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Effect of inorganic and organic selenium on performance of dairy Zaraibi goats and their suckling kids

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ABSTRACT

Thirty Zaraibi goats with average body weight of 42.45±1.25 kg and aged 3-5 years after kidding were divided into three similar groups (10 in each). All goats were fed the basal diet consisted of 50% concentrate (concentrate feed mixture + barley grains) and 50% *roughage* (fresh berseem + wheat straw). The goats in the first group (control) were fed the basal diet without supplement (G1). The other two groups were supplemented with 0.3 mg Se/kg DM intake as inorganic selenium (sodium selenite) in G2 or organic selenium (selenium yeast) in G3, respectively. Results showed that nutrients digestibility coefficients of DM, OM, CP, CF, EE and NFE as well as feeding values of TDN and DCP were significantly (P≤0.05) higher for G3 compared to G1 with insignificant differences with G2.No significant differences in average daily intake of DMI and CPI among different groups. Meanwhile, the average daily intake of TDN and DCP were greater (P≤0.05) for G3 compared to G1 with insignificant (P≤0.05) differences with G2.Group 3 showed significantly (P≤0.05) the highest yield of actual milk and 4% fat corrected milk (FCM) followed by G2, while G1 had the lowest yield. The contents of fat, solids not fat (SNF) and total solids (TS) were significantly (P≤0.05) higher in G3 compared to G1 with insignificant differences with G2. The highest yield of all milk constituents (fat, protein, lactose, SNF, TS and ash) were detected significantly (P≤0.05) in G3 followed by G2, while the lowest values were in G1. Group 1 recorded significantly (P≤0.05) the highest amounts of DM, TDN, CP and DCP per kg 4% FCM followed by G2, while the lowest values were in G3.Average daily feed cost was nearly similar for different groups, while feed cost per 1 kg 4% FCM was the highest in G1 followed by G2, but G3 had the lowest cost. Group 3 recorded significantly (P≤0.05) the highest output of daily 4% FCM yield, net revenue and economic efficiency followed by G2, however G1 had the lowest values. Number of weaned kids was higher and mortality rate was lower in G3 followed by G2, but G1 had the opposite trend (P≤0.05).Weaning weight (WW), total weight gain (TWG) and average daily gain (ADG) increased significantly (P≤0.05) in G3 compared to control G1, with insignificant differences with G2.Suckled milk as g per kid per day and the cost of suckled milk increased, while suckled milk as kg per kg weight gain decreased with selenium additives without significant differences. Output of ADG, net revenue and economic efficiency expressed as the percentage of net revenue compared to cost of suckled milk increased significantly (P≤0.05) with inorganic and organic selenium additives in G2 and G3 compared to control G1.

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Keywords: Zaraibi goats, inorganic and organic selenium, digestibility, intake, milk yield and composition, economic efficiency, kids growth.

INTRODUCTION

The biological functions of selenium in living organisms are mediated through various selenium proteins. Some selenoproteins have enzymatic functions (glutathione peroxidase, iodothyroninedeiodinase, etc.) and are very important for key biological functions (antioxidant activity, thyroid function, immunity, cancer prevention, mammary gland health, reproduction, etc.) (Mala *et al*., 2009).

Selenium status in small ruminants is influenced by the mother's supplementation status during *in vitro* fertilization, as selenium passes through the placenta to the fetus (Misurova *et al*., 2009). Adult animals depend on forage for selenium. Its bioavailability is influenced by many factors, including selenium status, amount of the element in the diet, form of the element (inorganic or organic), development of rumen fermentation, type of diet, hostility to other elements or food components, and others factors.

Major pathways of selenium loss from the organism include urine, feces, milk, and possibly exhaled air (Spears, 2003).

