

## Seasonal Variations of Some Trace Elements Concentrations of Baladi Goat Milk and their Relationship with Reproductive Characteristics Under Environmental Conditions of Aswan Governorate

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### ABSTRACT

This investigation aimed to determine the seasonal variations of zinc and copper concentrations in Egyptian Baladi goat milk, in relation to some reproductive characteristics under environmental conditions of Aswan governorate. Zinc and copper concentrations in Baladi goat's milk were determined using atomic absorption (AA) flame spectrometry techniques. The study was carried out on 32 pregnant Baladi goats that reared under the environmental conditions of Aswan governorate. According to season of kidding, goats were divided randomly into two comparable groups. Goats in the first group kidded in cool season and in the second one kidded in warm season. Results showed that higher concentrations ( $P < 0.05$ ) of zinc and copper were found in Baladi goat's milk during cool months and warm months ( $0.77 \pm 0.324$  and  $0.65 \pm 0.012$  vs.  $0.48 \pm 0.113$  and  $0.23 \pm 0.011$  mg/l) respectively. Kidding and twinning rates were insignificantly higher in Baladi goats kidded during the cool season (151.7 and 68.2%) than the warm season (144.4 and 61.5%). Rates of stillbirth, abortion and retained placenta were insignificantly higher in Baladi goats kidded during the warm season (15.4, 15.6 and 18.5%) compared with (11.4, 9.4 and 17.2%) in cool season, respectively. There is a positive correlation between copper concentrations in Baladi goats milk and both kidding and twinning rates. Similar trend, showed between zinc concentrations and kidding rate ( $r = 0.589$ ;  $0.577$  and  $0.614$ ), respectively. There was negative correlation between zinc and copper concentrations in Baladi goat's milk and stillbirth, abortion rates. Similar trend, showed with retained placenta rate. The study observed that the seasonal changes in concentrations of zinc and copper in Baladi goat's milk related strongly with reproductive process of goats. The reproductive phenomena of Baladi goats during the cool season was better than that during the warm season. Supplementation of zinc and copper to diets of Baladi goats during the warm season improve the reproductive characteristics.

**Keywords:** Baladi goats, season, zinc, copper, reproductive characteristics.

### INTRODUCTION

In Egypt, sheep and goats play an important role for providing economic benefits, particularly to the small framers under extensive system as in Upper Egypt. Under Upper Egypt conditions, intake of minerals depend mainly on the forages species, quantity and quality. Therefore, the imbalance in trace elements could be occurred. So, severe deficiency in trace elements can caused a serious nutritional disorder, great reduction in feed intake and conversion and reproductive complications. Combination of both shortage of feeding and severe heat stress (intensity and duration). Therefore, the animals unfurling distress, the ambient temperature reached about  $45^{\circ}\text{C}$  or more for several months of summer season. Egyptian Baladi goats is one of the animal breeds that reared in Upper Egypt. The goats depend on grazing of the crops residues for feeding. In the extensive system, the reproductive process of goats was affected by the mineral contents in the forages. Machado *et al.* (2005) and Meeske *et al.* (2006) reported that there was a fluctuations in mineral concentrations of clover during different seasons. Michlova *et al.* (2016) found that the different of the concentrations of minerals in small goat's milk related to the quality of feed and grazing, which is conjugated with variations in plants and climate. Zarazaga *et al.* (2004) reported that nutrition is an important factor affecting reproductive process in the farm animals. Many investigations interested with the role of trace elements in the reproduction process of goats (El-Nour *et al.*, 2010; Habeeb *et al.*, 2013; Kundu *et al.*, 2014). It is well established that trace elements affects all the reproductive efficiency in both males and females ruminants, particularly zinc, copper and

selenium. Zinc and copper influence on reproductive processes in cattle (Wilde, 2006). Abdel-Monem and El-Shahat (2011) found that supplementation of zinc to the diet of Baladi ewes improved the reproductive performance. Kundu *et al.* (2014) reported that supplementation of zinc to the basal diet of goats improved the reproductive parameters. Abd-El-Monem *et al.* (2015) reported that increasing the levels of copper in the diets tended to improve estrus response, pregnancy, lambing rates and litter size in Baladi sheep. The present investigation aimed to study the influence of seasonal variations in concentrations of trace elements (zinc and copper) in Baladi goat's milk reared under the environmental conditions of upper Egypt and their relationships with some reproductive characteristics.

