NUTRITIONAL AND MANAGEMENT STUDIES ON THE PIGEON:

EFFECT OF SELENIUM SOURCE AND LEVEL ON PIGEONS PERFORMANCE.

By

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Abstract: *An experiment was conducted to compare the effect of organic and inorganic sources of selenium (Se) and their levels on performance of pigeons. A total of 40 pair of parent Baladi pigeons (24 months old) were distributed equally according to their consistent mating systems (sex ratio of pigeons 1:1) to 5 treatments 8 pairs (4 replicates of 2 pairs each). Birds were housed under similar environmental conditions. The first treatment was fed a commercial diet and served as a control (contains 15.65 % CP, 2752.7 Kcal ME / Kg, and 0.1 mg Se / Kg diet). Other treatments were fed commercial diet, supplemented with two types of Se dietary sources; organic {(Se-enriched yeast (SY) and inorganic (sodium selenite (SS)} continuing two dietary levels of Se (0.1 or 0. 2 mg Se / Kg diet). Feed and water were offered ad libitum along the experimental period.*

Results obtained are summarized as follow :

1- Dietary organic selenium source (SY) had significant ($P \leq 0.05$) effect on squabs weight gain at 28 days of age, mortality percentage and economic efficiency.

2- Increasing the dietary Se levels decreased feed intake for pigeons without or with squabs during all experimental studied periods.

3- Increasing dietary Se levels increased the daily Se intake.

4-Egg number, egg weight, fertility and hatchability were significantly ($P \leq 0.05$) increased as dietary Se levels increased in the diet, but the infertile eggs and egg cycle were decreased.

5- Pigeons fed diets contained higher level of Se had significantly the highest number of weaned squabs, body weight and weight gain during 28 days of age compared with those fed the lowest Se level.

6- Economic efficiency (EE) of squab increased with the increase in Se level containing diet.

7- Dietary selenium levels significantly interacted ($P \leq 0.05$) to feed intake, Se intake, egg cycle, egg number, egg weight, fertility, hatchability, infertile eggs, number of weaned squabs, body weigh and, weight gain during 28 days of age.

It can be concluded that Selenium-enriched yeast (SY) recorded a greater result of the productive and reproductive performance than SS. The highest dietary Se level of pigeon (0.3mg Se/kg of diet) gave the best performance as compared with other Se levels. The diet contain (0.1mg Se/kg of diet) level was suggested to be suitable to cover the requirement without adverse effects on productive and reproductive performance of local Baladi squabs and pigeons under Egyptian conditions.

INTRODUCTION

Selenium has been recognized as an essential nutrient for over 40 yr. It is required for maintenance of health, growth, and physiological functions. Traditionally, selenium (Se) has been added to poultry diets via inorganic sources, such as sodium selenite (Na2SeO3). Research has shown that organic Se has more bioavailability than Se in sodium selenite **(Cantor *et al*., 1982)**. Therefore, Se organic sources, such as Se yeast, have been explored as an alternative to inorganic supplementation **(Payne *et al*., 2005).** Low Se content of human diets has been correlated with higher incidences of cancer **(Allan *et al.,* 1999)** Therefore; Feeding Se yeast inclusion to laying hens may add value to market eggs

The role of selenium in biological systems has been associated with its antioxidant activity **(Schwarz and Foltz, 1957).** Its physiological importance was recognized when it was found to be an essential structural component of the glutathione peroxidase enzyme (GSHpx) **(Rotruck *et al.,* 1973),** which has an important role in preventing oxidative damage in erythrocytes or tissues. In chickens, **Cantor *et al.,* (1975a)** found that selenium deficiency induced oxidative diathesis or pancreatic fibrosis. Supplementation of selenium to reach the optimum and required level in the diet was efficient in preventing such disorders.

Selenium deficiency may affect metabolism and production performance because it is essential for the synthesis of active thyroid hormones. **Utterback *et al.,* (2005)** showed that there were no differences in egg production, egg weight, feed intake, or mortality by using organic Se yeast as a Se source for laying hens. They added that Se yeast in laying hens diets is very effective for increasing the Se content of eggs. Also, **Payne *et al.* (2005)** found that the percentage hen-day production was not affected by Se source, where Se-enriched yeast (SY) increased egg Se concentrations more than that of sodium selenite.

