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Effect of Dietary Organic Selenium and Manganese Supplementation on Productive Performance of Local Laying Hens Fed Diet Contained Soybean Oil as a Source of Essential Fatty Acids.

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ABSTRACT

A total number of 300 Sinai laying hens and 30 cocks, 27 wks- old were used. The laying hens and cocks were weighed, and randomly divided into ten experimental groups with three replicates for each to investigate effects of layer dietary supplementation different levels of organic manganese (Mn-Met), selenium (Se-Met) and their mixture on productive and reproductive performance, internal egg quality, Mn and Se retention during the laying period from 27 – 43 weeks of age. The layer diets contained 1.5% soybean oil as a source of essential fatty acids and it contained gradually levels of organic Mn (20, 40, and 60 mg organic Mn /kg diet), organic Se (0.1, 0.2 and 0.3 mg organic Se /kg diet) and their mixture (20+0.1, 40+0.2 and 60+0.3 mg /kg diet (organic Mn + organic Se), where the diets premix of treatments 2,3 and 4 without Mn, 5,6 and 7 without Se and 8, 9 and 10 without Mn and Se compared to the control diet which contained mineral Mn and Se. Results showed that hens fed diets supplemented with 40mg organic Mn + 0.2 mg organic Se/ Kg diet, 60 mg organic Mn and 0.2 mg organic Se / Kg diet returned to occupy the first position in egg number as compared to the control diet by about 5.88, 5.49 and 4.66% respectively. The superiority of egg mass produced from hens fed diets supplemented with 0.2mg organic Se, 40mg organic Mn + 0.2mg organic Se and 40mg organic Mn/Kg diet. The best feed conversion resulted from the diet supplemented 0.2 mg organic Se, 40 mg organic Mn+ 0.2mg organic Se /kg diet and 60 mg organic Mn / kg diet. All dietary treatments recorded the lowest values in terms of content fresh yolk of total cholesterol. The diet contained 0.1mg organic Se and 40mg organic Mn /kg diet produced eggs with higher total antioxidant as compared with the control diet. In stored yolks, hens fed diets supplemented with 0.1, 0.2 mg organic selenium and 20mg organic Mn + 0.1mg organic Se / kg diet produced eggs with lower cholesterol concentration content. The fertility % of eggs from hens fed diets supplemented with 0.2 mg organic Se and 40 mg organic Mn / Kg diet increased compared to the control died. The higher value of scientific hatchability % occurred as a result of the diets supplemented with40 mg organic Mn and 40 mg organic Mn+0.2 organic Se /Kg diet / Kg diet than the control diet. All dietary treatments had significant higher selenium retention than control diet. The diet supplemented with 0.2 mg organic Se diet and 60 mg organic Mn /Kg diet resulted in decrease in total serum cholesterol compared to the control diet. The diet with organic Mn and Se together at the medium dose (40+ 0.2 mg / Kg diet) leads to higher value of serum antioxidant activity by about 33 % of control diet. The results indicated that the diet contained 0.2mg organic Se, 60 mg organic Mn and the mixture between 40 mg organic Mn+0.2mg organic Se /kg diet improved egg production performance, profile lipids, antioxidant activity in eggs and blood serum as well as economic efficiency of egg production.

Keywords: Organic manganese, Organic selenium, Laying performance, Egg quality, Fertility, Hatchability

INTRODUCTION

There are some types of vitamins and minerals such as selenium and manganese called antioxidants that help to protect the cells from oxidative stress which induce when the production of free radicals exceeds the body's ability to detoxify the reactive oxygen species (ROS), or to repair the damage caused by them, where the lipid bilayer losses its integrity leading to membrane damage and cell death when lipid peroxides are present (Padmaja *et al.,* 1997). In addition, gaseous exchanges and high metabolic rates during embryonic development can lead to the production of ROS (Halliwell, 1994).

Mineral nutrition is an important aspect for optimal egg production in laying hens. The provision of optimum mineral content in the feed is essential for the production of quality eggs for sale (Mabe *et al*., 2003). Among the well known antioxidants, manganese where it plays essential role in the growth embryo, after hatch and in bone development (Fawcett, 1994). Yildiz *et al.* (2011) mentioned that organic manganese supplementation significantly decreased the percentage of damaged eggs and increased the egg weight comparing with the inorganic source of the element. Venglovska *et al.* (2014) reported that manganese adding to the hens' diet resulted in a positive effect on eggshell quality and in preventing yolk lipid oxidation during cold storage of eggs compared to inorganic manganese. Xie *et al.* (2014) illustrated that manganese deficiency affects reproduction performance and reproductive hormones in layers. In addition, Carvalho *et al.* (2015) elucidated that the organic sources of manganese and other microelements increased trace mineral excretion without compromising egg shell quality or egg production.

Selenium is an essential trace mineral that is required by animals including poultry (NRC, 1994) for overall health and growth performance. According to the NRC (1994), Se requirement for layers ranges from 0.05 to 0.08 ppm, depending on daily feed intake. The essentiality of Se in the hen's diet is important for egg production and hatchability as well as for the overall performance of progeny chicks as shown by Cantor and Scott (1974). Paton *et al.* (2002), shown that organic Se (Se yeast) as well as inorganic Se when added to the maternal diet could be transferred to the egg and subsequently to the embryo.

Moreover, Dietary selenium plays an important role in all aspects of the immune system (Arthur *et al*., 2003). Leng *et al.* (2003) concluded that dietary organic Se enhances the immune status of the birds via increased mobilization and ability of immune cells to respond to infection. Selenium may play a beneficial role in multi-factorial illnesses with genetic and environmental linkages via epigenetic regulation in part via glutathione peroxidase activity (Bermingham *et al.,* 2014). The current study was carried out to investigate the productive and reproductive performance, egg quality as well as Mn and Se retention resulting from incorporating different levels of organic manganese and selenium in Sinai laying hens during the period from 27 to 43 weeks of age.

MATERIALS AND METHODS

This study was conducted at El-Serw Poultry Research Station, Animal Poultry Research Institute,

Agriculture Research Center, Ministry of Agriculture, Egypt. Three hundred Sinai laying hens and thirty cocks at their 27th weeks of age were randomly assigned into ten treatments of equal three replicates each. The birds were kept on deep litter, naturally ventilated laying house and exposed to a daily photoperiod of 16 hr during this study.

