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EFFECT OF DIETARY SUPPLEMENTATION WITH DIFFERENT SOURCES AND LEVELS OF SELENIUM ON ITS CONCENTRATION IN EGGS PRODUCED FROM GIMMIZAH HENS

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Abstract

This study was designed to investigate the effect of dietary supplementation with three different sources of selenium, Sel-Plex™ (SP), OSY-NRCE (OS) and sodium selenite, Na_2SeO_3, 45% Se (SS) at levels of 25, 50, 100, 200 and 400 µg/kg of laying hen diets containing oxidized palm oil (as a nutritional stress agent) on egg yolk and albumen selenium concentrations. At 35 wks of age, 255 Gimmizah local strain laying hens were randomly divided into seventeen equal groups. The first group was fed the basal layer diet (containing the adequate level of Se, 0.13 mg/kg diet) and served as positive control diet (+Cont), whereas, birds of the second group were fed the basal diet which contained the oxidized palm oil and free from Se supplementation and served as negative control diet (–Cont). Birds from the third to seventeenth groups were fed the negative control diet (–Cont) supplemented with either SP, OS or SS as sources of Se for two laying periods (35-39 and 39-43 wks). Each source of Se was supplemented at five experimental dietary levels (25, 50, 100, 200 and 400 µg/kg diet).

The most important results could be summarized as follows:

1- Sel-Plex™ (SP) resulted statistically the highest value (411.66 and 119.33 ng/g) of yolk Se concentration (Y Se Con) and albumen Se concentration (Al Se Con), respectively. The corresponding values of +Cont and –Cont treatments were 100.50, 38.33 and 60.00, 16.66 ng/g, in the same order.

2- Groups fed 400 µg of Se/kg diet gave statistically the highest value of Y Se Con and Al Se Con (321.76 and 92 ng/g), whereas, the lowest values were obtained with levels of 25 µg Se/kg diet (196.43 and 48 ng/g).

3- The highest values of Y Se Con and Al Se Con were observed at the end of the first laying period (35-39 wks), being 268.46 and 71.73 ng/g. Meanwhile, the second period (39-43 wks) showed statistically the lowest values.

4- Addition of SP resulted in the highest values of Y Se Con and Y + Al Se ED, being 411.66 ng/g and 12.87 %. Control-groups (+Cont and –Cont) recorded the lowest values.

INTRODUCTION

Selenium (Se) is a dietary essential nutrient for laying hens for the proper function of antioxidant enzymes. Commercial poultry production is associated with various stresses and Se, as a part of various selenoproteins, which can help to maintain antioxidant defenses, thus preventing damages to various tissues. In accordance with NRC (1994) Se requirement is quite low (ranges from 0.05 to 0.08 ppm). However, those data are not related to commercial conditions and it seems likely that Se requirement for optimal poultry health is much higher.

Historically, the Se source that has been used is the inorganic sodium selenite (Na_2SeO_3, SS). However, in 2000, an organic source of Se was approved for use as a feed supplement in poultry diets (FDA, 2000). This organic source is Se-enriched yeast (SY) that is produced by growing the yeast *Saccharomyces cerevisiae* in a high-Se deficient-sulfur media (AAFCO, 2003).

The selenium content of the egg yolk and albumen depends on its concentration in the hen diet and the form of dietary selenium (Surai, 2000, Paton *et al.,* 2002, Pappas *et al.,* 2005, Payne *et al.,* 2005 and Leeson *et al.,* 2008), and also on the age of laying hens (Sirichakwal *et al.,* 1984, Paton *et al.,* 2002 and Pappas *et al.,* 2005).

The objective of the present study aimed to investigate the effect of dietary supplementation with three different sources of selenium, Sel-Plex™ (SP), OSY-NRCE (OS) and sodium selenite, Na_2SeO_3, 45% Se (SS) on egg yolk and albumen selenium concentrations. Levels of Se used were 25, 50, 100, 200 and 400 µg/kg of laying hen diets containing oxidized palm oil (as a nutritional stress agent).