Selenium (Se), as a trace metal, has numerous biological functions in animals. As an antioxidant, Se plays essential roles in animal nutrition, immunity, reproduction, protection of DNA, proteins from oxidation, thyroid hormone synthesis and metabolism (Yatoo *et al*., 2013).I iodothyronine-5´-deiodinase is a seleno-enzyme required for the conversion of thyroid hormone into the active T3 hormone. Moreover, Se is an integral part of the enzyme glutathione peroxidase (GSH-Px) which is important for neutralizing free radicals or oxidants (Huang *et al*., 2012).In sheep, selenium deficiency is associated with a number of diseases that mainly include white muscle disease and suppression of the immune status (Rock *et al*., 2001). Therefore, proper supplementation of Se is of great importance to avoid the risks of immunosuppression, liver necrosis, cardiovascular disease and myopathy (Hartikainen, 2005).Thus, animal health and performance are negatively affected by selenium deficiency.

Selenium is usually added to ruminant feed in inorganic or organic form. Common inorganic forms of selenium include sodium selenite and selenate, while the organically bound forms are represented mainly by selenomethionine, which occurs naturally in plants or preparations based on salinized yeast, selenium proteins, or unicellular algae enriched with selenium, which contains also other selenium compounds, such as dimethyl selenonium propionate and Seallylselenocysteine (Travnicek *et al*., 2007).

Selenium (Se) is an essential mineral necessary to maintain normal physiological functions and provides an important food source for antioxidant defenses (Sordillo, 2013). It is obtained by animals as part of the basic components of the diet, and its transport across the placenta is an important factor for the physiological functions of the offspring (Moeini *et al*., 2011).

Selenium supplements can be provided using inorganic or organic sources. The complementary inorganic forms of Se are usually sodium selenite or selenite, while the organic forms are Se-rich ferments. Due to the different metabolism, it has been observed that the inorganic forms of Se have lower bioavailability than the organic forms (Weiss, 2005).In other words, it has been shown that organic selenium is more absorbed and used in ruminants than inorganic sources(Guyot *et al.*, 2007). In beef calves, switching from inorganic to organic selenium improved meat quality and muscle content, confirming the greater bioavailability of the organ compared to the inorganic form (Sgoifo Rossi *et al*., 2015). Decreased inorganic selenium uptake in ruminants can result from the reduction of dietary selenium (selenium and selenite) to insoluble forms such as elemental selenium or selenides in the rumen environment (Mehdi *et al*., 2013).

Ever since, selenium has significant antioxidant activity (Tinggi, 2008) and thus plays a vital role in the reproductive, endocrine and immune systems of animals. Currently, sodium selenite, an inorganic and selenium-rich, as an organic form of selenium, is a major supplement for animal diets. Selenium pivotally regulates various metabolic processes within the body and is an integral part of at least 25 selenoproteins (Zhou *et al*., 2013), some of which have a special enzymatic function (Nazıroğlu *et al*., 2012). In addition, selenium can act as a metabolic modifier (Dominguez-Vara*e t al*., 2009).

A large number of enzymes depend on selenium with selenocysteine at different active sites (Nazıroğlu *et al*., 2013). Selenium acts as a redox center that helps maintain membrane integrity (Özgül and Nazıroğlu, 2012), protects prostacyclin production (Néve, 1996) and reduces the potential for further oxidative damage to biomolecules such as lipids, lipoproteins, and DNA (Ozgül *et al*., 2012). Studies have suggested that selenium may enhance immunity, growth, reproductive performance and disease resistance (Ghazi *et al*., 2012). Selenium deficiency is in direct connection with increased susceptibility to various diseases that attack animals and reduce their productive and reproductive performance (Spears, 2011).

The most common inorganic selenite sources are Na-selenite and Na-selenate, which are usually supplied in mineral or injected mixtures. The organic sources of Se are seleno-amino acids [eg, selenomethionine (Se Met) and selenocysteine (SeCys)], which are found in Se yeast or in forages grown in selenium-rich soil. Providing organic Se to the dam is an effective way to meet Se requirements of newborn lambs because Se crosses the placental barrier into fetal tissues and enters breast secretions with greater transport efficiency over a broader supplementation range of organic Se versus inorganic Na-selenite (Stewart *et al*., 2012).