Layer's diet:

Hens were provided with feed and water *ad libitum* and were fed standard layer diet containing 2% soybean oil as a source of essential fatty acids, 2750 Kcal/Kg diet and 17 % crude protein. The diet was formulated according to the requirement recommended by National Research Council (NRC) 1994. Ingredients and chemical composition of the basal diet were shown in Table (1). All diets were isocaloric and isonitrogenous but the basal diet with premix 1 containing inorganic Mn and Se (T1) while the other diets contained gradually levels of organic Mn (20, 40, and 60mg /kg diet) for the experimental groups T2, T3 and T4, organic Se (0.1, 0.2 and 0.3 mg /kg diet) for the experimental groups T5, T6 and T7 as well as their mixture (20+0.1, 40+0.2 and 60+0.3 mg /kg diet (organic Mn +organic Se) for the experimental groups T8, T9 and T10, where the diets premix T2,T3 and T4 without Mn, T5,T6 and T7 without Se as well as T8, T9 and T10 without Mn and Se.

Body weight and laying performance

Body weight of hens in each replicate was determined in the beginning and end of the study at 27 and 43 week of age to assess the change body weight during the experimental period. Egg production %, egg number/hen, egg weight, egg mass, feed consumption and feed conversion ratio through the experimental periods were recorded.

Chemical analysis of egg yolk:

During the experimental period at 37 week of age, 2 eggs per replicate were collected. Eggs were divided into two portions. The 1st group was used to calculate fresh eggs quality, while the remaining eggs were stored in the refrigerator at 5°C for 21 days and then broken for internal quality assessment which included total cholesterol content and triglyceride content were determined,Also total antioxidant capacity by colorimetric method according to Koracevic *et al*., (2001).

Reproductive traits:

At 40 and 41weeks of age the eggs from each replicate were collected during 4consecutive days/week. The eggs were set forced in draft type incubator. Fertility was estimated as percentage of fertile eggs on 18 days of incubation to those set in the incubator. Hatchability was calculated as percentage of hatched chicks to fertile eggs (scientific value), also it was calculated as percentage of hatched chicks to total eggs (commercial value). At hatch, chicks were weighed to the nearest 0.1 gram using electric balance.

Manganese and selenium retention:

At 43 weeks of age, 30 male were selected on the basis of the average body weight (one male per each replicate). Birds were individually housed in metabolic cages (60 cm length. 50cm width. 60cm heigh) and fed their respective experimental diets (Table1), for a period of three days where, the excreta were quantitatively collected every 24 hours for three days; feed consumption data were also recorded.

Table 1. Composition and calculated analysis of the experimental diets (27- 43weeks of age).

Diets	The experimental diets									
Ingredients (%)	**C**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Yellow corn	58.37	58.37	58.37	58.37	58.37	58.37	58.37	58.37	58.37	58.37
Soy bean meal (44 %)	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75	18.75
Corn gluten (60 %)	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Soybean oil	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Wheat bran	6.75	6.75	6.75	6.75	6.75	6.75	6.75	6.75	6.75	6.75
Organic Mn (mg/kg)	0	20	40	60	0	0	0	0	0	0
Organic Se (mg/kg)	0	0	0	0	0.1	0.2	0.3	0	0	0
Organic (Mn + Se)	0	0	0	0	0	0	0	20+0.1	40+.02	60+0.3
Di-calcium phosphate	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39	1.39
Limestone	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16	8.16
premix[1]	0.3	0	0	0	0	0	0	0	0	0
premix[2]	0	0.3	0.3	0.3	0	0	0	0	0	0
premix[3]	0	0	0	0	0.3	0.3	0.3	0	0	0
premix[4]	0	0	0	0	0	0		0.3	0.3	0.3
NaCl	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
DL- Methionine (99%)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total	100	100	100	100	100	100	100	100	100	100
Calculated Analysis[5]										
Crude protein %	17	17	17	17	17	17	17	17	17	17
ME (Kcal / kg)	2750	2750	2750	2750	2750	2750	2750	2750	2750	2750
Crude fiber %	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Ether extract %	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18
Calcium (%)	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47	3.47
Av. Phosphorus (%)	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Methionine %	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Lysine	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
Meth. + Cyst. %	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61

1- Each 3kg of the premix contains 100 million IUVit A;2 million IU Vit.D_3;10 g Vit.E; 1 g Vit.K_3 ; 1 g Vit B_1; 5 g Vit B_2 ;10 mg Vit.B_{12} ; 1.5 g Vit B_6; 30 g Niacin ;10 g Pantothenic acid ;1g Folic acid;50 mg Biotin ; 300 g Choline chloride; 50 g Zinc; 4 g Copper; 0.3 g Iodine ; 30 g Iron; 0.1 g Selenium; 60g Manganese ;0.1 g Cobalt; and carrier CaCO3 to 3000 g.

2-The premix without Mn- 3-The premix without Se 4- The premix without Mn and Se

5-According to NRC 1994, the diet formulated to cover requirements of all nutrients without added antibiotics.

The excreta were dried in a forced oven at 70oC for 24 hours. Finally, the excreta were ground well and stored in plastic bags in pledge of analysis. The Mn and Se analysis of the excreta were carried out in Regional center of feed and

Food (RCFF), Agriculture Research Center, Ministry of Agriculture, Egypt (A.O.A.C., 2004).

Manganese or selenium retention (Mn or Se R) was calculated from the following formula, Mn or Se R = (Mn or Se content of dry matter of dry feed – Mn or Se content of dried excreta) x 100/ Mn or Se content of dry feed.

Biochemical analysis of blood:

At the end of the experimental period (43 weeks of age), 1 hens from each replicate (3 hens/ treatment) were chosen randomly, and blood samples were collected from the wing vein in clean and dry tubes then were centrifuged at 3500 rpm for 15 minutes , to separate the serum for biochemical analysis, which include total cholesterol, HDL and LDL by commercial kit. Also total antioxidant capacity was determined in serum by commercial kit by colorimetric method according to Koracevic *et al.,* (2001) as indicator of oxidation stress in living cells.

Economical efficiency:

At the end of the study, economical efficiency for egg production was expressed as hen-production thought the study and calculated using the following equation:

Economic efficiency (%) = (Net return LE/Total feed cost LE) × 100.

Statistical analysis:

Data were statistically analyzed using General Linear Models Procedure of the SPSS (2008), differences between treatments were subjected to Duncan´ s Multiple Range – test (Duncan, 1955).

The following model was used to study the effect of treatments on the parameters investigated as follows: **Yij = μ + Ti + eij**

where:

Yij = an observation, μ = overall mean, Ti = effect of treatment (i=1, 2, 3, ….. ,10) and eij = Random error.

