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PHYSIOLOGICAL INDICATORS AND LIVE WEIGHT GAIN OF CAMEL CALVES AS INFLUENCED BY SELENIUM SOURCE SUPPLEMENTATION

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SUMMARY

This study was carried out to investigate the impact of selenium source (i.e organic and inorganic) given at 8 mg/head/day on the antioxidant capacity of camel calves and their growth performance. Seventeen camels (nine male and eight female) at 18 months of age with 172.47±10.56 kg average body weight were randomly divided into three groups: group 1 (organic selenium, n=6), group 2 (inorganic selenium, n=6) plus vitamin E (15 IU/kg DM) and a control group (control, n=5). The three groups were housed in three semi-opened and shaded pens and fed the experimental diets for 115 days.

A significant increase (P<0.05) in blood plasma metabolites including glucose, total protein, albumin, and total lipids was observed. Also, the plasma concentration of triiodothyronine was higher (P<0.05) in both Selenium supplemented groups while the concentration of alkaline phosphatase was higher (P<0.05) only in the organic Selenium group. The values for alanine aminotransferase, aspartate aminotransferase, blood ureanitrogen, and creatinine were similar in the experimental groups and remained within the normal range. A significant improvement of antioxidantstatus was clearly reflected by the significant increase (P<0.05) in glutathioneperoxidase, catalase, total antioxidant capacity, and a decrease in malondialdehyde for supplemented groups vs control group. The concentrations of plasma selenium, calcium and potassium were higher (P<0.05) in treated groups. Sodium concentration was similar (P>0.05) in the experimental groups.

Average daily gain (g/d) was higher (P<0.05) in the Selenium supplemented groups with a clear difference between the organic selenium group compared with the others.

It has been concluded that the supplementation of selenium to growing camel diets by (8 mg/head/d) improved growth performance and reduced oxidative stress without any adverse effect on animals. In addition, organic source showed a better effect than the inorganic source.

Keywords: Camel calves, growth, selenium, blood metabolites, enzymes, hormones

INTRODUCTION

The Arabian camel (*Camelus dromedarius*) is most widely distributed in the hot arid areas of the Middle East and Africa. They are very important animals in many countries as they are used as meat, milk and draft animals. They survive in an arid environment where the supply of good quality forages is limited. Most camels are raised under a true nomadic husbandry system (Tibary and El Allali, 2020)

In Egypt the daily animal protein intake per capita is 18.9 g (El-Badawi, 2018) which is lower than the recommendations of FAO (1989) for the daily minimum level of animal protein per capita is 29.3 g . The contribution of camels in meat production in Egypt is 23500 tons/year which is about 8% of total meat production which was 275300 tons/year (CAPMS, 2018). Camel population in Egypt was one hundred forty thousand heads presented less than 1% of the total animal population (FAO, 2018). So that, the low contribution of camel meat production in Egypt is due to the shortage in their population. Therefore, increasing the participation of camels in meat production needs giving serious attention to dromedary camels fattening, and looking for promising solutions to solve the husbandry problems that face them such as high ambient temperature, solar radiation, water shortage, and poor vegetation

Generally, camels are economic meat producers. This is because of their ability to utilize fibre-rich diets and changing their feeding behavior according to season (Al Jassim 2019). In the same line, Farghaly (2009) obtained 557 g/head/d of ADG using 2-3 years old calves fed on 1% concentrated feed mixture plus molasses treated rice straw (low-cost feeding). Furthermore, the ADG was raised to 829 g/head/d when Yacout and El-Badawi (2001) used a concentrated feed mixture containing 10% crude protein under stall-feeding conditions. In addition, the camel can produce a large quantity of meat with consumption of fewer amounts of feeds (1.5–2.0 kg feed intake per 100 kg of body weight, and they can gain about 800–1000 g/day) (EL-Badawi, 2018). Moreover, camels are healthy meat producers with less fat carcass as well as having low levels of fat cholesterol (Abdel-Raheem *et al*., 2019) and high-quality protein with remarkable relative richness in some of the essential amino acids compared with the beef meat (Raiymbek *et al.*,2015). Concerning low feed cost, camels could provide economic and high-quality protein for humans.