The aim of this study is to evaluate the effects of adding inorganic versus organic forms of selenium to dairy Zaraibi goats on feed intake, digestibility, milk production and composition, feed conversion ratio and economic efficiency, as well as the growth performance of their kids.

MATERIALS AND METHODS

Experimental procedures used in this study were conducted at SakhaAnimal Production Research

Station, belonging to Animal Production Research Institute (APRI). Agriculture Research Centre (ARC), Ministry of Agriculture, Egypt.

Experimental animals and rations

Thirty Zaraibi goats with average body weight of 42.45±1.25 kg and aged 3-5 years after kidding were divided into three similar groups (10 in each). All goats were fed the basal diet consisted of 50% concentrate (concentrate feed mixture + barley grains) and 50% roughage (fresh berseem + wheat straw) to cover their recommended requirements according to **NRC (2007)**as shown in Table (1). The goats in the first group (control) were fed the basal diet without supplement (G1). The. other two groups were supplemented with 0.3 mg Se/kg DM intake as inorganic selenium (sodium selenite) in G2 or organic selenium (selenium yeast) in G3, respectively. Ingredients and chemical composition of basal diet used in feeding goats are presented in Table (1).

Table 1: Ingredients and chemical composition of basal diet used in feeding goats.

Item	Basal diet
Ingredients (DM basis, %)	
Concentrate feed mixture	36.95
Barley grains	12.35
Fresh berseem	32.13
Wheat straw	15.57
Chemical composition (DM basis, %)	
DM	36.20
OM	89.94
CP	12.73
CF	19.74
EE	2.57
NFE	54.90
Ash	10.06

Digestibility trails:

Three digestibility trails were conducted during the feeding period using 3 lambs from each group to determine the nutrients digestibility and feeding values of the experimental rations. Each digestibility trial consisted of 15 days as preliminary period followed by 7 days as collection period. Acid insoluble ash was used as a natural marker (Van keulen and Young, 1997). Feces samples were taken from the rectum of each goat twice daily with 12 hrs interval during the collection period. Samples of feedstuffs were taken at the beginning, middle and end of the collection period. Chemical analysis of samples of feedstuffs and feces were carried out according to the methods of AOAC (2005). Nutrient digestibility was calculated from the equation stated by Schneider and Flat (1975) as follows:

$$\text{DM digestibility \%} = 100 - \left[100 \text{ x } \frac{\text{AIA\% in feed}}{\text{AIA\% in feces}}\right]$$

$$\text{Nutrient digestibility \%} = 100 - \left[100 \text{ x } \frac{\text{AIA\% in feed}}{\text{AIA\% in feces}}\right] \text{ x } \left[\frac{\text{Nutrient \% in feces}}{\text{Nutrient \% in feed}}\right]$$

Where, AIA is acid insoluble ash.

Total digestible nutrients (TDN) and digestible crude protein (DCP) were calculated according to the classic formula of McDonald *et al.* (1995).

Milk yield and composition

The milk production was recorded biweekly using the manual milking technique and the udder was stripped completely and corrected for 4% fat corrected milk (4% FCM) calculated according to the formula of Gaines (1928): 4% FCM = Actual milk yield (kg) x 0.4 +15 x fat yield (kg). Milk samples were analyzed for total solids, fat, protein, lactose and ash were determined as reported in AOAC (2005). Solid non-fat (SNF) was calculated according to the formula stated by (Harding, 1995).

Feed conversion

Feed conversionefficiency in terms of DM, TDN and DCP required for one kg 4% FCM yield were calculated for every goat.

Economic efficiency

Cost of feed, feed cost /kg 4% FCM and the price of 4% FCM were calculated for every goat according to the prices of year 2020. Additionally, economic efficiency expressed as the ratio of price of 4% FCM yield and feed cost were calculated. Prices of concentrate feed mixture = 5000 LE/ton, barley grains = 4200 LE/ton, fresh berseem = 600 LE/ton, wheat straw = 1500 LE/ton, sodium selenite = 200 LE/kg, selenium yeast = 150 LE/kg, goat's milk = 7 LE/kg and price of weight gain of kids = 80 LE/kg.

