<thead>
<tr>
<th>Breed</th>
<th>Season</th>
<th>Overall mean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ewes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awassi</td>
<td>0.720 ± 0.2 &amp; 0.760 ±0.1 &amp; 0.740 ± 0.15 mg/l</td>
<td></td>
</tr>
<tr>
<td>Baladi</td>
<td>0.434 ± 0.2 &amp; 0.450± 0.2 &amp; 0.442± 0.20 mg/l</td>
<td></td>
</tr>
<tr>
<td><strong>Goats</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boer</td>
<td>0.702± 0.3 &amp; 0.734± 0.2 &amp; 0.718± 0.25 mg/l</td>
<td></td>
</tr>
<tr>
<td>Baladi</td>
<td>0.422± 0.3 &amp; 0.430± 0.3 &amp; 0.426± 0.30 mg/l</td>
<td></td>
</tr>
</tbody>
</table>

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

Zinc concentrations in milk of ewes

Concentrations of zinc in milk of ewes are presented in Table (7). Concentrations of zinc in milk were higher (6.8 ± 0.7 mg/l) of Awassi ewes compared with Baladi ewes (5.4 ± 0.6 mg/l) (P <0.05). The present means were closed to that reported by Gerchev and Mihaaylova.
Breed Awassi and Baladi ewes. This result agrees with Bhatt et al. (2015) status of ewes during the experiment. Macro-element mineral concentrations in blood plasma of goats, but the means were lower compared with that reported by Hernando and Park (2014) (11.7 ± 1.7 mg/l) in summer season compared to winter season in sheep. This result may be due to increased loss more quantity of sodium by sweating throughout the summer season.

Zinc concentrations in milk of goats

Concentrations of zinc in milk of goats are presented in Table (7). Concentrations of zinc in milk were higher (3.2 ± 0.3 mg/l) of Boer goats compared with Baladi goats (2.7 ± 0.3 mg/l) (P <0.05). The present means are closed to that reported by Kondyli et al. (2007) and Zamberlin et al. (2012) (2.4 – 3.7 mg/l) in milk goats, but the means were lower compared with that reported by Hernandez and Park (2014) (11.7 - 17.5 mg/l). Opposite trend, reported by Abed Al-Helaly et al. (2013) and Abdalla et al. (2013) found low concentrations of zinc in milk ewes (0.99-1.24 mg/l). Concentrations of zinc were higher (P <0.05) in winter season (3.3 ± 0.5, 2.9 ± 0.3 mg/l) than summer season (3.1 ± 0.2, 2.4 ± 0.4 mg/l) in two breed Boer and Baladi goats. Similar trend was reported by Bartowska et al. (2013) who found that seasonal variations of mineral in goat's milk might be due to the fluctuations in goats feeding during the different grazing season.

Table 7. Mean ± SE (mg/l) of zinc in milk of ewes and goats during summer and winter season.

<table>
<thead>
<tr>
<th>Breed</th>
<th>Summer</th>
<th>Winter</th>
<th>Overall mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ewes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awassi</td>
<td>6.4 ± 0.6*</td>
<td>7.2 ± 0.8*</td>
<td>6.8 ± 0.7*</td>
</tr>
<tr>
<td>Baladi</td>
<td>5.1 ± 0.5*</td>
<td>5.7 ± 0.7*</td>
<td>5.4 ± 0.6*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goats</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boer</td>
<td>3.1 ± 0.2*</td>
<td>3.3 ± 0.5*</td>
<td>3.2 ± 0.3*</td>
</tr>
<tr>
<td>Baladi</td>
<td>2.4 ± 0.4*</td>
<td>2.9 ± 0.3*</td>
<td>2.7 ± 0.3*</td>
</tr>
</tbody>
</table>

* values within the same row having different superscripts are significantly different at (P <0.05).