### MATERIALS AND METHODS

#### Climate conditions and location :

The farm of goats there is in Kom Ombou, Aswan governorate. The weather of Aswan is dry. The seasons were divided into two seasons cool season and warm season. Ambient temperature throughout the experimental period was ranged between ( $20$  to  $45$ ) and ( $9$  to  $35^{\circ}\text{C}$ ) during warm and cool season respectively. While, the relative humidity was ranged between ( $16$  to  $26$ ) and ( $18$  to  $40\%$ ) during warm and cool season respectively

#### Experimental animals and management:

Total of 32 pregnant Baladi goats ranged between 18- 25 kg BW were used during two season and 29 goat dose kidded in the cool months and 27 goats were kidded during warm months. The age and parity of all animals ranged between 2 to 4 year and 3<sup>rd</sup>

to 5<sup>th</sup>, respectively. The goats reared in enclosed area. The goats were fed on some concentrate at night and grazing on residues of crops in the morning. The pasture content of residues of herbs and Alfa alfa and wheat .

**Reproductive characteristics:**

The reproductive characteristics were estimate as (kidding rate, stillbirth rate, abortion rate, retained placenta rate and twining rate) by Tadeg *et al.* (2015): Kidding rate = Number of kids born/total number of goats kidded. Stillbirth rate = Number of kids stillborn / total number of kids born. Abortion rate= Number of goats aborted /total number of goats pregnant. Retained placenta rate = Number of goats with retained placenta (≥ 12 hr) / number of goats kidded. Twining rate = Number of twins / total number of kids born.

**Assessment of zinc and copper:**

The baladi goat's milk samples were collected from 29 goats that kidded during cool season and 27 goats that kidded during warm season. The samples were taken in the morning, after fourteen days post-partum. Copper and zinc were analyzed by using atomic absorption (AA) flame according to (AOAC, 2000).

**Statistical analysis:**

**One-way analysis**

The statistical model included one factor ( season of the year). T. test using SAS (2002). When the comparison between percentage, Chi Squire was performed. Pearson correlation coefficients were used. The used model was: **Yij= μ + Bi + eij Where:** Yij = the observations trait, μ = overall mean Bi =effect of season (cool =1, warm = 2) and eij = experimental error

**RESULTS AND DISCUSSION**

**Zinc concentration in Baladi goat's milk:**

From table (1) the overall mean of zinc concentration of Baladi goat's milk was 1.25 ± 0.221 m/l . The present finding is ranged between ( 0.99 and 2.12 mg/l ) as found by Slacanac *et al.* (2011) and Abed Al-Helaly *et al.* (2013) of goat's milk. Lower concentration 0.56 mg/l of zinc in goat milk was reported by Jooyandeh *et al.* (2010). Meanwhile, the present value is lower than that reported by Kondyli *et al.* (2007), being 3.7 mg/l in goat milk. Concentration of zinc in Baladi goat's milk was higher during cool season (0.77 ± 0.324 mg/l) than in warm season (0.48 ± 0.113 mg/l, *P* ≤0.05) (Table, 1). The present result agreed with that reported by Khan *et al.* (2003) and Kędzierska-Matysek *et al.* (2013). Similar trend was reported by Bartowska *et al.* (2013), who reported that seasonal variations of mineral in goat's milk might be due to the changes in goats feeding during the different grazing season.

**Table 1. Zinc and copper concentrations (X ± SE, mg/l) in Baladi goat's milk throughout warm and cool season**

| Elements | Warm season               | Cool season               | Overall mean |
|----------|---------------------------|---------------------------|--------------|
| Zn       | 0.48 ± 0.113 <sup>a</sup> | 0.77 ± 0.324 <sup>b</sup> | 1.25 ± 0.221 |
| Cu       | 0.23 ± 0.011 <sup>a</sup> | 0.65 ± 0.021 <sup>b</sup> | 0.44 ± 0.011 |

<sup>a, b</sup>: values within the same row with different superscripts are significantly different at 5% level.

**Copper concentration in Baladi goat's milk:**

The overall mean of copper concentration in Baladi goat's milk was 0.44 ± 0.011 mg/l (Table, 1). Concentration of copper was similar to the result reported by El-Bagermi *et al.* (2014) and Michlova *et al.* (2016) being 0.40 and 0.53 mg/l in goat milk, respectively. Jooyandeh *et al.* (2010) reported lower concentration of copper in goat milk 0.05 mg/l. However, higher concentration of copper in goat milk was reported by Kondyli *et al.* (2007) being 0.8 mg/l. Concentration of copper in goat milk during the cool season was higher (*P* ≤0.05) than warm season (Table, 1). Similar finding were reported by Khan *et al.* (2003) and Kędzierska-Matysek *et al.* (2013). Michlova *et al.* (2016) reported that the variation in concentrations of goat's milk minerals might be due to feed and pasture quality, during the different grazing seasons.

**Reproductive characteristics of Baladi goats during the warm and cool seasons:**

Warm season showed higher values of each of stillbirth, abortion and retained placenta rates than those obtained in cool season. Meanwhile, kidding and twining rates showed the opposite trend, being higher in cool season than those during warm season (Table,2). However, all difference in these rates are insignificant (*P* ≤0.05).