Suckling kids

Total of 54 born kids produced from three experimental groups (18 in each) suckled their dams until weaning at 90 days of age (normal weaning). Kids were weighed weekly from birth until weaning and total weight gain, average daily gain and mortality rate were calculated.

Statistical analysis:

Data were analyzed by least square means analysis of variance using General Linear Models (GLM) procedure of IBM SPSS Statistics (2020) for one-way ANOVA. The model used to analyze the different treatments studied for lambs was as follows:

$Yij = \mu + Ti + eij$

Where: Yij = Observation, μ = Overall mean; Ti = Effect of i treatments and eij= Experimental error. Duncan's Multiple Range test was used to detect differences between means of the experimental groups (Duncan, 1955).

RESULTS

Nutrients digestion and feeding values

Nutrients digestion and feeding values for different groups are presented in Table (2). Nutrients digestibility coefficients of DM, OM, CP, CF, EE and NFEas well as feeding values of TDN and DCP were significantly (P≤0.05) higher for G3 compared to G1. Whereas, nutrients digestibility and feeding values of G2 were insignificantly (P≤0.05) differ with G1 and G3. These results might be due to increase the availability of Se in the form of Sel-yeast.

Table 2: Nutrients digestion and feeding values for different groups.

Item	Experimental groups			SEM
	G1	G2	G3	
Nutrients digestion coefficients %				
DM	66.92^{b}	68.72^{ab}	70.95^{a}	0.71
OM	67.87^{b}	69.68^{ab}	71.36^{a}	0.65
CP	63.15^{b}	64.91^{ab}	67.02^{a}	0.67
CF	61.26^{b}	62.89^{ab}	65.08^{a}	0.66
EE	73.47^{b}	76.40^{ab}	77.90^{a}	0.78
NFE	69.38^{b}	70.93^{ab}	72.59^{a}	0.62
Feeding values %				
TDN	62.47^{b}	64.04^{ab}	65.74^{a}	0.60
DCP	7.99^{b}	8.22^{ab}	8.53^{a}	0.09

a, b: values in the same row with different superscripts differ significantly at P≤0.05.

Feed intake

Feed intake by goats in different groups is shown in Table (3). Data showed no significant differences in average daily intake of DMI and CPI for lambs fed SS and SY compared with control. Meanwhile, the average daily intake of TDN and

DCP were greater (P≤0.05) for lambs fed SY compared with those fed control with insignificant (P≤0.05) differences with those fed SS. The increases in the intake of TDN and DCP might be attributed to increase TDN and DCP values with selenium supplementation.

Table 3: Feed intakeby goats in different groups.

Item	Experimental groups			±SE
	G1	G2	G3	
As fed basis (g/head/day)				
Concentrate feed mixture	600	600	600	
Barley grains	200	200	200	
Fresh berseem	3000	3000	3000	
Wheat straw	300	300	300	
Total	4100	4100	4100	
As dry basis (g/head/day)				
DMI	1484.38	1484.38	1484.38	8.57
TDNI	927.56[b]	950.80[ab]	976.03[a]	13.03
CPI	188.96	188.96	188.96	1.09
DCPI	118.61[b]	122.12[ab]	126.68[a]	1.84

a, b: values in the same row with different superscripts differ significantly at P≤0.05.

Milk yield and composition

Milk yield, composition and constituent's yield of goats in different groups are shown in Table (4). Results of milk yield revealed significant differences (P≤0.05) among different groups, which G3 showed significantly (P≤0.05) the highest yield of actual milk and 4% fat corrected milk (FCM) followed by G2, while G1 had the lowest yield. Yield of actual milk and 4% FCM of G2 and G3 increased by 8.20, 18.03 and 10.17, 22.88% compared to G1, respectively. Concerning milk composition, the contents of fat, solids not fat (SNF) and total solids (TS) were significantly (P≤0.05) higher in G3 compared to G1 with insignificant differences with G2. The highest yield of all milk constituents (fat, protein, lactose, SNF, TS and ash) were detected significantly (P≤0.05) in G3 followed by G2, while the lowest vales are shown in G1. In the present study, lactation yields of milk, fat and TS were analyzed to emphasize the benefits of supplementation of goats with Se-yeast.