MATERIALS AND METHODS

The present study was carried out at El-Gimmizah Poultry Research Farm, in El-Gahrbia governorate, Agriculture Research Center (ARC) Ministry of Agriculture, Egypt.

Three different sources of selenium: Sel-Plex™ (SP-organic), OSY-NRCE (OS-organic) and sodium selenite (SS-inorganic) were used at the levels of 25, 50, 100, 200 and 400 µg/kg diet of Gimmizah local layer strain. Such evaluation was carried out under the stress of the presence of 250 mEq of peroxide number/kg of oil obtained by oxidizing palm oil dietary supplementation. Egg selenium concentrations, efficiency of deposition of selenium and distribution of selenium were determined for the purpose of evaluation and comparison.

1- Management and experimental design

A total of 255 hens, aged 35 weeks old of Gimmizah local strain were randomly divided into seventeen equal groups (15 birds /group) allotted to the seventeen experimental diets. Birds were housed individually in separate standard galvanized layer cages.

Hens of the first group were fed the basal layer diet [containing the adequate level of Se (0.13 mg/kg diet, as recommended by NRC, 1994) and served as positive control diet (+Cont)], whereas, birds of the second group were fed the basal diet which contained the oxidized palm oil and free from selenium supplementation and served as negative control diet (—Cont). Birds from the third to seventeenth group were fed the basal diet (+Cont-diet) and supplemented with either SP, OS, or SS as sources of selenium. Each source of selenium was supplemented at five experimental dietary levels (25, 50, 100, 200 and 400 µg/kg diet).

All birds were kept under similar hygienic and environmental conditions. Photoperiod was 17 h (natural and artificial)/day, and the ambient temperature ranged from, 20–23 °C. Feed and water were provided *ad-libtum*. Layers were fed diets containing 16.5 % crude protein, 2745 kcal ME/kg and total selenium 0.13 mg/kg of feed (according to the requirements recommended by, NRC 1994), until the beginning of the experiment. The experimental birds were randomly chosen and distributed to the dietary treatments, nearly of the same body weights and approximately equal in the production rate. The experimental diets were formulated to be iso-caloric and iso-nitrogenous according to the requirements recommended by the National Research Council (NRC, 1994). Diets were prepared weekly, kept away from light to prevent the possibility of fat oxidation and formulated as presented in Table 1. The experiment continued for 9 wks (35 to 39 and 39 to 43 wks). Separated yolks and albumens of each experimental dietary treatment group and laying period were pooled and stored at -20 °C until further analysis for selenium contents.

2- Determination of selenium

Samples from egg yolk and albumen were analyzed for selenium concentration using a fluorometric method (method 996.16, 2003) at the National Nutrition Institute, General Organization for Hospitals and Teaching Institutes, Cairo, Egypt.

Selenium was determined by Unicam 939QZ Atomic Absorption Spectrometer fitted with a GF 90 Zeeman Graphite Furnace and an FS 90 Furnace Autosampler.

3- Efficiency of deposition of selenium in the egg (%)

The efficiency of deposition of selenium in egg yolk and albumen was calculated as the ratio of the amount of selenium deposited to the amount of selenium consumed by the hen over the same period.

4- Oxidation of the refined palm oil

Oxidized palm oil (250 mEq of peroxide number/kg oil) was prepared at laboratories of El-Gimmizah Station, Agriculture Research Center, Ministry of

Agriculture, by aeration of the refined palm oil at 145°C for 24 hours (Dror *et al.*, 1976). The peroxide value was calculated as follow:

$$\text{Peroxide number (mEq / kg oil)} = \frac{\text{Volume of thiosulphate} \times \text{Standard (0.01)} \times 1000}{\text{Weight of sample}}$$