From table (2) Kidding rate of Baladi goats was 148.1%. The value is agreed with that found by Abd-Allah *et al.* (2015), being 140% in Baladi goat that reared under environmental conditions in Egypt. The obtained result is higher than that finding by Aldomy *et al.* (2009) and Ince (2010), who found that the kidding rate of goats ranged between 81 and 114.5 %, respectively. While the rate was lower than that reported by Bouvery *et al.* (2003) who found that the kidding rate of goats ranged between (170- 260 %). Kidding rate of Baladi goats was higher during cool season (151.7%) than warm season (144.4%), however, the difference was insignificant (*P* ≤ 0.05) (Table, 2). Andries *et al.* (2011) reported that there was variation in Kidding rate during the season being 198% in spring season and 188% in fall season.

The percentage of stillbirth 13.4% is presented in Table (2). The present result is almost equal to that obtained by Tadeg *et al.* (2015), being 12.8% in goats of Ethiopia. Lower value (28.57%) was reported by Abd-Allah *et al.* (2015) of Baladi goats in Egypt. The present result is higher than that reported by Aldomy *et al.* (2009) and Mude *et al.* (2010), who found the stillbirth percentage was 8.5 and 10% respectively. Stillbirth percentage during warm season was higher (15.4%) than in cool season (11.4%), however, the difference was insignificant (*P* ≤ 0.05). The result is agreed with that reported by Ershaduzzaman *et al.* (2007) and Debele *et al.* (2011), who found that the stillbirth percentage was higher in hot season than cold one.

The average of abortion rate was 12.5% (Table, 2 ). Similar abortion rate reported by Aldomy *et al.* (2009) (13%) of goats. Higher abortion rate in goats was reported by Mude *et al.* (2010) and Zahraddeen *et al.* (2010) 20 and 26%, respectively. Abortion rate during the warm season was higher (15.6%) than that during

the cool season (9.4%), however, the difference was insignificant ( $P \leq 0.05$ ). Similar trend, reported by Mahmud *et al.* (2014), who reported that abortion rate was lower in cold season than in hot season in goats.

Rate of retained placenta was 17.9% table ( 2). The obtained result agrees with that reported by Mahmud *et al.* (2014),16.9%. Lower rate of retained placenta reported by Tadeg *et al.* (2015) and Alenyorege and Mensah (2015) 7.4 and 11%, respectively. But, the present rate of retained placenta was lower than that found by Zahraddeen *et al.* (2010) in goats 34.0%. Incidence of retained placenta during warm season was higher 18.5 than in cool season (17.2%), however, the difference was insignificant ( $P \leq 0.05$ ). Similar trend was reported by Mahmud *et al.* (2014).

Twining rate in Baladi goats was 65.1% table (2). Moeen-ud-Din *et al.* (2008) and Aldomy *et al.* (2009) reported lower rate in goats, 24.9 and 45.4%, respectively. Twining rate of Baladi goats in cool season was higher 68.2% than in warm season 61.5%, however the difference was insignificant ( $P \leq 0.05$ ). This result is in agreement with that reported by Webb and Mamabolo (2004), reported that twining rate in goats was lower in hot season than in cold season.

**Table 2. Percentages of some reproductive characteristics of Baladi goats throughout warm and cool seasons**

| Rates             | Warm season    | Cool season    | Overall        |
|-------------------|----------------|----------------|----------------|
| Kidding           | 144.4<br>39/27 | 151.7<br>44/29 | 148.1<br>83/56 |
| Stillbirth        | 15.4<br>6/39   | 11.4<br>5/44   | 13.4<br>11/83  |
| Abortion          | 15.6<br>5/32   | 9.4<br>3/32    | 12.5<br>8/64   |
| Retained placenta | 18.5<br>5/27   | 17.2<br>5/29   | 17.9<br>10/56  |
| Twining           | 61.5<br>24/39  | 68.2<br>30/44  | 65.1<br>54/83  |

**The correlation between zinc concentrations in Baladi goat's milk and reproductive characteristics:**

There is a positive correlation ( $P \leq 0.05$ ) between each of kidding and twinning rate and zinc concentrations was showed in Baladi goat's milk table ( 3 ). While, negative correlation was recorded between each of stillbirth and abortion and zinc concentrations in Baladi goat milk. Similar trend, was observed of retained placenta and concentration of zinc in baladi goat milk (Table, 3). The obtained correlation is in agreement with that reported by Kędzierska-Matysek *et al.* (2013), who found positive correlation between zinc in goat milk and reproductive process. Vázquez-Armijo *et al.* (2011) reported that zinc is directly affect on reproductive process of goats by expression of estrus, embryo implantation and reduction in spermatogenesis. Also, O'Donoghue and Boland (2002) found that lower zinc concentration was related to increase abnormal estrus and abortion rate in cows. Aliyu *et al.* (2015) reported positive correlation between zinc and amino acids in goat milk.