Table 4: Milk yield, composition constituent's yield of goats in different groups.

Item	Experimental groups			SEM
	G1	G2	G3	
Milk yield (kg/day)				
Actual milk	1.22[c]	1.32[b]	1.44[a]	0.03
3.5% FCM	1.18[c]	1.30[b]	1.45[a]	0.03
Milk composition %				
Fat	3.75[b]	3.88[ab]	4.03[a]	0.04
Protein	3.23	3.29	3.34	0.03
Lactose	4.15	4.21	4.27	0.03
SNF	8.18[b]	8.31[ab]	8.42[a]	0.05
TS	11.93[b]	12.19[ab]	12.45[a]	0.08
Ash	0.80	0.81	0.81	0.01
Milk constituents yield (g/day)				
Fat	45.85[c]	51.31[b]	57.99[a]	1.33
Protein	39.49[c]	43.51[b]	48.06[a]	0.94
Lactose	50.74[c]	55.67[b]	61.44[a]	1.17
SNF	100.01[c]	109.89[b]	121.16[a]	2.31
TS	145.85[c]	161.20[b]	179.15[a]	3.64
Ash	9.78[c]	10.71[b]	11.66[a]	0.20

a, b: values in the same row with different superscripts differ significantly at P≤0.05.

Feed conversion ratio

Feed conversion ratio of goats in different groups is shown in Table (5). Inorganic and organic selenium supplementation led significant (P≤0.05) improvement in feed conversion ratio compared to control group. Which G1 (control) recorded significantly (P≤0.05) the highest amounts of DM, TDN, CP and DCP per kg 4% FCM followed by G2, while the lowest values were done in G3. The improvements in feed conversion could be attributed the increase of 4% FCM yield with selenium supplementation.

Table 5: Feed conversion ratio and economic efficiency of goats in different groups.

Item	Experimental groups			±SE
	G1	G2	G3	
Feed conversion ratio				
DM (kg/kg 4% FCM)	1.26[a]	1.14[b]	1.02[c]	0.04
TDN (kg/kg 4% FCM)	0.79[a]	0.73[b]	0.67[c]	0.02
CP (g/kg 4% FCM)	160.14[a]	145.36[b]	130.32[c]	4.39
DCP (g/kg 4% FCM)	100.49[a]	93.91[b]	87.34[c]	1.97
Economic efficiency				
Feed cost (LE/day)	6.09	6.34	6.34	0.06
Feed cost (LE/kg 4% FCM)	5.16[a]	4.88[b]	4.37[c]	0.12
Output of 4% FCM (LE/day)	8.26[c]	9.10[b]	10.15[a]	0.28
Net revenue (LE/day)	2.17[c]	2.76[b]	3.81[a]	0.24
Economic efficiency[1]	1.36[c]	1.44[b]	1.60[a]	0.04
Economic efficiency[2]	35.63[c]	43.53[b]	60.09[a]	3.61

a, b: values in the same row with different superscripts differ significantly at P≤0.05.
[1] Economic efficiency = output of 4% FCM yield/ feed cost.
[2] Economic efficiency = net revenue x 100/ feed cost.

Economic efficiency

Economic efficiency of goats in different groups is shown in Table (5). Average daily feed cost was nearly similar for the different groups, while feed cost per 1 kg 4% FCM was the highest in G1 followed by G2, but G3 had the lowest cost. On the other side, G3 recorded significantly (P≤0.05) the highest output of daily 4% FCM yield, net revenue and economic efficiency followed by G2, however G1 had the lowest values. These results are confirmed with the increase of 4% FCM yield with selenium supplementation. Economic efficiency expressed as the ratio of output of 4% FCM yield to feed cost of G2 and G3 increased by 5.88 and 17.65% compared to G1, respectively. The corresponding values of economic efficiency expressed as the percentage of net revenue to feed cost were22.17 and 68.65%, respectively.