RESULTS AND DISCUSSION

Concerning body weight (BW) in the end of study at 43 weeks of age illustrated that dietary organic Mn-methionine (Mn-Met), Se, seleno-methionine (Se-Met) and their mixture at different levels of supplementation had insignificant (P≥0.05) impact on BW at 43 –wks.–old as shown in Table (2). However, it is clearly observed that the control group had the highest BW records compared to the dietary treatments. In this respect, when the diet supplemented with 40 mg organic manganese + 0.2 mg organic selenium, the BW record was about 96.54% of control group and being lower than the hens fed diet with the other mixtures of manganese and selenium. It evident that the experiments were carried out on adult hens (27-wks.-old) had already reached the average of mature live body weight of this strain. Physiologically any increase above this average record indicates that hens tended to obesity and reflects the incidence of abdominal and visceral fat deposition, a matter which is considered a disadvantage especially with egg laying hens. This opinion is supported by the results in the current study in terms of productive performance where, the some tratments exceed control ones in egg number and egg mass records. This means that their lower body weight utilized less food for maintenance and the rest was converted into eggs. So, it was not strange to find that all treatments showed better egg production values than control. The results in the present study are consist with the study by Arafa *et al.* (2016) who illustrated that the Hy-line (W36) hens fed diet contained natural antioxidant had significantly lower (P ≤ 0.05) final body weight than control diet at 44 weeks of age.

The lower BW due to the dietary treatments may be due to organic manganese play rolls in managing oxidative stress (Richards *et al*., 2010), also selenium is key component of the antioxidant system, reducing lipid peroxidation (Surai, 2000). In addition, this effect on body weight probably due to potential mechanisms of dietary antioxidants on body weight such as decrease lipogenesis, increases lipolysis, stimulate FA β-oxidation, inhibit adipocyte differentiation and attenuate inflammatory responses and suppress oxidative stress (Zuluage *et al*., 2015).

Table 2. Effect of dietary organic manganese, selenium and mixtures of them on body weight, laying performance and economic efficiency of Sinai laying hens.

Tret.	Control	Organic Mn (mg/kg diet)			Organic Se(mg/kg diet)			Mn + Se			±SE	Sig.
		20	40	60	0.1	0.2	.03	20+0.1	40+0.2	60+0.3		
Body weight and laying performance												
IBW[1]	1520	1515	1510	1515	1520	1511	1508	1513	1513	1510	2.76	NS
FBW[2]	1783	1748	1692	1665	1722	1740	1697	1710	1722	1715	11.1	NS
EW[3]	52.39^{ab}	52.86^{ab}	52.96^{ab}	51.51^{b}	52.67^{ab}	53.26^{a}	53.15^{ab}	52.11^{ab}	52.64^{ab}	52.47^{ab}	0.16	0.05
EM[4]	4045.2^{ab}	3874.9^{b}	4150.7^{ab}	4193.6^{ab}	4029.1^{ab}	4302.2^{a}	3985.8^{ab}	3853.6^{b}	4296.5^{a}	3992.9^{ab}	32.5	0.05
EP%[5]	68.96^{abc}	65.57^{c}	70.06^{abc}	72.74^{a}	68.33^{abc}	72.18^{ab}	67.02^{bc}	66.10^{c}	73.01^{a}	68.07^{abc}	3.59	0.05
FI (g)[6]	112.91^{ab}	112.64^{ab}	113.27^{ab}	113.38^{ab}	114.03^{ab}	112.42^{b}	112.37^{b}	112.77^{ab}	114.76^{a}	112.05^{b}	0.23	0.05
FCR[7]	3.15^{abc}	3.27^{ab}	3.08^{ab}	3.04^{abc}	3.018^{abc}	2.93^{abc}	3.17^{c}	3.29^{a}	3.01^{bc}	3.05^{abc}	0.03	0.05
Economic efficiency (EE)*												
TFC[8]	39.88	39.78	40.0	40.04	40.26	39.69	36.68	39.82	40.52	39.56	-	-
EN[9]	77.23	73.43	78.47	81.47	76.53	80.83	75.07	74.03	81.77	76.23	-	-
T R[10]	54.06	51.4	54.93	57.03	53.57	56.58	52.55	51.82	57.24	53.36	-	-
N R[11]	14.2	11.63	14.94	17.0	13.31	16.89	12.87	12.01	16.72	13.8	-	-
EEF[12]	35.61^{ab}	29.25^{b}	37.34^{ab}	42.44^{a}	33.03^{ab}	42.55^{a}	32.42^{ab}	30.18^{b}	41.36^{a}	34.89^{ab}	1.49	0.05

[1] = initial body weight; [2]= Final body weight; [3]= Egg weight; [4]= Egg mass; [5]= Egg production %;[6]= Fedd intake (g/hen/day) [7]= Feed conversion ratio; [*]According to price of diet ingredients where : yellow corn, 2.27; Soy been meal, 5.05; Corn gluten, 7.50; Wheat bran, 2.22;; Di-calcium, 4.55; limestone, 1.50; Vit. and Min., 20.0; Na Cl, 0.50 ; Meth, 32.0; Lysine, 32.0., the price of 1egg= 0. 7 Egyptian pound; [8]= Total feed cost; [9]= Egg number /hen /study; [10]= Total return; [11]= Net return; [12]= economic efficiency (%) = (Net return LE /Total feed cost LE) × 100; a,b,c,.. : means in the same row bearing different superscripts are significantly different (p ≤ 0.05)

Egg production traits:

The response of egg production performance through the period of the feeding trail is shown in Table 2. As a rule, it must be mentioned that all dietary treatments did not significantly differ from the control diet. However, the hens fed diet supplemented with 40 mg organic manganese + 0.2 mg organic selenium / Kg diet returned to occupy the first position in respect of egg production %, this improvement

was by about 5.87% as compared to the control diet. While, the least values of egg production% were recorded by the hens fed diet with 20 mg organic manganese followed by the diet with 0.3 mg organic selenium / Kg die, but this decrease was not significant comparing with the control diet.

Results obtained clearly showed that the diet supplemented with 0.2 mg organic selenium /Kg diet showed the highest records in terms of egg weight, while the lowest value of egg weight (g/ egg) were those attained by the diet with 60 mg organic manganese/Kg diet which was significantly ($P \leq 0.05$) lower than egg weight produced results from the diet contained 0.2 mg organic selenium/ Kg diet.

Indeed, results of egg mass during this study confirmed the superiority of egg mass produced from hens fed diets supplemented with 0.2mg organic selenium, 40mg organic manganese + 0.2mg organic selenium and 40mg organic manganese/Kg diet compared to the control diet. It is interesting to note that the hens fed diet supplemented with medium dose of organic manganese and selenium together (40mg + 0.2mg) egg mass records were higher than those produced from the hens fed diet 40 mg organic manganese / Kg di *et al*one by about 3.5% suggesting a synergistic effect.