5- Statistical analysis

Data were statistically analyzed according to SAS program (SAS Inistitute, Inc., 1988), by the application of the least square procedure. Tests of significance for the difference among treatments were estimated according to Duncan's (1955). General linear models procedure with, a factorial design, (5 × 5 × 2), ANOVA model were used for the statistical analysis. Generally, the statistical model used was as follows:

$$X_{ijkl} = \mu + \alpha_i + B_j + C_k + \alpha B_{ij} + \alpha C_{ik} + BC_{jk} + \alpha BC_{ijk} + e_{ijkl}$$

Where:

- **X_{ijkl}** = Observation.
- **μ** = Overall mean.
- **α_i** = Effect of selenium sources.
- **B_j** = Effect of selenium levels.
- **C_k** = Effect of laying periods.
- **αB_{ij}** = Effect of the interaction between sourcs and levels of selenium.
- **αC_{ik}** = Effect of the interaction between sources of selenium and laying periods.
- **BC_{jk}** = Effect of the interaction between levels of selenium and laying periods.
- **αBC_{ijk}** = Effect of the interaction between selenium sources, levels of selenium and laying periods.
- **e_{ijkl}** = Residual (random error).

RESULTS AND DISCUSSION

The effect of supplementing Gimmizah layer diet with Sel-Plex™ (SP), OSY-NRCE (OS) or sodium selenite (SS) at 25, 50, 100, 200 and 400 µg/kg dietary levels as compared to the positive control diet (+Cont-diet, basal diet) and the negative control diet (—Cont-diet, basal diet containing 4% of oxidized palm oil at 250 mEq of peroxide number/kg of oil, level and free also from selenium supplementation) on egg selenium concentration (Y Se Con and Al Se Con, ng/g), efficiency of deposition of selenium in egg yolk and albumen (Y Se ED and Al Se ED, %) and selenium distribution in egg, yolk and albumen (Y Se Dis and Al Se Dis, %) during the experimental laying periods (35-39 and 39-43 wks) are shown in Tables 2, 3 and 4.

Egg selenium concentration (mg/g)

Results presented in Table 2 show that there is a highly significant (P<0.001) effect of Se source during the experimental laying periods with respect to egg yolk and albumen selenium concentration. Effect of SP-treatment recorded the highest value of Y Se Con (411.66 ± 19.61 ng/g) and Al Se Con (119.33 ± 6.60 ng/g). On the other hand, –Cont-treatment gave the lowest value being, 60.00 ± 2.39 and 16.66 ± 1.38 ng/g, respectively.

Results of the effect of dietary Se levels effect on egg selenium concentration, presented in Table 2 show highly significant (P<0.001) differences between treatments. Level of 400 µg Se/kg diet gave the highest value of Y Se Con (321.76 ± 39.22 ng/g) and Al Se Con (92.00 ± 10.58 ng/g), whereas, level of 25 µg Se/kg diet recorded the lowest value 196.43 ± 18.55 and 48.00 ± 3.99 ng/g, in a respective order.

Results presented in Table 2 show that, there is significant (P<0.001) effect due to the experimental laying periods in egg yolk and albumen selenium concentration. During the first experimental period (35-39 wks) the birds laid eggs statistically characterized by the highest value of, Y Se Con (268.46 ± 19.18 ng/g) and Al Se Con (71.73 ± 5.10 ng/g), whereas, during the second period (39-43 wks) lower values, 232.53 ± 17.19 and 65.73 ± 4.88 ng/g, respectively, were obtained.

The results of the present study showed highly significant interactions between S × L and S × P on the concentration of Se in egg yolk and albumen and S × L × P on concentration of egg yolk. However, the latter interaction on concentration of Se in egg albumen was found insignificant. In addition, L × P interaction on concentration of Se in egg yolk and albumen was found insignificant (Table 2).