Growth performance of suckling kids

Growth performance of suckling kids in different groups is presented in Table (6). Number of weaned kids was significantly (P≤0.05) higher in G3 followed by G2, but was lower in G1. Mortality rate was the least with organic selenium (G3), followed by inorganic selenium (G2), but was the highest in control (G1) with significant differences (P≤0.05). Moreover, it was noticed that losses was concentrated among twin and triplet kids while no losses among single born kids. Mortality rate presented in this study did not exceed normal rate stated by many researchers.

Weaning weight, total and daily weight gain increased significantly (P≤0.05) higher in G3 compared to control G1, with insignificant differences with G2. The average daily gain of kids in G2 and G3 was increased by 4.17 and 8.03% compared to G1, respectively.

Suckled milk as g per kid per day and the cost of suckled milk increased, while suckled milk as kg per kg weight gain decreased with selenium additives without significant differences. Output of ADG, net revenue and economic efficiency expressed as the percentage of net revenue compared to cost of suckled milk increased significantly (P≤0.05) with inorganic and organic selenium additives in G2 and G3 compared to control G1. While economic efficiency expressed as the ratio between output of ADG and cost of suckled milk tended to increase with selenium additive without significant differences.

Table 6: Growth performance of suckling kidsin different groups.

Item	Experimental groups			±SE
	G1	G2	G3	
No. of born kids	18	18	18	0.10
No. of weaned kids	15^{c}	16^{b}	17^{a}	0.30
Mortality rate (%)	16.67^{a}	11.11^{b}	5.56^{c}	1.61
Birth weight (kg)	2.31	2.30	2.32	0.01
Weaning weight (kg)	10.54^{b}	10.87^{ab}	11.21^{a}	0.12
Total weight gain (kg)	8.23^{b}	8.57^{ab}	8.89^{a}	0.11
Average daily gain (g)	91.44^{b}	95.25^{ab}	98.78^{a}	1.19
Suckled milk (g/head/day)	813.55	825.22	847.28	6.88
Suckled milk (kg/kg ADG)	8.90	8.67	8.58	0.11
Cost of suckled milk (LE/day)	4.88	4.95	5.08	0.04
Output of ADG (LE/day)	7.32^{b}	7.62^{a}	7.90^{a}	0.10
Net revenue (LE/day)	2.43^{b}	2.67^{a}	2.82^{a}	0.09
Economic efficiency[1]	1.50	1.54	1.56	0.02
Economic efficiency[2]	49.95^{b}	53.98^{a}	55.53^{a}	1.95

a, b: values in the same row with different superscripts differ significantly at P≤0.05.
[1] **Economic efficiency = price of ADG/ cost of suckled milk.**
[2] **Economic efficiency = net revenue x 100/ cost of suckled milk.**

DISCUSSION

In the current study, the finding that the supplement SY was more efficient than SS in enhancing nutrients digestibility and nutritive value could be explained in the light of the view that absorption and bioavailability of selenium is considered one of the most important factors in its utilization because selenium must be absorbed before utilization (Mahima, 2012). At this point, several studies have been compared the bioavailability of dietary supplementation of inorganic vs. organic selenium. They have proved that organic selenium has 120-200 % more bioavailability than sodium selenite in sheep (Hall *et al*., 2011). In ruminants, the low absorption of inorganic selenium, comparing to organic one, could be attributed to the reductive rumen environment where the microorganisms convert selenium compound to insoluble form impairing its absorption in the intestine (Serra *et al*., 1994). So, the inorganic selenium becomes less available for absorption than organic selenium. Thus the beneficial effects of organic selenium predominate over the inorganic one in ruminants (Mehdi *et al*., 2013). To this point, when Se was supplemented at 0.4 ppm, Se yeast was more effective than sodium selenite to increase (P≤0.05) digestibility of DM, OM, CP, NDF and ADF in sheep (Alimohamady *et al*., 2013). In addition, dietary supplementation of SY at high levels (150 and 300 ppm) was also efficient to enhance digestibility of DM and CP in lactating dairy cows (Wang *et al*., 2009). In goats, although supplementation with either organic or inorganic Se had no significant effect on nutrients digestibility, however, the dry matter, organic matter and crude protein intake significantly increased with organic Se than inorganic one as reported by Zohreh *et al.* (2016). They concluded that organic Se seems to be a better choice, considering the nitrogen and energy available for metabolism. Ibrahim and Mohamed (2018) found that digestibility of OM, CP, CF, EE, NFE and the values of digestible crude protein (DCP) and total digestible nutrients (TDN) were increased (P≤0.05) for lambs fed SY compared with those fed SS or control.