Egyptian Maghrebi camel is a dual-purpose animal reared for meat and milk production. It is medium in size but relatively has a high growth rate. It could gain about 700-1000 g/d in body weight during the first year under intensive (Wardeh, 2004) and fattening conditions (Ashour *et al*., 2021).

Generally, the trace minerals requirement should be covered due to their importance in body biological functions . These trace elements are necessary for enzymes and hormones which affect living (Hennigar and McClung, 2015).

Considering selenium (Se) as an essential trace element in animal nutrition, it plays an important role in the prevention of fertility disorders, oxidative stress, and cell membrane damage. More than 30 seleno enzymes have been described in a hierarchy process. It plays a critical in metabolism due to its role in converting T4 (thyroxin inactive form) to T3 (active form) (Hefnawy and Tortora-Perez, 2010).

Many studies focused on the role of Se supplementation on the adult camels under different conditions, levels, sources and physiological status (Al-Qarawi *et al*., 2001, Seboussi *et al*., 2009, Faye *et al*., 2014 and Faye *et al*., 2011), respectively, but in growing camel, information is limited. Therefore, this study aimed at assess and evaluating mSe source on blood metabolites, thyroid hormones, antioxidant status, and blood minerals as physiological indicators of growth performance of Maghrabi camel calves raised in the north coastal zone of Egypt.

MATERIALS AND METHODS

This experiment was conducted in Camel Studies and Production Development Center in Matrouh governorate which is located in the hot dry area of the North-Western Coastal Zone of Egypt (Latitude: 31°21′00″ N, longitude: 27°13′59″ E and elevation of 41 meters above sea level. The laboratory work was carried out at biochemical analysis lab, Camel Research Department, Animal Production Research Institute, Agricultural Research Center, Giza, Egypt. This study lasted for 120 days from May to August.

Experimental animals and management:

Seventeen healthy and growing Maghrabi camels (9 males and 8 females) with average body weight (BW) of 172.47±10.56 kg, at 18 month old were used in the study. The calves were randomly divided into 3 groups (OSG: organic Se group n=6 and ISG: inorganic Se group n=6 and CG: control group n=5). All groups contain males and females. Sex does not affect ADG at this stage (Bakheit *et al*., 2017 and Ashour *et al*., 2021). The three groups were housed in three semi-opened and shaded pens. All calves were fed individually the same basal complete rations at 2% of body weight which was adjusted weekly. According to farm protocol,diets composed of alfalfa hay, concentrate feed mixture, and rice straw with (40% roughage: 60% concentrate) the chemical composition of feedstuffs are presented in Table (1). Rations were offered twice daily at 8.00 and 14.00 hours. The dietary ingredients consisted of alfalfa, rice straw, and the commercial concentrate feed mixture (25% yellow corn, 25% wheat bran, 20% barley, 15% rice bran, 9% cotton earn peeled, 3% molasses, 2% limestone and 1% salt). Water was allowed freely all day.

Table 1. Chemical composition of camel calves feedstuffs (% dry matter basis)

Item	Alfalfa	Concentrated mixture	Rice straw
Dry matter (DM)	89.96	89	89.25
Organic matter (OM)	90.00	87.64	86.33
Crude protein (CP)	13.76	13.48	4.92
Crude fibers (CF)	36.20	9.00	37.87
Ether extract (EE)	1.28	2.81	1.03
Nitrogen free extract (NFE)	38.76	62.36	42.51
Ash	10.00	12.35	13.67

Selenium supplementation:

Before the start of the experiment, blood, feeds and water samples were taken to assess Se's concentration to determine the dose to be used. The overall mean of whole blood Se was 18.43 ng/ml. the normal concentration reported by Fay and Bengoumi, (2018) was around 100 ng/ml. So that The maximal tolerable dose recommended by Faye and Seboussi, (2009) was 8 mg/head/d) was offered in the form of selenomethionine as organic source and sodium selinate as inorganic source to cover the requirements of animal The Se addition was provided by Premex Inc. Company, United States of America. The Se from the two sources were in powder form and given daily by putting the dose inside a date according to Faye *et al*., (2014).