In general, with respect to egg selenium concentration, experimental findings of this study are in agreement with those found by Ort and Latshaw (1978), Swanson *et al.* (1983), Sirichakwal *et al.* (1984), Surai (2000), Paton *et al.* (2002), Payne *et al.* (2005) and Leeson *et al.* (2008). On the contrary, results reported here in do not agree with the findings of Latshaw and Osman (1975) and Latshaw and Biggert (1981).

Selenium availability in feedstuffs depends on many factors, and varies considerably. These factors include the amount and chemical form of the element ingested with food, solubility within the intestine, the physiological state of the organism, interactions with other elements, diseases, drug administration and age. In this respect, the supplementation form of Se used in this study (Sel-Plex, organic source) is characterized by high availability in different animal species (Paton *et al.*, 2002). They reported that, a possible reason for elevating concentrations of Se in the yolk and white due to providing dietary Se is that the hen has additional metabolic pathways which transfer Se into the egg.

Results of Swanson *et al.* (1983) in which the barrier to Se incorporation into egg white when selenite is fed may be explained by the fact that egg white is synthesized in the oviduct and egg yolk is primarily synthesized in the liver. The lower incorporation of dietary Se in egg white, relative to yolk, could reflect the lower concentration of Se in oviduct, relative to liver tissue.

Pappas *et al.* (2005) stated that, Se in common with many other minerals, may be preferentially deposited in the yolk compared to the albumen, which is a consequence of the activity of mineral-binding lipoproteins in the formation of the egg yolk. Inorganic Se is passively absorbed.

Efficiency of deposition of selenium in the egg (%)

Results concerning the effect of Se sources during the experimental laying periods on the efficiency of deposition of selenium in egg yolk and albumen are shown in Table 3. The SP-treatment significantly recorded the highest value of Y Se ED (8.97 ± 0.24 %), Al Se ED (3.90 ± 0.20 %) and Y+Al Se ED (12.87 ± 0.42 %). On the other hand, —Cont-treatment showed the lowest value, 2.21 ± 0.07, 1.37 ± 0.10 and 3.58 ± 0.17 %, respectively. Findings reported herein are in agreement with those found by Pappas *et al.* (2005).

The influence of dietary Se levels on the efficiency of deposition of selenium in the egg yolk and albumen was highly significant ($P<0.001$). Level of 50 µg Se/kg diet recorded the highest value of Y Se ED, Al Se ED and Y+Al ED (7.04 ± 0.61, 3.41 ± 0.28 and 10.46 ± 0.87 %, respectively). Meanwhile, the highest level of Se supplementation (400 µg Se/kg) gave the lowest value 4.80 ± 0.31, 1.94 ± 0.09 and 6.74 ± 0.38 % in a respective order.

Data presented in Table 3 show that there is a significant ($P<0.001$) effect due to the experimental laying periods on efficiency of deposition of Se in egg yolk and albumen. During the first experimental laying period (35-39 wks) the efficiency of Se deposition values for Y Se ED, Al Se ED and Y+Al ED were 6.56 ± 0.36, 2.97 ± 0.16 and 9.54 ± 0.50 %, respectively, whereas, during the second period (39-43 wk) values were 5.83 ± 0.30, 2.59 ± 0.13 and 8.42 ± 0.42 % in the same order.

The results of the present experiment showed highly significant interactions between S × L and S × P on the efficiency of deposition of Se in egg yolk and albumen and egg yolk plus albumen (Table 3).

Distribution of selenium in the egg (%)

Significant (P<0.001) effect due to Se sources on distribution of selenium in egg yolk and albumen was noted (Table 4). However, differences between SP, OS and SS sources were found to be insignificant in the distribution of Se in egg yolk and albumen. The SS-treatment gave the highest value of Y Se Dis (72.08 ± 0.65 %), whereas, --Cont-treatment showed the highest value of Al Se Dis (36.83 ± 1.26 %).