2-Minerals concentrations in blood plasma of ewes and goats

Sodium concentrations in blood plasma of ewes

Concentrations of sodium in blood plasma of ewes were presented in Figure (1). Concentrations of sodium in blood plasma of Awassi ewes were significantly higher (2321.5 ± 10.8 mg/l) compared with Baladi ewes (2034.3 ± 8.8 mg/l) (P <0.05). The obtained means were agree with that reported by Sowande et al. (2008) (2326.9 mg/l), but the mean was higher than that reported by El-Bagermi et al. (2014) (5.4 - 7.1 mg/l). Lower concentrations reported by Abdalla et al. (2013) and Abed Al-Helaly et al. (2013) (0.24 - 0.79 mg/l) respectively. On contrast, higher concentrate reported by Goran et al. (2010) (9.5 mg/l). In the present study the lower concentrations of zinc in milk of ewes compared some authors may be due to dietary levels of zinc in two experiments (Underwood, 1981). Zinc concentrations were higher (P <0.05) in winter season (7.2 ± 0.8, 6.4 ± 0.6 mg/l) than summer season (5.7 ± 0.7, 5.1 ± 0.5 mg/l) in two breed Awassi and Baladi ewes. This results agree with that reported by Khan et al. (2003), who found that concentrations of zinc in milk in the cold season was higher (1.29 mg/l) than hot season (0.56 mg/l) in sheep.

Potassium concentrations in blood plasma of ewes

Potassium concentrations in blood plasma of ewes are presented in Figure (3). Figure (3) indicate higher concentrations of potassium in blood plasma of Awassi ewes compared with Baladi ewes (P <0.05). This means agree with that reported by Sowande et al. (2008) (208.3 mg/l) in sheep. The means were higher than that reported by El-Bagermi et al. (2014) (40.05 mg/l).
this different result might be due to differences of breed or content of minerals in feed. Potassium concentrations in blood plasma was higher (P <0.05) in winter season than summer season, similar finding, reported by Khan et al. (2003) and Sowande et al.(2008) found that potassium concentrations in blood plasma during winter season were higher than summer season the in sheep.

Potassium concentrations in blood plasma of goats
Potassium concentrations in blood plasma of goats are presented in Figure (4). Concentrations of potassium of Boer goats was higher compared with Baladi goats (P <0.05) Figure (4). The means of potassium of two breed were agreement with that reported by Al-Sobaiyl (2010) and Altuğ et al. (2013) (138.9 -206.7 mg/l) in sheep. On contrary, higher concentrations were reported by Hafid et al. (2013) 250.8 mg/l in ewes. Potassium concentrations in blood plasma of goats were higher (P <0.05) during the winter than summer season. The result was agreement with that reported by Khan et al. (2003) who found potassium concentrations in blood plasma was higher during the winter season than summer.

Copper concentrations in blood plasma of ewes
Copper concentrations in blood plasma of ewes were shown in Figure (5). Concentrations of copper in blood plasma of Awassi ewes were higher compared with Baladi ewes (P <0.05) Figure (5). The obtained means were agree with that reported by Hajer et al. (2014) and Nawito et al. (2015) (0.44 – 0.84 mg/l) in ewes, but the means was lower than that reported by Ebrahim et al. (2016) and Samadieh et al. (2017) (1.01 – 1.09 mg/l) in sheep. Copper concentrations were higher (P <0.05) in winter season compared with summer season in the two breeds. Similar trend reported by Dar et al. (2014) and Bafti (2016) in sheep. Khan et al. (2003) reported that in ewes copper concentrations in blood plasma was higher during the winter season than summer.

Zinc concentrations in blood plasma of ewes
Zinc concentrations in blood plasma of ewes were shown in Figure (7). Concentrations of zinc in blood plasma of Awassi ewes were higher compared with Baladi ewes (P <0.05) Figure (7). The means were closed to that reported by Ebrahim et al. (2016) and Samadieh et al. (2017) 0.58 and 1.79 mg/l respectively. Higher concentration of zinc in sheep milk was reported by Nawito et al. (2015) 4.3mg/l. The different result might be
due to differences of breed or content of minerals in feed or grazing. Zinc concentrations were higher (P <0.05) in winter season compared with summer season in two breeds of ewes. Similar trend, reported by Khan et al. (2008) and Dar et al. (2014) found that plasma copper concentration was higher during winter than summer season in ewes. Khan et al. (2003) observed that in ewes zinc concentrations in blood plasma was higher during the winter season than summer season.