Colorimetric methods were adopted for the determination of glucose (Glu), total protein (TP), albumin (Alb), total cholesterol (TC), triglyceride (TG), total lipids (TL), alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), blood urea nitrogen (BUN) and creatinine (Crt). Antioxidant biomarkers; glutathione peroxidase (GSH-Px), catalase (CAT), malondialdehyde (MDA), and total antioxidant capacity (TAC) were measured by kit manufactured locally kits of Bio Diagnostic Company (Dokki, Giza, Egypt). Globulin concentration (Glob) was calculated by the difference between TP and Alb.

Blood samples (about 10 ml) were collected monthly, from the Jugular vein into clean, dry test tubes containing heparin as an anti-coagulant. Plasma was separated by centrifugation at 3000 rpm for 20 minutes and then stored at -20º C for later analysis. The red blood cells were washed three times with an isotonic solution of NaCl (0.9%) and centrifuged for 4 minutes at 4,000×g. The supernatant was immediately collected for the determination of glutathione-peroxidase (GSH-Px). The preparation of samples was carried out according to the procedure supplied with a kit manufactured by Bio Diagnostic Company (Dokki, Giza, Egypt).

Plasma metabolic hormones, including triiodothyronine (T3) and thyroxine (T4), were quantified by radioimmunoassay (RIA) method using commercial kits supplied by Siemens Medical Solutions Diagnostics (Los Angeles, CA 90045-6900. USA).

The blood selenium concentration was measured using a gas chromatograph (GC) Agilent technologies 7890A interfaced with a polar Agilent HP-5ms (5%-phenyl methyl polysiloxane) capillary column (30m×0.25 mmi. d. and 0.25 µm film thickness). Sodium (Na), potassium (K), and calcium (Ca) were measured by using kits manufactured locally by Bio Diagnostic Company (Dokki, Giza, Egypt).

Total body gain (TBG, kg), and average daily gain (ADG, g/head/d) were determined. Changes in live BW were recorded individually using digital platform balance at biweekly intervals before morning feeding. TBG was calculated as the differences between the final body weight (FBW) and the initial body weight (IBW), then these values were divided by period in days to get the average daily weight (ADG) for each animal.

Ethics Statement:

The study was conducted after obtaining the needed permits and approvals from Institutional Animal Care and Use Committee (CU- IACUC), Cairo University, Egypt., (Approval number CU II F 25 18, dated October 2018).

Statistical Analysis:

Data analysis was carried out by applying General Analysis of Linear Model (GLM) Procedure (SAS, 2008) with the following model used: $Y_{ij}= \mu + T_i + e_{ij}$.

Where, Y_{ij}= observed parameters, µ= Overall mean, Ti= Effect of selenium source (i=1-3, 1=CG, 2=OSG, and 3=ISG) and e_{ij}= Experimental error. Significant differences among means were detected by using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Blood parameters:

Results of the studied blood biochemical parameters Glucose, TP, Alb. Glob, TG, TC, and TL are presented in Table (2).

Blood Glu increased significantly (P<0.05) by about 13% in supplemented groups (OSG and ISG) compared with CG. This result is contrary to Alhidary *et al*. (2016a) who found that trace elements supplementation including Se does not affect Glu level. . However, AL–Suhaimi *et al*., (2009) reported that the high Glu level was due to the camel's ability to store water under same summer conditions. Previously, Elmahdi, *et al*., (1997) pointed out that hyperglycaemia in camels could be due to higher gluconeogenic activity in the liver with lower cell response to insulin. Recently Alim *et al*., (2019) studied the neural adaptation of the dromedary camel to hot arid conditions and found that the camel genotype is markedly affected by water preservation throughout high water reabsorption rate by the kidney, and that Glu may help as a carrier of reabsorbed water.