With respect to the dietary Se level effects on the distribution of Se in egg yolk and albumen, data presented in Table 4 showed significant (P<0.05) differences between treatments. Level of 400 µg Se/kg diet gave the highest value of Y Se Dis (70.21 ± 1.16 %) and the lowest value of Al Se Dis (29.78 ± 1.16 %), whereas, level of 50 µg Se/kg showed the highest value of Al Se Dis (33.30 ± 0.95 %) and the lowest value of Y Se Dis (66.69 ± 0.95 %). No significant effect due to the experimental laying periods on the distribution of Se in both egg yolk and albumen was obtained.

Results may be explained on the basis that, various Se compounds give different patterns of distribution because egg white proteins are synthesized in the oviduct, and yolk proteins are synthesized in the liver. Chicken, like any mono-gastric animals, probably cannot synthesize seleno amino acids from inorganic Se compounds just as they cannot synthesize amino acids from inorganic sulfer compounds.

Quantitave of much importance, the quanitative distribution of Se between the yolk and the white is strongly affected by the nature of Se fed. The differences in the metabolism of Se compounds which resulted in differences in the distribution of Se in egg yolk and white may be related to differences in the dynamics of selenomethionine incorporation via incorporation into liver and synthesis there of yolk proteins as compared to synthesis of albumen in the oviduct.

Table 1. Composition and calculated analysis of the experimental positive and negative control diets.

Ingredients	+Cont	– Cont
	%	
Ground yellow corn (9 %)	51.5	51.5
Soybean meal (44 %)	23.74	23.74
Wheat bran	11	11
Refined palm oil	4	-
Oxidized palm oil*	-	4
Di-Calcium phosphate	1.5	1.5
Limestone	7.6	7.6
Sodium chloride	0.3	0.3
Vitamin mixture**	0.1	0.1
Mineral mixture***	0.1	0.1
Dl-Methionine	0.06	0.06
Choline chloride	0.1	0.1
Total	100	100
Calculated nutrient content**** :		
Metabolizable energy (Kcal/kg)	2745	2745
Crude protein (%)	16.53	16.53
Ether extract (%)	6.47	6.47
Crude fiber (%)	3.55	3.55
Calcium (%)	3.34	3.34
Avilable phosphorus (%)	0.49	0.49
Linoleic (%)	1.87	1.25
Dl-Methionine (%)	0.31	0.31
L-Lysine (%)	0.82	0.82
Selenium (mg/kg)*****	0.13	0.03

* Containing 250 mEq of peroxide number/kg oxidized oil.

** Ibex International Limited Company. Each kg of the mixture contains: Vit. A, 10000 IU, Vit. D_3, 2000 IU, Vit. E, 10 mg, Vit. K_3, 2 mg, Vit. B_1, 1 mg, Vit. B_2, 5 mg, Vit. B_6, 1.5 mg, Vit. B_{12}, 10 mg, Nicotinic acid, 30 mg, Folic acid, 1 mg, Pantothenic acid, 15 mg and Biotin, 50 mg.

*** Ibex International Limited Company. Each kg of the mixture contains: Copper, 4 mg, Iron, 30 mg, Manganese, 60 mg, Zinc, 50 mg, Iodine, 0.3 mg and Cobalt, 0.1 mg.

**** According to NRC (1994).

***** 1mg= 10^3 µg.

Table 2. Effect of dietary supplementation with different sources and levels of selenium during two laying periods on concentration of selenium (ng/g) in egg yolk and albumen, (Mean ± S.E) of Gimmizah laying hens fed diets containing, 250 mEq of peroxide number / kg of oxidized palm oil.