In respect of feed intake / hen / day and feed conversion ration (Table 2) the results obtained indicated that no significant ($P \geq 0.05$) effect was detected in feed intake during the collective period as compared to the control diet. But, the diet with 40mg organic manganese+0.2 mg organic selenium significantly increased feed intake / hen /day compared to the diet with 60mg organic manganese+0.3 mg organic selenium, 0.3mg organic selenium and 0.2 mg organic selenium / kg diet.

Results concerning the feed conversion ratio showed that there are significant variations among dietary treatments were detected during collective period from 28 to 43 weeks of age. It could be mentioned that the best feed conversion resulted from the diet supplemented 0.2 mg organic selenium, 40 mg organic manganese+ 0.2mg organic selenium /kg diet and 60 mg organic manganese / kg diet compared to the control and other dietary treatments.

In general, there was improvement in laying performance due to usage some diets supplemented with organic manganese or selenium as described above, this agreement with Sara *et al.,* (2008) who indicated that the use of organic Se improved egg production and egg weight. Leeson *et al.,* (2008) showed that egg production was greater in breeder hens fed 0.3 mg / Kg diet of Se. In addition, in a study with laying hens, a dietary organic source of Mn gave better results, in respect of weight gain, egg weight, percentage of undamaged eggs, and tibia bone quality indices, than inorganic manganese (Yildiz *et al*., 2011). Conversely, Sechinato *et al.* (2006) did not detect any effects of manganese or selenium supplementation, alone or combined, either in organic or inorganic form, on egg production. Also, the results in the current study was disagreement with the study by Maciel *et al.* (2010) who did not observe any improvement in egg production, feed intake, feed conversion from laying hens supplemented with manganese in organic form. Also,

The beneficial influence in the current study is speculative; one likely explanation to understand these results is that the diets supplemented with the different levels of organic manganese, selenium and their combination had lower body weight records as compared to the control diet (Table 2) where the increase body weight during laying period was associated with excessive liver and abdominal fat which resulted in negative effects on egg production (Mohati-Asli *et al*., 2012).

It was surprise that some treatments which lead to improve in production performance (60 mg organic Mn and 0.2mg organic Se) themselves which resulted in decrease cholesterol in fresh eggs (Table 6), also the diets with 60 mg organic manganese and 0.2mg organic selenium had the lowest values of serum cholesterol and the best values of HDL/LDL ratio (Table 6), this refer to the improvement in egg performance may be due to these minerals play key roles in managing oxidative stress, where in animal cells there are two forms of superoxide dismutase (SOD),the first form present in cytoplasm and dependent on the copper and zinc, and the first form dependent- manganese in the mitochondria (Underwood and Suttle, 1999). The superoxide dismutase (SOD) enzymes form a first-line defense that converts oxygen radicals to hydrogen peroxide, which is a less toxic molecule (Hydrogen peroxide) which is then converted to water through the action of glutathione peroxidase, a selenium containing enzyme. In a case of mineral deficiency, SOD activity is decreased, which can induce cellular death, this can results from increased amounts of lipid, protein and nucleic acid damage, (Kokoszka *et al*., 2001).

In addition, Leeson and Summers., (2001) mentioned that the organic minerals can be increase from the stability of the complex in the upper digestive system where organic trace minerals is that the binding of the organic ligand(s) to the mineral, thereby minimizing mineral losses to antagonists and allowing the complex to be delivered to the absorptive epithelium of the small intestine for mineral uptake.

The results illustrated that the best value of economic efficiency was that produced by the eggs from hens fed diet supplemented with 0.2 mg organic selenium followed by the hens fed diet contained 60 mg organic manganese and 40 mg organic manganese+0.2mg organic selenium/kg diet which gave better results than control diet by about 19.49. 19.18 and 16.15 % respectively. On the other hand, the low level of manganese and the low level of mixture between manganese and selenium (20mg+0.2mg /kg diet) produced insignificant ($P \geq 0.05$) lower economic efficiency than control diet.

Chemical analysis of egg's yolk:

Data presented in Table (3) showed some significant difference among treatments in respect of the fresh yolk content of total cholesterol where, all dietary treatments recorded the lowest values but, only the diets supplemented with different levels of organic selenium (0.1, 0.2 and 0.3 mg /kg diet) and the low level of mixture organic manganese and selenium (20 mg + 01 mg / kg diet) resulted in a significant decrease ($P \geq 0.05$) in content yolk of total cholesterol comparing with the control diet. No significant influence of dietary treatments on triglycerides in eggs yolk of fresh eggs as compared to the control diet. On the other hand, the diet contained 0.1mg organic selenium and 40mg organic manganese /kg diet produced eggs with higher total antioxidant when compared with the control diet.

In terms of the chemical analysis of stored eggs, the results showed that hens fed diets supplemented with 0.1, 0.2 mg organic selenium and 20mg organic manganese + 0.1mg organic selenium / kg diet produced eggs with lower cholesterol concentration content by about 37.0, 34.63 and 17.5 % respectively than control group.

Table 3. Effect of dietary organic manganese, selenium and mixtures of them on chemical analysis of fresh yolks yolk of Sinai laying hens.

Treatments		Fresh egg yolks			Stored egg yolks		
		T. cholesterol (mg/g)	Triglyceride (mg/g)	T. Antioxidant (mM/L)	T. cholesterol (mg/g)	Triglyceride (mg/g)	T. Antioxidant (mM/L)
Dietary organic Manganese, Selenium and mixtures of them (mg /Kg diet)							
Control		36.04^{a}	132.78^{ab}	0.44^{bc}	10.8^{b}	86.2	0.66^{c}
Mn mg/Kg	20	23.80^{abc}	134.52^{a}	0.53^{ab}	15.2^{b}	89.86	0.91^{a}
	40	25.70^{abc}	127.56^{b}	0.67^{a}	19.5^{ab}	98.14	0.36^{e}
	60	31.84^{ab}	133.71^{a}	0.44^{bc}	29.95^{a}	87.8	0.72^{bc}
Se mg/Kg	0.1	13.77^{cd}	127.96^{b}	0.68^{a}	7.06^{b}	91.55	0.75^{bc}
	0.2	21.65^{bcd}	133.71^{a}	0.41^{bc}	6.76^{b}	84.59	0.72^{bc}
	0.3	9.98^{d}	134.52^{a}	0.32^{c}	13.21^{b}	93.43	0.81^{b}
Mn+Se mg/Kg	20+0.1	16.23^{cd}	133.58^{a}	0.53^{ab}	8.91^{b}	84.06	0.38^{e}
	40+.02	27.29^{abc}	135.19^{a}	0.35^{c}	19.30^{ab}	88.07	0.51^{d}
	60+.03	31.43^{ab}	132.11^{ab}	0.44^{bc}	28.51^{a}	84.86	0.38^{e}
SE		1.84	0.65	0.03	1.81	0.91	0.04
Sig.		0.05	0.05	0.05	0.05	NS	0.05

NS= Non significant; a,b,c :means in the same row bearing different superscripts are significantly different ($p \leq 0.05$).