These results agreed with those obtained by Ibrahim and Mohamed (2018) who did not find any significant differences in the intake of DM and CP, but found significant (P≤0.05) increase in the intake of TDN and DCP with selenium supplementation.

The improvement in milk yield may due to the positive and significant effect of Se-treatment on immunity, antioxidant capacity and productive performance as reported by Ghazi *et al*. (2012). Kholif and Kholif (2008) stated that supplementing buffalo ration with 10mg/h/d selenized yeast or

10mg/h/d organic Se improved rumen fermentation and nutrient digestibility and also improved milk production and composition. We have previously shown that organic selenium (Se-yeast) supplementation has considerable influence on the production traits of dairy goats, expressed as an average daily performance (Bagnicka *et al*., 2016). Briefly, in that study, daily milk, fat, protein, casein, lactose, total solids and non-fat solid yields increased significantly with organic Se supplementation (Reczyńska *et al*., 2019).In previous study on dairy cows, whose diets were supplemented by 6 g of Se-yeast per d per cow, milk yield was higher in the organic Se treatment group vs. the inorganic one (Bagnicka *et al*., 2017). Saba *et al*. (2019) indicated that milk yield was the highest with selenium yeast followed by sodium selenite and lastly the control for both breeds of Farafra and Saidi ewes, but the differences were significant only between selenium yeast and control (P≤0.05).

These results agreed with those obtained by Ibrahim and Mohamed (2018) who found that feed conversion (FC) of DM (FC-DM), DCP (FC-DCP) and TDN (FC-TDN) were improved (P≤0.05) for Ossimi lambs fed SS and SY vs. those fed control. Xun *et al*. (2012) reported that feed conversion efficiency by sheep was also increased compared with selenium yeast (P < 0.01).

In cattle, selenium deficiency can have economically significant impacts such as reduced fertility, placental retentions, and the incidence of mastitis and merits (Sordillo, 2013). According to Eulogio *et al*. (2012) the performance and economic feasibility of the use of selenium and vitamin E allowed to obtain a profit margin. Sushma *et al*. (2015) found that dietary Se supplementation did not show any effect on feed cost Nellore ram lambs. Kumar *et al*. (2008) reported that cost of feed per kg weight gain were less by about 11% and 17% in groups supplemented with Se at 0.15 and 0.30 ppm levels, respectively, as compared to control group.

Literature gave high mortality of born kidsdid not exceed 18% in Zaraibi goats as reported by Abdelhamid *et al.* (1999). In other comparative study by Abdelhamid *et al*. (1999), who found that the average total weight gain was 9.27 kg in Zaraibi kids.

In the same way, ADG was enhanced with supplemental selenium sources in goats (Yue *et al*., 2009). Kumar *et al*. (2009) concluded that supplemental organic selenium was more effective than inorganic in improving growth performance in male lambs. The results are in consistent with similar findings reported by Shi *et al*. (2011) working on growing male goats. They found that FBW was increased (P≤0.05) in different selenium sources-supplemented bucks compared with control, and the ADG was greater (P≤0.05) with feeding Nano-selenium and selenium yeast than sodium selenite.

CONCLUSION

From the results of the present study, it could be concluded that inorganic selenium (sodium selenite) and organic selenium (selenium yeast) supplementation for dairy Zaraibi goats at the level of 0.3 mg Se/kg DM intake has led to significant improvement indigestibility, feed intake, milk yield and composition, feed conversion and economic efficiency as well as growth performance of their suckling kids.

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