Items	Egg weight / hen (g)	Y Se Con	Al Se Con
		(ng / g)	
Source of Se (S):	***	***	***
+Cont	$51.52^a \pm 0.27$	$100.50^d \pm 1.66$	$38.33^d \pm 1.27$
–Cont	$44.69^d \pm 0.22$	$60.00^e \pm 2.39$	$16.66^e \pm 1.38$
SP	$50.38^b \pm 0.28$	$411.66^a \pm 19.61$	$119.33^a \pm 6.60$
OS	$48.60^c \pm 0.18$	$365.66^b \pm 15.92$	$94.66^b \pm 4.43$
SS	$48.06^c \pm 0.20$	$314.66^c \pm 10.95$	$74.66^c \pm 3.94$
Level of Se (L), (µg / kg diet):	***	***	***
25	$46.02^e \pm 0.21$	$196.43^e \pm 18.55$	$48.00^e \pm 3.99$
50	$47.34^d \pm 0.21$	$216.76^d \pm 21.63$	$59.66^d \pm 5.76$
100	$49.32^c \pm 0.20$	$242.76^c \pm 25.63$	$69.66^c \pm 7.40$
200	$50.46^b \pm 0.26$	$274.76^b \pm 30.71$	$74.33^b \pm 8.18$
400	$51.39^a \pm 0.27$	$321.76^a \pm 39.22$	$92.00^a \pm 10.58$
Laying period (p), (wks):	***	***	***
35 - 39	$48.52^b \pm 0.16$	$268.46^a \pm 19.18$	$71.73^a \pm 5.10$
39 - 43	$49.29^a \pm 0.17$	$232.53^b \pm 19.19$	$65.73^b \pm 4.88$
Interactions:			
S × L	***	***	***
S × P	**	***	***
L × P	*	**NS**	**NS**
S × L × P	**NS**	***	**NS**

- Y Se Con: concentration of selenium in the yolk, Al Se Con: concentration of selenium in the albumen.
- Source of Se: +Cont, positive control (basal diet), –Cont: negative control (basal diet containing 4% of oxidized palm oil + 0µg/kg of Se), SP: Sel-Plex, Alltech, Inc. (organic selenium), OS: OSY-NRCE, Int. Res. Center (organic Se), SS: sodium selenite (inorganic selenium).
- 1 mg= 10^3 µg= 10^6 ng.
- Significant level: NS = not significant, * = P≤ 0.05, ** = P≤ 0.01, *** = P≤ 0.001.
- Means followed by different superscripts (a, b, c, d and e) in the same column are significantly different (P≤0.05).

Table 3. Effect of dietary supplementation with different sources and levels of selenium during two laying periods on efficiency of deposition of selenium (%) in egg yolk and albumen, (mean ± s.e) of gimmizah laying hens fed diets containing 250 meq of peroxide number /kg of oxidized palm oil.

Items	Y Se ED	Al Se ED	Y + Al ED
	---------------(%)---------------		
Source of Se (S):	***	***	***
+Cont	$4.33^{d} \pm 0.08$	$2.27^{d} \pm 0.09$	$6.61^{d} \pm 0.15$
–Cont	$2.21^{e} \pm 0.07$	$1.37^{e} \pm 0.10$	$3.58^{e} \pm 0.17$
SP	$8.97^{a} \pm 0.24$	$3.90^{a} \pm 0.20$	$12.87^{a} \pm 0.42$
OS	$8.08^{b} \pm 0.28$	$3.52^{b} \pm 0.24$	$11.61^{b} \pm 0.50$
SS	$7.41^{c} \pm 0.43$	$2.84^{c} \pm 0.15$	$10.25^{c} \pm 0.56$
Level of Se (L), (µg/ kg diet):	***	***	***
25	$6.77^{ab} \pm 0.59$	$3.17^{ab} \pm 0.26$	$9.94^{b} \pm 0.82$
50	$7.04^{a} \pm 0.61$	$3.14^{a} \pm 0.28$	$10.46^{a} \pm 0.87$
100	$6.67^{b} \pm 0.56$	$3.04^{b} \pm 0.23$	$9.72^{b} \pm 0.78$
200	$5.71^{c} \pm 0.42$	$2.34^{c} \pm 0.13$	$8.05^{c} \pm 0.54$
400	$4.80^{d} \pm 0.31$	$1.94^{d} \pm 0.09$	$6.74^{d} \pm 0.38$
Laying period (p), (wks):	***	***	***
35 - 39	$6.56^{a} \pm 0.36$	$2.97^{a} \pm 0.16$	$9.54^{a} \pm 0.50$
39 - 43	$5.83^{b} \pm 0.31$	$2.59^{b} \pm 0.13$	$8.42^{b} \pm 0.42$
Interactions:			
S × L	***	***	***
S × P	***	***	***
L × P	**	**NS**	**
S × L × P	**	**NS**	**NS**