No significant alternations were detected in triglycerides in stored eggs yolk produced due to using any of the dietary treatments. However, Yolk content of total antioxidant was significantly ($P \leq 0.05$) affected by the dietary 20 mg organic manganese /kg diet and 0.3 mg organic selenium where, these treatments caused significant increase stored yolk content of total antioxidant, in contrast the total antioxidant in stored yolk significantly ($p \leq 0.05$) decreased due results from the diets contained 40mg organic manganese, 20 + 0.1, 60 + 0.3 and 40 + 0.2mg organic manganese +organic selenium /kg diet compared to the control diet.

The results in the current study illustrated that organic manganese and selenium resulted in improve the internal egg quality in terms of the triglycerides, cholesterol and total antioxidant especially in fresh eggs yolk, there is no discrepancy between results in the present study and the findings by Miura *et al.* (2001) who reported that natural antioxidant reduces the content of cholesterol and triglycerides. In addition, Venglovska *et al.* (2014) reported that feed supplementation with Mn from organic sources appears to be more effective in preventing yolk lipid oxidation during cold storage of eggs than that from Mn-sulphate.

The reduction of cholesterol and increase total antioxidant in yolks by feeding diets supplemented with natural antioxidant may be explained as follow; natural antioxidant decreased oxidative profiles and cholesterol due to decreasing cholesterol absorption where, Panda *et al.*, (2003) hypothesized that the cholesterol – lowering effect was due to reduced cholesterol absorption from the gastrointestinal tract and/or by the deconjugation of bile salts in the intestine, which would prevent their reabsorption via the enterohepatic circulation.

An explanation could be that Mn from organic sources may improve the stability of yolk lipids through superoxide dismutase (SOD), whose optimal activity could prevent the initiation of lipid peroxidation. Wawrzykowsky and Kankofer (2011) confirmed the presence of SOD and its activity in hen egg yolk. Their study also showed significant decrease in SOD activity after a9-day storage of egg yolk samples. It appears that variation in SOD activity of egg yolk during storage may indicate such a role of manganese in the stability of egg yolk lipids. In respect of Se, Zduńczyk *et al.* (2013) found that increasing the inclusion levels of vitamin E and Se in a diet with a high PUFA content has no effect on egg production and quality, but it increases the concentrations of both antioxidants and retinol in the yolk. It is interesting to note that at sight on these results, it is illustrated that the levels of cholesterol was decreased by stored egg yolks irrespective of the treatments, this effect may be the cholesterol in egg yolk is very low density lipoprotein (VLDL), they are the major carries endogenous triglycerides and the half-life of VLDL in serum is only 1 to 3 hours (Vasudevan and Sreekumari, 2001)

Reproductive traits:

The effect of dietary organic Mn, Se and their mixture on fertility%, hatchability and chick body weight at hatch are shown in Table (4).The results clearly observed that fertility % of eggs from hens fed diets supplemented with 0.2 mg organic Se and 40 mg organic Mn / Kg diet increased by about 2.1 and 1.29 % only as compared to the control died. Conversely, our results indicated that the low level of both organic selenium alone and mixture of organic Mn + Se resulted in a significant decrease in fertility% comparing with the control group, meanwhile the other dietary treatments ameliorated this adverse effect, but this improvement was insignificant as compared to the control group.

In terms of commercial hatchability, it is worth to mention that the eggs from hens fed diet contained 0.2 mg organic selenium / Kg diet showed better records than control diet by 4.41 % followed by the diets supplemented with 40 mg organic Mn+0.2 organic Se /Kg diet and 40 mg organic Mn / Kg diet, while the other treatments did not differ from control group.

Results of the hatchability of fertile eggs come in accordance with those of hatchability of set eggs, the higher value of scientific hatchability % occurred as a result of the diets supplemented with40 mg organic Mn and 40 mg organic MN+0.2 organic Se /Kg diet / Kg diet compared to the control diet by about 4.73 and 4.55 % respectively. On the other hand, the diet contained 20mg organic manganese / Kg diet tends to significantly ($P \leq 0.05$) lower percentage of scientific hatchability diet by 5.55% of control diet, but the other dietary treatments did not actually fifer from control group.

Additionally, it is clear from the present results reported that chick's weight at hatch (g/chick) significantly (P≤0.05) decreased by the diets with 0.2 mg organic selenium, 20 and 60 mg organic manganese / Kg diet compared to control diet. While, no significant influence of other treatments on chick's weight at hatch could be detected.

Table 4. Effect of dietary organic manganese, selenium and mixtures of them on reproductive traits of Sinai laying hens

Treatments		Reproductive traits			
		Fertility%	Hatchability of total eggs	Hatchability of fertile eggs	BW/chick at hatch
Dietary organic Manganese, Selenium and mixtures of them (mg /Kg diet)					
Control		95.19^{abc}	86.58^{ab}	90.94^{abc}	35.68^{ab}
Mn	20	93.51^{cde}	80.21^{c}	85.89^{d}	34.98^{c}
	40	94.10^{bcd}	89.61^{a}	95.24^{a}	35.85^{ab}
	60	96.42^{ab}	83.89^{bc}	86.92^{cd}	35.00^{c}
Se	0.1	91.70^{e}	86.17^{ab}	94.01^{ab}	34.92^{c}
	0.2	97.15^{a}	90.74^{a}	93.44^{ab}	35.29^{bc}
	0.3	95.87^{abc}	82.15^{bc}	85.60^{d}	36.78^{ab}
Mn+Se	(20+0.1)	92.31^{de}	83.64^{bc}	90.54^{bc}	35.72^{ab}
	(40+0. 2)	94.58^{bcd}	89.92^{a}	95.08^{a}	35.83^{ab}
	(60+0. 3)	95.58^{abc}	84.27^{bc}	87.98^{cd}	37.22^{a}
SE		0.36	0.73	1.69	0.19
Sig.		0.05	0.05	0.05	0.05

a,b,c :means in the same column bearing different superscripts are significantly different (p ≤ 0.05).