Table 2. Biochemical parameters of growing Maghrabi camels as affected by different sources of selenium supplementation (LSM±SE)

Traits	CG	OSG	ISG
Glucose (mg/dl)	115.33^{b} ±4.13	130.83^{a} ±3.77	130.97^{a} ±3.77
Total Protein (g/dl)	6.76^{b} ±0.18	8.12^{a} ±0.17	7.98^{a} ±0.17
Albumin (g/dl)	3.92^{b}± 0.19	4.87^{a} ±0.18	4.80^{a}± 0.18
Globulin (g/dl)	2.84^{b}± 0.12	3.25^{a}± 0.11	3.18^{a}± 0.011
Triglycerides(mg/dl)	62.00±3.25	55.77±2.97	62.07±2.97
Cholesterol mg/dl	61.20±2.47	65.89±2.26	67.33±2.26
Total lipids (mg/dl)	365.56^{b}± 18.35	457.87 ^{a}± 17.75	450.93^{a}± 17.75

a-b Least square means with different superscripts in the same row differ significantly (P<0.05), CG control group without any supplementation, OSG organic source group, and ISG inorganic source group.

In the same line, TP increased significantly (P<0.05) by 20% for OSG and 18% for ISG more than CG . However, the variation between the treated groups was negligible. Plasma Alb concentration showed the same trend 24% higher in OSG than CG and 22% higher in ISG than CG. The same results were observed in serum Globulins which increased from 2.84 g/dl in CG to 3.25g/dl in OSG by about 14%, and ISG was increased to 3.18 g/dl, by about 12%. According to Hefnawy and Tortora-Perez (2010) who reviewed most publications on Se in the animal and found that it is tied with proteins with selenocysteine form and it is mostly involved in enzymes formation. So that, the increase in TP values

may be due to the influence of Se on protein synthesis which is confirmed by the significant increases in studied enzymes (ALP, GSH-Px, and CAT). To maintain the colloidal osmotic pressure and water preservation camel has a great ability to synthesize and store protein (Zongping, 2003). Connecting to our results the higher levels of Alb in the supplemented groups may be reflect that Se has a positive role in enhancing mechanisms of water preservation .

The other studied component of blood proteins was Glob which is related to immunity. Immunological parameters were not studied. But according to literature increasing concentration of IgG in serum in cows, which associated with higher blood Se levels (Hefnawy and Tortora-Perez, 2010) In the same line in camels, Karimi *et al*. (2015); and Hussain *et al*. (2016) found a significant decrease in blood proteins due to low immunity caused by Trypanosoma infection. So that, the increase of Glob may be due to the influence of immune response by Se supplementation.

On the other hand, blood proteins are affected by feeding conditions. So, this result is confirmed by Osman and Al-Bosadah (2000) for high feed quality and availability feeding resources in green season cause increase blood protein levels. In addition, Amin *et al*. (2007) observed a high level of Alb in the green season, while higher Glob in summer. Delvaud *et al*. (2013) studied the effect of prolonged underfeeding periods and found that Glob level is positively correlated with feed intake. These results are in agreement with Badawy *et al*. (2008) in Egypt, and also in Algeria Aichouni *et al*. (2013), which reported an increase in plasma Glob concentration during winter (rainy season).

For studying lipid profile, TG, TC, and TL were assessed. The observation was no significant variation (P>0.05) among the three groups in TG and TC, but a slight increase in treated groups with priority in ISG. The similarity in age and physiological stage of the experimental animal may be the reason for low differences in TG and TC between groups because these parameters did not affect by age or sex as found by Saeed *et al*. (2004); Ali *et al*. (2008). In addition, Yousif *et al*. (2016), and Ali *et al*. (2008) reported that also season has no effect.

Total lipids were significantly higher (P<0.05) in treated groups OSG and ISG than CG. An increase by about 25.25% was observed in OSG more than CG and by 23.35% in ISG, which gives superiority to Se addition regardless of the source. These results may be due to the antioxidant role played by Se in protecting lipids from peroxidation. Moreover, Adel and El-Metwaly (2012) mentioned that TL could be modulated by dietary energy levels. In addition, Asadi *et al*. (2009) reported an increase in TL values during the increase of camel's age.