- Y Se ED: efficiency of deposition of selenium in the yolk, Al Se ED: efficiency of deposition of selenium in the albumen, Y+ Al Se ED: efficiency of deposition of selenium in the yolk plus albumen.
- Source of Se: +Cont, positive control (basal diet), –Cont: negative control (basal diet containing 4 % of oxidized palm oil + 0 µg Se /kg), SP: Sel-Plex, Alltech, Inc. (organic selenium), OS: OSY-NRCE, Int. Res. Center (organic Se), SS: sodium selenite (inorganic selenium).
- 1 mg= 10^{3} µg= 10^{6} ng.
- Significant level: NS = not significant, * = P≤ 0.05, ** = P≤ 0.01, *** = P≤ 0.001.
- Means followed by different superscripts (a, b, c, d and e) in the same column are significantly different (P≤0.05).

Table 4. Effect of dietary supplementation with different sources and levels of selenium during two laying periods on distribution of selenium (%), in egg yolk and albumen, (Mean ± S.E) of Gimmizah laying hens fed diets containing 250 mEq of peroxide number / kg of oxidized palm oil.

Items	Y Se Dis	Al Se Dis
	----------(%)----------	
Source of Se (S):	***	***
+Cont	65.78[b] ± 0.78	34.21[b] ± 0.78
–Cont	63.16[c] ± 1.26	36.83[a] ± 1.26
SP	70.16[a] ± 0.69	29.83[c] ± 0.69
OS	70.50[a] ± 0.88	29.49[c] ± 0.88
SS	72.08[a] ± 0.69	27.91[c] ± 0.69
Level of Se (L), (µg / kg diet):	*	*
25	67.31[bc] ± 1.11	32.68[ab] ± 1.11
50	66.69[c] ± 0.95	33.30[a] ± 0.95
100	67.74[abc] ± 0.93	32.25[abc] ± 0.93
200	69.72[ab] ± 1.08	30.27[bc] ± 1.08
400	70.21[a] ± 1.16	29.78[c] ± 1.16
Laying period (p), (wks):	**NS**	**NS**
35 - 39	67.96 ± 0.74	32.03 ± 0.74
39 - 43	68.71 ± 0.60	31.28 ± 0.60
Interactions:		
T × L	**NS**	**NS**
T × P	*	*
L × P	**NS**	**NS**
T × L × P	**NS**	**NS**

- Se Dis: distribution of selenium separately in the yolk and albumen.
- Source of Se: +Cont, positive control (basal diet), –Cont: negative control (basal diet containing 4 % of oxidized palm oil + 0 µg Se /kg), SP: Sel-Plex, Alltech, Inc. (organic selenium), OS: OSY-NRCE, Int. Res. Center (organic Se), SS: sodium selenite (inorganic selenium).
- 1 mg= 10^3 µg= 10^6 ng.
- Significant level: NS = not significant, * = P≤ 0.05, ** = P≤ 0.01, *** = P≤ 0.001.
- Means followed by different superscripts (a, b, c, d and e) in the same column are significantly different (P≤0.05).