![Figure 7. Concentrations (mg/l) of zinc in blood plasma of Awassi and Baladi ewes during hot and cold season](image)

**Zinc concentrations in blood plasma of goats**

Zinc concentrations in blood plasma of goats were shown in Figure (8). Concentrations of zinc in blood plasma of Boer goats were higher compared with Baladi goats (P <0.05) Figure (8). The present means are in agreement with that reported by Altug et al. (2013) and Hajer et al. (2014) found that concentration of zinc in serum and plasma was 0.57 and 1.2 mg/l respectively. On contrast, higher concentration of zinc was reported by Donia et al. (2014) and Navito et al. (2015) (4.01 - 5.9 mg/l) in ewes. In the present study the lower concentrations of zinc in blood plasma of goats compared some another authors may be due to dietary levels of zinc in two experiments (Underwood, 1981). Zinc concentrations were higher (P <0.05) in winter season compared with summer season in two breeds of goats. Similar trend, reported by Khan et al. (2008) who found seasonal variations in blood minerals in goats.

![Figure 8. Concentrations (mg/l) of zinc in blood plasma of Boer and Baladi goats during hot and cold season](image)

3-Correlation coefficient (r) of sodium, potassium, copper and zinc in blood and milk of Awassi, Baladi ewes and Boer, Baladi goats.

Correlation coefficients of sodium, potassium, copper and zinc in blood and milk of Awassi, Baladi ewes and Boer, Baladi goats are presented in Table (8). In Awassi ewes milk copper was significantly negatively correlated (- r = 0.567, P<0.05) with blood plasma copper. While, significantly and positively correlated (r = 0.788, 0.657 P<0.05) was showed among milk zinc and blood plasma zinc in Awassi and Baladi ewes respectively. Non-significant negative correlation was found for sodium and potassium in blood plasma and milk in Awassi and Baladi ewes Table (8). Positive correlation was observed in Boer and Baladi goats milk sodium, potassium and copper and blood plasma Table (8), but milk zinc was positively correlated with blood plasma in Boer and Baladi goats. Similar trend was reported by Ranjith and Pandey (2015) in Deccani sheep.

![Table 8. Correlation coefficient (r) of sodium, potassium, copper and zinc in blood and milk of Awassi, Baladi ewes and Boer, Baladi goats.](image)

## CONCLUSION

The present results display that concentrations of sodium, potassium, copper and zinc in blood plasma were higher in Awassi ewes and Boer goats compared with Baladi ewes and goats. Concentrations of studied elements in milk and blood plasma during the hot season recorded lower levels than cold season in ewes and goats. Thus the results recommended supplementation of mixture of salts to diet of animals during the hot season in order to conservation of the minerals concentration in the normal levels in milk or blood. In addition, the assay of the studied minerals (sodium, potassium, copper and zinc) in milk compared with blood plasma is more easy and also accurate in ewes and goats.

## REFERENCES


دراسات مقارنة تركز بعض المعادن في اللين وبلازما الدم في الأغذية واللحم الحيواني للإعارة أثناء فترة ما بعد
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تم إجراء هذه الدراسة لศنابة تركز كلاً من الصوديوم، البوتاسيوم، الحساس والزئبق في اللين وبلازما الدم في الأغذية واللحم الحيواني للإعارة أثناء فترة ما بعد الولادة البالغة. تم تحضير العينات بالمجيء في الرائحة على متن حصيرة في المصلحة، ثم تقييم المعادن باستخدام جهاز الانتشار الميكانيكي. الزئبق والبوتاسيوم والصوديوم في اللين واللحم الحيواني للإعارة. بالإضافة إلى ذلك، قدرت الدراسة المنخفضة مستوى المواد المتفحنة في اللين واللحم الحيواني للإعارة بفضل البداية في الشاذ من كلاً من النافع المتبع بالمعدة للإعارة، توصى الدراسة بإعداد مراقبة الأشخاص المعتادة في المحليات أثناء فترة إعداد الصوديوم، لتصنيف في اللين واللحم الحيواني للإعارة.