These results are compatible with the findings of Rutz *et al.* (2003), who reported that the supplementation of organic manganese and zinc (30 and 30 mg/kg) to broiler breeder hen diets increased the fertility and hatchability. In addition, these data are in harmony with the results of Abdallah *et al.* (2014) who illustrated that there was significant increase in fertility % for eggs of groups fed 100% and 50% Organic trace minerals, 50% Organic Cu and 50% Organic Se compared with control inorganic trace minerals. The use of organic minerals in diets significantly improved hatchability % compared with control Inorganic trace minerals. Moreover, Yenice *et al.*, (2015) showed that the dietary supplementation of organic (chelated with methionine) manganese at high levels (80mg/kg) increased the hatchability of the fertile eggs and hatchability of set eggs compared to that of the other groups.

A potential reason to the improvement in hatchability % due to the adding 40 mg organic manganese /Kg diet by 4.73% of control is that manganese plays a very important role in bone development, both in the embryo and after hatch. The ground substance of developing bone, particularly the proteoglycan matrix in which collagen and elastin are embedded, requires manganese for glycosylation of its protein core molecule (Fawcett, 1994). In addition, manganese-dependent enzymes promote formation of the proteoglycan matrix in the cartilage model for developing bone (Rath *et al*., 1997).

In accordance with the findings by Surai *et al.*, (1997), who postulated that the beneficial consequences of an effective protection against lipid peroxidation of birds semen are likely to result from two related mechanisms: (a) Defense against peroxidative damage is essential to maintain the structural integrity of the spermatozoa; (b) Minimization of lipid peroxidation will prevent any reduction in the concentrations of the functionally important n-6 polyunsaturated fatty acids of the semen phospholipids. Thus, enhancement of the antioxidant capacity of semen by supplementation of natural antioxidants such as organic Mn and Se could present a major opportunity for improving fertility %.

This improvement in fertility and hatchability% results from supplementation 0.2 mg organic Se/ kg diet may be due to Selenium is an essential cofactor for approximately 25 selenoproteins (Fairweather-Tait *et al.*, 2011), including the glutathione peroxidases (GPx1–8 (Brigelius-Flohe and Maiorino 2013), selenoprotein P and thioredoxin reductases. GPxs are enzymes crucial for detoxification and protecting cells from oxidant damage. GPx4 is found in both mitochondria and cytosol; it is expressed in most tissues but is found in a high concentration in the testes. GPx4 has been proposed to have functions in apoptosis and protecting mitochondrial function from damaging radicals (Cole-Ezea *et al.*, 2012), sperm development (Toppo *et al.*, 2008) and embryonic development (Ufer *et al.*, 2011).

Surai and Fisinin (2013) illustrated that there are important roles of selenium in the maintenance of semen quality and optimal Se status of poultry males and Se is considered to be an important factor in ensuring the fertility of breeding stock. Also, selenium status of the eggs from breeding birds is of great importance for the maintenance of the antioxidant system of the developing embryo. It is generally accepted that the hatching process is an oxidative stress and improvement in antioxidant defenses of the embryo can increase hatchability.

In addition, the combination between 40mg organic manganese+ 0.2mg organic selenium increased the scientific hatchability and this improvement was higher than organic manganese and selenium alone suggesting synergistic effect. The possible reason for this influence may be due to there are many factors that can interfere with the antioxidant status of a chick, and many of these oxidative stress factors act at different stages of development before hatch (Surai 2007).

Manganese and selenium retention

Regarding the selenium retention as shown in Table (5), it is evident that the best values of manganese retention were observed due to the diets contained 60, 40 mg organic manganese, 20mg organic manganese+0.1mg organic selenium, 40mg organic manganese+0.2mg organic selenium, 0.3 mg organic selenium and 20 mg organic manganese / Kg diet where the differences were significant as compared to the control diet. While, the other dietary treatments (0.1 and 0.2 mg organic selenium / Kg diet) had no significant influence on manganese retention compared to the control group. Also, all dietary treatments had significant higher selenium retention than control diet especially the diet supplemented with 0.2 mg organic selenium / kg diet because this treatment returned to occupy the first position in respect of selenium retention and significantly exceeded the control diet by about 47.59%.

The improvement in manganese and selenium retention may be due to many mechanisms, initially, trace mineral salts tend to dissociate in the low pH environment of the upper gastrointestinal tract, leaving the minerals susceptible to various nutrient and ingredient antagonisms that impair absorption (reduce bioavailability) (Underwood and Suttle, 1999). A previous study has shown that compared with inorganic form, the absorption rate of organic minerals in the gastrointestinal tract is higher (Ji *et al.*, 2006). In addition, animals fed chelated sources of essential trace minerals excrete lower amounts in their feces and the risk of environmental contamination may be reduced from manure (Lesson 2003).

Table 5. Effect of dietary organic manganese, selenium and their mixtures on Mn and Se retention of Sinai laying hens.

Traits	Control	Organic Mn (mg/kg diet)			Organic Se(mg/kg diet)			Mn + Se			SE	Sig.
		20	40	60	0.1	0.2	.03	20+0.1	40+0.2	60+0.3		
Mn retention												
FI/3d	344.7	391.57	443.17	351.13	350.10	488.80	354.87	254.10	394.00	273.67		
Ex./3d	89.90	139.02	128.39	122.57	112.70	136.62	95.72	88.20	133.11	94.92		
F Mn[1]	37.13	39.80	59.8	79.80	37.13	37.13	37.13	39.80	59.8	79.80		
I Mn[2]	12.80	15.58	26.5	28.02	13.00	18.15	13.18	10.11	23.56	21.84		
Mn E[3]	109.60	71.63	72.75	57.42	94.65	101.25	86.22	58.21	89.95	104.56		
MnO[4]	9.85	9.96	9.34	7.04	10.67	13.83	8.25	5.13	11.97	9.93		
Mn r[5]	23.05^{d}	35.68^{c}	64.99^{a}	75.12^{a}	17.90^{d}	23.79^{d}	36.51^{c}	49.20^{b}	48.50^{b}	53.73^{b}	3.44	0.05
Se retention												
F Se[6]	0.15	0.15	0.15	0.15	0.12	0.22	0.32	0.12	0.22	0.32		
I Se[7]	0.05	0.06	0.07	0.05	0.04	0.11	0.11	0.03	0.09	0.09		
Se E[8]	0.21	0.07	0.09	0.09	0.04	0.04	0.12	0.06	0.08	0.09		
Se O[9]	0.02	0.01	0.01	0.01	0.004	0.006	0.011	0.006	0.011	0.009		
Se r[10]	64.07^{g}	82.72^{de}	83.40^{d}	79.90^{f}	89.25^{ab}	94.56^{a}	89.65^{ab}	80.86^{ef}	87.13^{c}	89.64^{b}	1.50	0.05

[1]=the concentration of Mn in feed; [2]=the intake of Mn; [3]= the excretion of Mn; [4]= the out of Mn; [5]= the retention of Mn; [6]=the concentration of Se in feed; [7]=the intake of Se; [8]= the excretion of Se; [9]= the out of Mn; [10]= the retention of Se; a,b,c…g: means in the same column bearing different superscripts are significantly different (p ≤ 0.05).