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تأثير إضافة مصادر ومستويات مختلفة من السيلينيوم على تركيزه فى البيض الناتج من دجاج الجميزة

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أجريت هذه التجربة لدراسة تأثير إضافة ثلاثة مصادر من السيلينيوم وهى، المركبين التجاريين سيل بليكس وخميرة غنية بالسيلينيوم كمصدرين للسيلينيوم العضوى وسيلينات الصوديوم (٤٥ % سيلينيوم) كمصدر للسيلينيوم المعدنى حيث أضيف كل مصدر من المصادر الثلاثة إلى علائق الدجاج البياض بخمسة مستويات وهى ٢٥ ،٥٠، ١٠٠، ٢٠٠، ٤٠٠ ميكروجرام/كجم من عليقة الدجاج البياض التى تحتوى على زيت النخيل المؤكسد (كإجهاد غذائى) على تركيز السيلينيوم فى كل من الصفار والبياض. إستخدم عدد ٢٥٥ من بدارى سلالة الجميزة (عمر ٣٥ أسبوع) حيث قسمت عشوائيا إلى ١٧ مجموعة غذائية. وقد غذيت المجموعة الأولى على عليقة البياض الأساسية (والتى تحتوى على المستوى الكافى من السيلينيوم ١٣ مجم/كجم من العليقة) وإعتبرت عليقة الكنترول الموجب، وغذيت طيور المجموعة الثانية على العليقة الأساسية والتى تحتوى على زيت النخيل المؤكسد وغير مضاف إليها أى من مصادر السيلينيوم وإعتبرت عليقة الكنترول السالب، بينما غذيت المجموعات من الثالثة حتى السابعة عشر على العليقة الأساسية (عليقة الكنترول السالب) والتى أضيف إليها أحد مصادر السيلينيوم (سيل بليكس Sel–Plex™ أو خميرة غنية بالسيلينيوم OSY-NRCE أو سيلينات الصوديوم sodium selenite) لفترتين من إنتاج البيض (من ٣٥–٣٩، من ٣٩– ٤٣ أسبوع) حيث أضيف كل مصدر من مصادر السيلينيوم الثلاثة بخمسة مستويات وهى ٢٥ ، ٥٠ ، ١٠٠ ، ٢٠٠ ، ٤٠٠ ميكروجرام/كجم عليقة. ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى:

١– الطيور المغذاه على علائق السيل بليكس Sel-Plex (SP) أعطت إحصائيا القيم الأعلى (٤١١,٦، ١١٩,٣٣ نانوجرام/جم) لتركيز السيلينيوم فى كل من صفار وبياض البيضة على الترتيب، بينما كانت القيم المناظرة لكل من الكنترول الموجب والسالب ١٠٠,٥٠ ، ٣٨,٣٣ ، ٦٠,٠٠ ، ١٦,٦٦ نانوجرام/جم على التوالى.

٢– مجموعات الدجاج البياض المغذاه على علائق تحتوى على مستوى ٤٠٠ ميكروجرام سيلينيوم/كجم أعطت إحصائيا القيم الأعلى لتركيز السيلينيوم فى كل من الصفار والبياض (٣٢١,٧٦، ٩٢ نانوجرام/جرام) بينما أعطت مجموعات ٢٥ ميكروجرام/كجم عليقة تركيزات أقل (١٩٦,٤٣ ، ٤٨ نانوجرام/جرام).

٣– أوضحت النتائج إرتفاع مستويات السيلينيوم فى كل من صفار وبياض البيض الناتج فى المرحلة الإنتاجية الأولى من ٣٥–٣٩ أسبوع (٢٦٨,٤٦ ، ٧١,٧٣ نانوجرام/جرام)، بينما إنخفضت هذه المستويات معنويا فى الفترة الإنتاجية الثانية ولكن كانت تركيزاته إحصائيا الأقل فى الفترة الثانية من ٣٩–٤٣ أسبوع (٢٣٢,٥٣ ، ٦٥,٧٣ نانوجرام/جرام).

٤– أدت إضافة السيل بليكس Sel-Plex™ (SP) إلى الحصول على تركيزات أعلى (إحصائيا) لعنصر السيلينوم بالنسبة لكفاءة ترسيبه فى صفار وبياض البيض (٨,٩٧، ٣,٩ %).