Liver and kidney functions:

All liver, kidney, and thyroid results are shown in Table (3). A slight increase (P>0.05) in ALT and AST activities with non-significant differences (P>0.05) in OSG more than the other two groups were observed during this study. But, their values are within the normal range, which indicates that no harmful effect is caused by supplementation. On the other hand, ALP activity showed a significant increase (P<0.05) in OSG higher than CG, and the other ISG was intermediated between them. The higher activity in AST, ALT, and ALP were attributing it to the positive correlation with thyroid hormones and high metabolic rate (Aichouni *et al*., 2013; Faye and Bengoumi, 2018). These findings are confirmed by our result for growth performance. In addition, the plasma activity of the ALP in camel is mostly affected by age with higher values in young camels than adults and the increase is related to the osteogenesis action of osteoblasts, which is very active in growing young camels, and it continues beyond 18 months in this species as reported by Faye and Bengoumi (2018). This information is also confirmed by our results and the significant increase in ALP activity may be due to influencing in growth rate and skeletal conformation on animals.

Table 3. Thyroid, liver and kidney functions in growing Maghrabi camels as affected by different sources of selenium supplementation (LSM±SE)

Traits	CG	OSG	ISG
Liver function			
ALT (IU/L)	11.94 ±0.59	12.10 ±0.54	11.25 ±0.54
AST (IU/L)	25.49 ±1.94	27.85 ±1.77	25.54 ±1.77
ALP (IU/L)	114.29^{b} ±7.30	138.72^{a} ±7.24	134.33^{ab}±7.24
Kidney function			
BUN (mg/dl)	20.17±1.46	20.85±1.33	18.51±1.33
Crt (mg/dl)	1.55±0.12	1.48±0.11	1.58±0.11
Thyroid function			
T3 (ng/ml)	9.42^{b}±0.29	10.31^{a}±0.28	9.95^{a}±0.28
T4 (ng/ml)	108.23±17.21	112.74±15.17	96.26±15.17

a-b Least square means with different superscripts differ significantly (P<0.05), CG control group without any supplementation, OSG organic source group, and ISG inorganic source group.

ALT: Alanine aminotransferase, AST: aspartate aminotransferase, ALP: alkaline phosphatase, BUN: blood urea nitrogen, Crt: creatinine, T3: Triiodothyronine, T4: thyroxine.

The values of BUN and Crt were found to be non-significant (P>0.05) among the three groups which means that kidney functions were not affected by treatment. Moreover, these values in the normal range were recorded by other previous studies reviewed by Faye and Bengoumi (2018)

BUN and Crt can be taken as an indicator for Kidney efficiency, (Kamili *et al*., 2013). Whereas hyperuremia is observed during renal failure. Furthermore, BUN levels and metabolism in camels are more comparable than other ruminant animals because high reabsorption rate to use it as a non-protein nitrogen source (Faye and Bengoumi, 2018). From previous literature, BUN concentration is mostly affected by diet and dehydration. This reflects that our results were due to supplement and avoiding other management and feeding conditions.

Thyroid hormones:

The level of T3 revealed a significant response to selenium supplementation and the highest value was recorded in the organic group. T4 showed insignificant differences among the three groups as shown in Table (4).

A significant increase (P<0.05) in T3 levels was recorded in the supplemented groups compared with the control group. These results may due to the sensitivity of the thyroid gland to blood Se level because it plays a very important role in its activity. Moreover, selenoenzymes have a significant effect on the activation of T3 from T4. In the same line, a significant reduction inT3 level was recorded under Se deficiency conditions and a high concentration of T3 was found in calves supplemented with selenium (Hefnawy and Tortora-Perez, 2010).

Antioxidant biomarkers:

The impact of Se supplementation from different sources on GSH-Px, MDA, CAT, and TAC, in growing camels are presented in Table (4). All plasma oxidative biomarkers were affected significantly (p<0.05) by treatment. The Se supplemented camels recorded better resistance against oxidative stress when compared with those in the control group.