It should be noted that different organic trace minerals are not equally stable at low pH, and therefore will not necessarily increase the bioavailability of a given mineral to the same extent (Guo *et al.*, 2001). This beneficial influence was probably related to changes in the mineral element repartition in the hens and in particular to manganese accumulation in bones, promoted by the use of organic forms of mnganese (Yildiz *et al.*, 2011).

Increased serum total cholesterol and LDL levels in control group (Table6) resulted in increase the risks of lipid peroxidation. The body modulates antioxidant system, such as SOD and GSH-Px activity, to scavenge ROS. Decreases in SOD activity, for example in a mineral deficiency, can lead to increased amounts of lipid, protein and nucleic acid damage, which can induce cellular death (Kokoszka *et al.*, 2001). Thus, the integrity of cell membrane leads to increase the absorption of these minerals.

Serum biochemical traits of hens

Data obtained on serum biochemical traits of hens are shown in Table (6). In respect of total cholesterol (mg/dl), it is noticed the diet supplemented with 0.2 mg organic Se diet and 60 mg organic Mn /Kg diet resulted in decrease in total serum cholesterol compared to the control diet by about 17.96 and 7.29% respectively.

Table 6. Effect of dietary organic manganese, selenium and their mixtures on serum biochemical traits in Sinai laying hens at 42 weeks of age.

Treatments		Serum biochemical traits					
		T. cholesterol (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	HDL /LDL	HDL/T. cholesterol	Antioxidant activity (mM/L)
Dietary organic Manganese, Selenium and mixtures of them (mg /Kg diet)							
Control		124.87^{bc}	4.13^{bcd}	54.73^{abc}	0.08^{bc}	0.035^{bc}	0.21
Mn mg/Kg	20	148.90^{abc}	4.97^{ab}	59.30^{abc}	0.08^{bc}	0.03^{bc}	0.20
	40	159.27^{ab}	2.77^{et}	75.70^{a}	0.04^{d}	0.012^{d}	0.19
	60	115.77^{bc}	5.50^{a}	51.10^{bc}	0.12^{a}	0.05^{a}	0.24
Se mg/Kg	0.1	148.97^{abc}	3.07^{cde}	64.77^{ab}	0.05^{cd}	0.02^{cd}	0.16
	0.2	102.45^{c}	4.20^{bc}	38.30^{c}	0.11^{ab}	0.04^{ab}	0.23
	0.3	140.70^{abc}	2.85^{et}	54.75^{abc}	0.06^{cd}	0.02^{cd}	0.09
Mn+Se mg/Kg	(20 + 0.1)	189.65^{a}	2.30^{t}	68.40^{ab}	0.04^{d}	0.018^{d}	0.21
	(40 + 0.2)	155.35^{abc}	2.95^{det}	47.90^{bc}	0.06^{cd}	0.02^{cd}	0.28
	(60 + 0.3)	149.80^{abc}	3.65^{cde}	76.60^{a}	0.04^{d}	0.02^{cd}	0.22
±SE		6.09	1.14	5.77	0.01	0.002	0.05
Sig		0.05	0.05	0.05	0.05	0.05	NS

a,b,c :means in the same column bearing different superscripts are significantly different (p ≤ 0.05).

Statistical analysis revealed significantly differences among treatments in serum HDL (mg/dl), where supplementation organic Mn up to 60 mg /Kg diet of Sinai laying hens produced a significant increase in serum HDL as compared to the control diet, while the diet contained high level of organic selenium and low level of manganese together resulted in a significant decrease serum HDL compared to control diet.

It is obvious that hens fed diets supplemented with 0.2 mg organic Se, 60 mg organic Mn and 40 mg organic Mn+ 0.2 mg organic Se / Kg diet decreased the level of serum LDL compared to the control diet.

In terms of the ratio of HDL/LDL, the high level of organic Mn (60 mg) and 0.2 mg organic Se / Kg diet had the best value of ratio HDL/LDL compared to the control diet, on the other hand when the low and high levels of organic Mn and Se were supplemented together in the Sinai layer's diet (20mg + 0.1 mg and 60 mg + 0.3 mg /Kg diet) the value of HDL/LDL was significantly (P ≤ 0.05) lower than control group.

In this respect, feeding Sinai laying hens on diet supplemented with 60 mg organic Mn / Kg diet resulted in a significant($P \geq 0.05$) increase the HDL / Total cholesterol, meanwhile the hens fed diets contained 40 mg organic Mn and 20 mg organic Mn+ 0.2 mg organic Se / Kg diet had significantly ($P \leq 0.05$) lower HDL/ total cholesterol than control diet.

Regarding serum antioxidant activity, when different levels of organic manganese, selenium and their mixture were added to the diet no significant ($P \geq 0.05$) effect were observed. However, the diet with both organic Mn and organic Se together at the medium dose (40+ 0.2 mg / Kg diet) lead to higher value of serum antioxidant activity by about 33 % of control diet.

These results are consist with Attia *et al.* (2006) found that vitamin E and/or Se supplementation significantly decreased triglycerides. Moreover, Sun *et al.* (2012) who reported that when organic sources of Zn, Mn, Cu and Se were added to the diet for broiler breeders instead of inorganic forms of these microelements had a positive effect on lipid metabolism (decreased plasma cholesterol and triglycerides, increased yolk triglycerides via increasing HDL and decreasing LDL).

This result perhaps due to the different sources of minerals might change lipid metabolism by regulating apolipoprotein synthesis, where, Cu, Mn, and Se were reported to be associated with apo E (Kawano *et al.*, 1987), and apo A (Bleys *et al.*, 2008) synthesis, which playing critical roles in lipoprotein metabolism. Ljubic *et al.* (2006) suggested that the organic Se supplementation influences cholesterol metabolism in adipose tissue by decreasing the total cholesterol concentration during the fattening period and increasing the free cholesterol concentration after 48 h feed deprivation.

The results in the current study indicated that the diet contained 0.2mg organic Se, 60 mg organic Mn and the mixture between 40 mg organic Mn+0.2mg organic Se /kg diet improved egg production performance, profile lipids, antioxidant activity in eggs and blood serum as well as economic efficiency of egg production.