**Table 3. Correlation coefficients between zinc and copper concentration in Baladi goat's milk and reproductive characteristics.**

| Elements | Reproductive characteristics rates ( %) |            |          |                   |         |
|----------|---|------------|----------|-------------------|---------|
|          | Kidding                                 | Stillbirth | Abortion | Retained placenta | Twining |
| Zn       | 0.614*                                  | -0.884*    | -0.768*  | -0.595*           | 0.461   |
| Cu       | 0.589*                                  | -0.693*    | -0.707*  | -0.825*           | 0.577*  |

<sup>a, b</sup>: values within the same row with different superscripts are significantly different at 5% level.

**The correlation between copper concentration in Baladi goat's milk and reproductive characteristics**

There is a positive correlation ( $P \leq 0.05$ ) between each of kidding and twinning rate and copper concentration in Baladi goat's milk was observed table(3). However, the correlation between each stillbirth, abortion and retained placenta and copper concentration in baladi goat milk was negative table(3 ). The present result agreed with that found by Kędzierska-Matysek *et al.* (2013), who reported a positive correlation between copper in milk and reproductive process in goats. Blache *et al.* (2008) reported that nutritional status considered one of the important factors effect on reproductive process in goats. Sales *et al.* (2011) reported that copper play an important role in regulating progesterone production by luteal cells via involvement of superoxide dismutase in crossbred heifers. Positive correlation between copper and amino acids in goat's milk was reported by Aliyu *et al.* (2015).

**CONCLUSION**

The present investigation display that seasonal fluctuation of zinc and copper concentrations in Baladi goat's milk was related obviously with variations in the reproductive process of goats, like improve the reproductive phenomena of goats during the cool season than in warm season. Supplementation of zinc and copper to diets of Baladi goats during warm season are highly beneficial as proved by improving the reproductive characteristics under environmental condition of Aswan governorate.

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### التغيرات الموسمية لتركيزات بعض العناصر الصغرى في لبن الماعز البلدي وعلاقتها ببعض الخصائص التناسلية تحت الظروف البيئية لمحافظة أسوان

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الهدف من هذه الدراسة تقدير التغييرات الموسمية في تركيز كلا من الزنك والنحاس في لبن الماعز البلدي وعلاقة هذه التغييرات ببعض الخصائص التناسلية للماعز تحت الظروف البيئية لمحافظة أسوان. استخدم جهاز الامتصاص الذرى في تقدير الزنك والنحاس في لبن الماعز البلدي. أجريت هذه الدراسة على ٣٢ من الماعز البلدي. تم متابعة الحيوانات خلال الموسمين البارد والحر تبعاً لموسم الولادة، المجموعة الأولى هي ولدت خلال الموسم البارد، والثانية ولدت خلال الموسم الحار. كان محتوى عينات لبن الماعز البلدي من الزنك والنحاس أعلى معنوياً في الموسم البارد  $0.324 \pm 0.077$  و  $0.65 \pm 0.12$  مليجرام/لتر بالمقارنة بالموسم الحار  $0.48 \pm 0.113$  و  $0.23 \pm 0.11$  مليجرام/لتر على التوالي. كان معدل الولادات و التوائم أعلى خلال الموسم البارد  $151.7$ ،  $68.2\%$  منه في الموسم الحار  $144.4$ ،  $61.5\%$ . كان معدل نفوق المواليد، الإجهاض و احتباس المشيمة أعلى خلال الموسم الحار  $15.4$ ،  $15.6$  و  $18.5\%$  مقارنة بالموسم البارد  $11.4$ ،  $9.4$  و  $17.2\%$  على التوالي. تبين أن هناك ارتباط معنوي موجب بين تركيز النحاس في لبن الماعز البلدي ومعدل الولادات والتوائم وكذلك تركيز الزنك ومعدل الولادات ( $r= 0.589$ ،  $0.577$ ،  $0.614$ ) على التوالي. كان هناك ارتباط معنوي سالب بين تركيز الزنك والنحاس في لبن الماعز البلدي ومعدل نفوق المواليد، الإجهاض و احتباس المشيمة. أظهرت الدراسة ان التغييرات الموسمية في تركيزات الزنك والنحاس في لبن الماعز البلدي كانت مرتبطة بالأداء التناسلي للماعز. كان هناك تحسن في الأداء التناسلي للماعز البلدي خلال الموسم البارد عنه في الموسم الحار. توصى الدراسة بإضافة الزنك والنحاس إلى أغذية الماعز البلدي خلال الموسم الحار لتحسين الخصائص التناسلية.