Table 4. Antioxidant biomarkers of growing Maghrabi camels as affected by different sources of selenium supplementation. (LSM±SE)

Traits	CG	OSG	ISG
GSH-Px (IU/g Hb)	39.94^{b} ±1.61	48.61^{a} ±1.47	48.05^{a} ±1.47
MDA (nmol /ml)	30.31^{a}± 0.97	18.70^{b} ±0.88	21.22^{b}± 0.88
CAT (U/L)	0.518^{b}± 0.021	0.634^{a}± 0.019	0.657^{a}± 0.019
TAC (mM/L)	0.729^{b} ±0.013	0.870^{a} ±0.012	0.884^{a} ±0.012

a-b Least square means with different superscripts differ significantly (P<0.05, CG control group without any supplementation, OSG organic source group, and ISG inorganic source group.
GSH_Px: glutathione peroxidase, MDA: malondialdehyde, CAT: catalase, and TAC: total antioxidant capacity.

The GSH-Px activity was higher by 22 % In OSG and 20% in ISG than in control. Similarly, an increase by 22.4 and 26.8 % in CAT activity was observed in the treated groups (OSG: and ISG) than CG. But the highest concentration was achieved by inorganic supplementation. Moreover, TAC showed the same trend, OSG raised by about 11% and ISG was 21% (OSG and ISG) compared with control CG. MDA decreased significantly (P<0.05) in treated groups by about 38% for OSG and by about 29% for ISG lower than control CG. All results clearly indicated that an improvement of antioxidant status was achieved by Selenium addition in growing camel diets.

GSH-Px is mostly affected by Se supplementation and its values varied according to intake (Alhidary *et al*., 2016 b; Kamada, 2017; Faye and Bengoumi, 2018). Improving GSH-Px level helps in controlling hydrogen peroxide and lipid peroxide produced by normal metabolic processes. MDA is a stable by-product of the cell membrane's lipid peroxidation. So, it is widely used as a stress marker and reactive oxygen species (ROS) detector (Gawel *et al*., 2004; Dedar and Patil, 2013). The reduction of MDA reflects the enhancement of the antioxidant ability of the body. This finding clarifies our results which showed a reduction by about 29 - 38% in supplemented groups. In addition, Fararh *et al*., (2016) found that reduction in MDA concentration in Se supplemented camels. Furthermore, Cao *et al*., (2014) concluded that organic supplementation seemed to be more effective and advantageous. This result is in agreement with Saleh *et al*., (2009). In addition, CAT had the same trend. The catalytic activity of catalase allows the transformation of superoxide anion into hydrogen peroxide (H2O2) and water and inactivates large amounts of oxidants (Mates, 2000). The improvement of antioxidant status causes an increase in TAC levels in the blood (Alhidary *et al*., 2016b).

Mineral profile:

Mineral values are presented in Table (5). These results indicated that all assessed minerals (Na, K, and Ca) had a significant response (P<0.05) to selenium supplementation from both sources.

Moreover, OSG was higher, but insignificant except for sodium the differences were non-significant but showed the same trend. The blood Se concentration in the supplemented groups was higher by about two folds than in the control group. For all studied minerals, addition of Se resulted in a significant change regardless of its source. Furthermore, non-significant differences were observed between the two groups OSG and ISG. Animals in OSG showed the highest values for Na, K, and Ca with ingested organic Se *Vs* inorganic in ISG.

Table 5. Mineral elements of in growing Maghrabi camels as affected by different sources of selenium supplementation. (LSM±SE)

Elements	CG	OSG	ISG
Se (ng/ml)	22.72c ±1.46	43.34^{a} ±1.33	37.04^{b} ±1.33
Na (mmol /L)	128.52 ±3.85	138.91±3.51	131.99 ±3.51
K (mmol /L)	3.94^{b}± 0.25	4.92^{a}± 0.22	4.87^{a}± 0.22
Ca (mmol/L)	2.30^{b}± 0.23	2.58^{a}± 0.22	2.55^{a}± 0.22

a-b Least square means with different superscripts differ significantly (P<0.05), CG control group without any supplementation, OSG organic source group, and ISG inorganic source group, Se: selenium, Na: sodium, K: potassium, Ca: calcium

According to Faye and Seboussi (2009), the high value of camel blood Se in treated groups was the result of the high sensitivity of camel to Se intake, and organic Se is more efficient than inorganic. Our findings were similar to several studies on the effect of supplementation of Se at different physiological stages of calves and adult camels which was done by Seboussi *et al*. (2009); Faye *et al* (2014b) and in other species in cattle Gunter *et al*. (2013), in goat Kachuee *et al*. (2013), and sheep Davis *et al*. (2006). Na plasma concentration is the main indicator of plasma osmolarity, blood pressure, kidney performance, and some hormones such as antidiuretic hormone (ADH), aldosterone, and the renin-angiotensin system. The insignificant variation between the three groups in Na value may be an indication of no negative effect for Se supplementation on kidney function.