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تأثير إضافة السلينيوم و المنجنيز العضوي علي الأداء الإنتاجي للدجاج البياض المحلي المغذي علي عليقة تحتوي علي زيت الصويا كمصدر للأحماض الدهنية الأساسية

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استخدم في هذا البحث عدد٣٠٠ دجاجة بياض من سلالة سينا المحلية و ٣٠ ديك عمر ٢٧ اسبوع. وقد تم وزنها وتوزيعها عشوائيا بناءا علي وزن الجسم الي ١٠ معاملات تجريبية ولكل معاملة ٣ مكررات وذلك لدراسة تأثير اضافة مستويات مختلفة من المنجنيز والسلنيوم العضوي والخليط بينهما في العليقة البياض علي الأداء الإنتاجي والتناسلي وجودة البيض الداخلية واحتجاز كل منهما وذلك لدجاج السينا البياض خلال الفترة من ٢٧- ٤٣ أسبوع من العمر. تم امداد الدجاجات بعليقة بياض تحتوي علي ١,٥% زيت صويا كمصدر للأحماض الدهنية الأساسية . كل العلائق متساوية في الطاقة والبروتين ولكن تحتوي علي مستويات متدرجة من المنجنيز العضوي (٢٠و ٤٠و ٦٠ مجم / كجم عليقة), و السلينيوم العضوي (٠,١و ٠,٢ و ٠,٣ مجم / كجم عليقة) وكذلك الخليط بينهما (٢٠+١,٠ و ٢٠+٢,٠ و٦٠+٣,٠ مجم منجنيز+سلينيوم / كجم علف), حيث أن البريمكس المخصص للعليقة ٢ و٣ و٤ خالي من المنجنيز والبريمكس المخصص للعليقة ٥ و ٦ و ٧ بدون سلينيوم والبريمكس المخصص للعليقة ٨و ٩ و ١٠ بدون منجنيز وسلينيوم وذلك مقارنة بالعليقة المقارنة التي تحتوي علي منجنيز وسلينيوم معدني. وقد اوضحت النتائج أن مجموعة المقارنة كانت دائما لها الوزن الأعلي للجسم الحي والتغير في وزن الجسم مقارنة بالمعاملات التجريبية. الدجاجات المغذاه علي العليقة المحتوية علي ٤٠مجم منجنيز عضوى+٠,٢مجم سلينيوم عضوى / كجم علف و٦٠ مجم منجنيز عضوي / كجم علف و ٠,٢مجم سلينيوم عضوي / كجم علف شغلت المركز الأول فيما يتعلق بعدد البيض / دجاجة مقارنة بالعليقة المقارنة بحوالي ٥,٨٨ و٥,٤٩ و٤,٦٦% علي التوالي. واظهرت النتائج تفوق في كتلة البيض المنتجة من الدجاجات المغذاه علي العليقة المحتوية علي ٠,٢ مجم سلينيوم عضوي , ٤٠ مجم منجنيز عضوي+٠,٢ مجم سلينيوم عضوي / كجم علف و ٤٠ مجم منجنيز عضوي / كجم عليقة مقارنة بالعليقة المقارنة. يمكن القول أن أفضل معدل تحويل غذائي نتج عن استخدام العليقة المضاف اليها ٠,٢ مجم سلينيوم عضوي , ٤٠ مجم منجنيز عضوي +٠,٢ مجم سلينيوم عضوي و ٦٠ مجم منجنيز عضوي / كجم عليقة مقارنة بالعليقة المقارنة وباقي المعاملات التجريبية. سجلت كل المعاملات تجريبية لأقل قيمة فيما يتعلق بمستوي الكوليستيرول في صفار البيض الطازج. العلقة الحتوية علي ٠,١ مجم سلينيوم / كجم علف و كذلك المضاف اليها ٤٠ مجم منجنيز عضوي / كجم عليقة ادت الي انتاج بيض عالي في محتواه من مضادات الأكسدة الكلية عند المقارنة بصفار البيض الناتج من الدجاجات المغذاه علي العليقة المقارنة. وفيما يختص بالتحليل الكميائي لصفار البيض المخذن فقد ادت التغذية علي العلائق المضاف اليها ٠,١ و ٠,٢ مجم سلينيوم عضوي و ٢٠ مجم منجنيز عضوي + ٠,١ مجم سلينيوم عضوي / كجم عليقة انتاج بيض منخفض في محتواه من الكوليستيرول مقارنة بالعليقة المقارنة. تحسنت الخصوبة % للبيض الناتج من الدجاجات التي تم تغذيتها علي العلائق المضاف اليها ٠,٢ مجم سلينيوم عضوي , و ٤٠,٠ مجم منجنيز عضوي / كجم علف مقارنة بالعليقة المقارنة. حققت المعاملة المضاف اليها ٤٠ مجم منجنيز عضوي وكذلك المضاف اليها ٤٠مجم منجنيز عضوي+٠,٢ مجم سلينيوم عضوي / كجم عليقة أفضل نسبة للفقس من البيض المخصب مقارنة بالعليقة المقارنة. يتضح من النتائج المتحصل عليها أن افضل القيم للمنجنيز المحتجز نتج عن استخدام العلائق المحتوية علي ٦٠ و ٤٠ مجم منجنيز / كجم علف و ٢٠ مجم منجنيز عضي + ٠,١ مجم سلينيوم عضوي / كجم علف و ٠,٣ مجم سلينيوم عضوي و ٢٠ مجم منجنيز عضوي / كجم عليقة ويلاحظ ان تلك الإختلافات كانت معنوية مقارنة بالعليقة المقارنة. وأوضحت النتائج أن كل المعاملات التجريبية حققت اعلي معدل لإحتجاز السلينيوم وبدرجة معنوية مقارنة بالعليقة المقارنة. إنخفض مستوي الكوليستيرول منخض الكثافة بتغذية الدجاجات علي العلائق المضاف اليها ٠,٢ مجم سلينيوم عضوي , ٦٠ مجم منجنيز عضوي , و ٤٠مجم منجنيز عضوي+٠,٢ مجم سلينيوم عضوي / كجم عليقة مقارنة بالعيقة المقارنة. أوضحت النتائج أن العليقة المضاف اليها كل من المنجنيز والسلينيوم العضوي معا عند مستوي ٤٠ +٠,٢ مجم / كجم عليقة ادت الي اعلي قيمة للنشاط المضاد للأكسدة بحوالي ٣٣% مقارنة بالعليقة المقارنة. أوضحت النتائج أن العليقة المضاف اليها ٠,٢ مجم سلينيوم عضوي و ٦٠مجم منجنيز عضوي وايضا المضاف اليها الخليط بين المنجنيز والسلينيوم العضوي (٤٠ مجم + ٠,٢ مجم /كجم عليقة) قد حسنت من اداءانتاج البيض نوعية البيضات والنشاط المضاد للأكسده في البيض وسيرم الدم وكذلك الكفاءة الإقتصادية فيما يخص انتاج البيض.