This observation is confirmed by the BUN and Crt results discussed previously. Potassium has an important role in cell membrane potential, nervous system, acid-base balance, and muscular activity, and cardiac functions (Faye and Bengoumi, 2018). The significant increase in the treated groups in plasma K concentration may be the result of improved antioxidant system which protects cell membranes from oxidative stress caused by ROS. Calcium is a macromineral which plays a very an essential role as an electrolyte in muscular contraction, nerve conduction, blood clotting, skeleton building, and some metabolic reactions (Faye and Bengoumi, 2018). Al-Busadah (2010) noticed that a hypercalcaemia was found in young camel calves compared to adult camels. On the other hand, Saeed, *et al*. (2004) reported that camel age did not affect Ca levels. The obtained Ca values are within the normal range as referenced by (Faye and Bengoumi, 2018).

Growth performance:

The growth performance of the experimental camel calves is shown in Table (6). All groups were almost similar in their initial body weight. But, by the end of the experiment, TBG, ADG, and GR showed significant differences (P<0.05) among experimental groups with superiority in OSG.

Table 6. Average daily live body weight of growing camels supplemented with organic and inorganic selenium. (LSM±SE)

Item	CG	OSG	ISG
Initial body weight (kg)	174.60 ± 11.20	173.16 ±10.23	170.00±10.23
Final body weight (kg)	226.47^{c} ±11.55	251.59^{a} ±10.55	238.54^{b} ±10.55
Total body gain (kg)	51.87^{c}±5.54	78.43^{a}±5.13	68.54^{b}±5.13
Average daily gain (g)	451^{c}±0.02	682^{a}±0.02	596^{b}±0.02

a-b Least square means with different superscripts differ significantly (P<0.05), CG control group without any supplementation, OSG organic source group, and ISG inorganic source group

Meat production is the main target of the fattening process which appeared through ADG. The growth rate of young animals mainly depends on management practices and feed quality and quantity. But, in general, camel's growth curve is similar to other farm animals (Kadim *et al*., 2013). The calculated values for ADG and GR followed the pattern of the other domestic farm animals at the same age which recorded by Kadim *et al*. (2008). Moreover, they reported that growing camels has a sensitive response to any improvement in managerial condition at this age, which was 260 g/d for non-supplemented animals up to 550 g/d for animals fed a high-quality diet. Generally, Se plays an indirect role

in growth-promoting in calves. Its effect is done by removing all constraints that may inhibit growth (Mehdi and Dufrasne, 2016).

A variable effect of Se on the growth performance of animals was observed by many studies. Alhidary *et al*. (2016a) reported an improvement of growth of growing camel by 14.4% as a result of trace minerals supplementation. Concerning with the finding of the current study. The improvement in GR may be due to the great activity of antioxidants of the body which led to more energy and nutrient availability for tissue accretion (Russel *et al*., 2016). Moreover, Mehdi and Dufrasne (2016) reviewed that the regulation of adipose tissue metabolism by T3 hormone which is a seleno-dependent hormone.

In addition to the beneficial effect of Se supplementation, several studies mention that a great effect on meat quality and characteristics like: color, flavor, texture, and nutritive value (Sun, *et al*., 2002). This effect is related to GPX-SH, which protects lipid peroxidation. Furthermore, Khan *et al*. (2015) reported that meat cholesterol content was affected by Se addition. The reduction of cholesterol is a health benefit because Cholesterol oxidation products cause atherosclerosis, cytotoxic, mutagenic, and carcinogenic. Several studies cited that a positive effect on the immune system and productivity by regulating antioxidant balance. Even though, the obtained result showed an increase in lipid profile. but also, Raiymbek *et al*.,2015 demonstrated that camel meat is comparable to beef meat especially in cholesterol which has a small amount of it in intramuscular tissue. This difference between blood and meat may be due to the variation in fat metabolism and fat mobilization in camel to transfer it to the hump.

CONCLUSION

Se supplemented diets for growing and fattening camel, especially from organic source has a positive effect on growth performance and antioxidant responses via the recoded increases in ADG, TBG, FBW especially in the OSG). In addition, the recoded enhancement on blood total protein, albumin, globulin, which were higher in treated groups (with especial reference to OSG) than the control one but still within normal physiological rang and metabolic hormones (T3 and T4). Furthermore, increase the antioxidant enzymes activity and the noticeable reduction in MDA in the treated groups than control group. Therefore, further studies are required to define the effects of Se supplementation and to quantify interactions between other not studied physiological responses of pre-puberty camels. The level, source, and synergistic combinations of other trace mineral supplementation should be considered when determining the most beneficial effect for productive and reproductive performance and the health of camels at the early stage of age.

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المؤشرات الفسيولوجية وزيادة الوزن الحي لحيران الإبل تحت تأثير مصادر مختلفة من السيلينيوم

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أجريت هذه الدراسة لمعرفة تأثير إضافة السيلينيوم من مصادر مختلفة) العضوي وغير العضوي (بمعدل ٨ ملجم /رأس /يوم على كفاءة مضادات الأكسدة لحيران الإبل وأداء نموها. تم تقسيم سبعة عشر جملًا "٩ ذكور و٨ إناث" بعمر ١٨ شهراً بمتوسط وزن ١٧٢.٤٧± ١٠.٥٦ كجم) متوسط ± (SE بشكل عشوائي إلى ٣ مجموعات: المجموعة الأولى "السيلينيوم العضوي ، ن =٦" ، المجموعة الثانية "السيلينيوم غير العضوي ، ن =٦" بالإضافة إلى فيتامين هـ ١٥" وحدة دولية /كجم مادة جافة (ومجموعة المقارنة) الكنترول، ن =٥" تم إيواء المجموعات الثلاث في حظائر شبه مفتوحة ومظللة وتقديم العليقة مع الاضافة لمدة ١١٥ يومًا.

لوحظت زيادة معنوية ($P<0.05$) في مكونات بلازما الدم بما في ذلك الجلوكوز والبروتين الكلي والألبومين والدهون الكلية. كما كان تركيز الهرمون ثلاثي اليود أعلى ($P<0.05$) في كلتا المجموعتين مع الاضافة بينما كان تركيز الفوسفاتيز القلوي (ALP) أعلى ($P<0.05$) فقط في مجموعة Se العضوية. كانت قيم إنزيمات الكبد ALT و AST، واليوريا في الدم، والكرياتينين متقاربة في المجموعات الثلاثة وكانت جميعها ضمن النطاق الطبيعي. ظهر تحسن كبير في حالة مضادات الأكسدة بشكل واضح من خلال الزيادة المعنوية ($P<0.05$)في الجلوتاثيون بيروكسيديز ، الكاتلاز ، إجمالي كفاءة مضادات الأكسدة ، وانخفاض في مالونديالديهيد للمجموعات المعاملة مقابل المجموعة المقارنة. كان تراكيز السيلينيوم والكالسيوم والبوتاسيوم في البلازما أعلى معنويا ($P<0.05$) في المجموعات المعاملة. كما كان تركيز الصوديوم متقارباً ($P>0.05$) عبر المعاملات.

كان معدل الزيادة اليومية "جم/رأس /يوم" أعلى معنويا ($P<0.05$) في المجموعات المعاملة بالسيلينيوم مع وجود فرق واضح بين مجموعة السيلينيوم العضوي مقارنة مع المجموعات الأخرى.

والخلاصة أن إضافة عنصر السيلينيوم إلى علائق الإبل النامية بنسبة "٨ مجم /رأس /يوم" أدى إلى تحسين أداء النمو وتقليل الإجهاد التأكسدي دون أي تأثير سلبي على الحيوانات. بالإضافة إلى ذلك ، أظهر المصدر العضوي تأثيرًا أفضل من المصدر غير العضوي.