Selenium is a dietary essential nutrient for laying hens **(NRC, 1994)**. The laying hen requirement for Se ranges from 0.05 to 0.08 ppm depending on daily feed intake **(NRC, 1994).** This Se amount can be met by that of corn soybean meal containing diet without additional supplementation. However, Se content of feed grains widely varied from region to region **(NRC, 1994),** and thus it is a common practice in the poultry diets. The maximum allowed Se inclusion level in the United States is 0.30 ppm. Historically, Se source that has been used is the inorganic sodium selenite (Na2SeO3; SS). However, in 2000, an organic source of Se was approved for use as a feed supplement in poultry diets **(FDA, 2000).** This organic feed additive is produced by growing the yeast *Saccharomyces cerevisiae* in a high-Se medium **(AAFCO, 2003).**

Leeson *et al.* (2008) reported that egg production was not affected by Se source or dietary fat containing diets. Egg production was greater ($P \leq 0.01$) in hens fed 0.3 mg/kg of Se of both source. Hatchability of eggs obtained from hens fed 0.1 mg/kg of Se containing diet was lower ($P < 0.05$) than those hens fed Se yeast, whereas hens fed Se inclusion at level 0.3 mg/kg was comparable cross treatments. Eggs of hens fed organic Se inclusion had greater ($P \leq 0.01$) ones. **Pan *et al.* (2007)** showed that the addition of organic or inorganic Se caused a significant increase in Se concentration of whole-egg**. Yoon *et al.* (2007)** found that selenium supplementation did not influence ($P \leq 0.05$) the growth performance of broilers at 42 d of age. **Sahin *et al*. (2008)** suggested that supplementation with Se-Met can be considered to be more protective than Na2SeO3 by reducing the negative effects of oxidative stress induced by heat stress in quail.

The objective of this study was to evaluate the effect of either organic or inorganic selenium levels (0.1, 0.2 and 0.3mg Se/ kg diet) inclusion on the productive and reproductive performance of pigeons during the laying period under Egyptian condition.

MATERIALS AND METHODS

The experimental work was carried out at El - Gimmizah Production Sector and El - Gimmizah Poultry Research Farm, Agricultural Research Center, Ministry of Agriculture; throughout 6 consecutive months during years 2007 / 2008. Treatment, were classified according to supplemented selenium (Se) to two sources treatment, each treatment was received either Se-enriched yeast (SY) and sodium selenite (SS) inclusion under each Se source, two different levels (0.1 and 0.2 mg / kg diet plus 0.1 mg Se / Kg in the control diet) were tested. .

The first group of pigeons was served as a control (diet No. 1 contains 15.65 % CP, 2752.7 Kcal ME / Kg, and 0.1 mg Se / Kg diet, Table 1). Whereas the ether groups, received the control basal diet supplemented with either two sources of Se (SY or SS) under each source two different levels (0.1 or 0.2 mg / Kg diet as selenium enriched yeast; treatments 2 and 3), and sodium selenite; treatments 4 and 5 respectively). The composition of experimental diets is shown in (Table 1).

A total number of 40 pairs of parent Baladi pigeons (24 months old) were distributed according to their consistent mating systems (sex ratio of pigeons 1:1) randomly into equal four treatments containing 8 pairs (4 replicates of 2 pairs each). Birds were housed under similar environmental conditions, all pairs were randomly collocated in wire poultry cages (100 x 70 x 40 cm high), the front of the cage batteries were modified to suspend feed and water. Feed and water were provided to birds *ad-libitum*. In each breeding cage, two males and two females pigeons (Baladi pigeons) were allowed to form couples on a random basis. In each breeding cage, the pigeons were able to feed their squabs up to the age of 28 days as a weaning stage. At this age, squabs were ready and in prime condition for slaughter or were transferred to be reared further. Throughout the year, natural light patterns were buffered, with pigeons experiencing naturally long day length in four seasons.

During the experimental period, the following measurements were performed or calculated: initial body weight, final body weight, changes in body weight, daily feed intake per pair with or without squab, total feed intake per pair, daily Se intake per pair, total Se intake per pair with or without squab, egg cycle (interval between to consecutive egg laying (days)), egg number, egg weight, fertility, infertile eggs, embryo dead, hatchability, squabs production per pair, squabs growth during 28 days, body weight gain (BWG) in squabs during 28 days, squabs mortality rate, livability, net return (NR) and economic efficiency (EE).

Data were analyzed using general linear model (GLM) procedure of statistical analysis system **(SPSS 1997).** Significant differences among individual means were analyzed by Duncan"s multiple range test **(Duncan, 1955).**

RESULTS AND DISCUSSION

Growth performance of pigeons:

Results in (Table 2) indicated that pigeons body weight and body weight gain were not affected by source and level of Se ($P \geq 0.05$) containing diets during 24-30 months of age. Also, there were no significant interaction between Se source and levels for BW and BWG. The overall growth performance results are in general agreement with results of **Miller *et al.* (1972)** who reported that no difference in body weight and body weight gain of broilers fed various concentrations (0 to 0.5 ppm) of Se from SS or SM, also **Edens *et al.* (2001)** reported no differences in BW when broilers were fed diets contained 0.20 ppm Se from SS or SY. **Spears *et al.* (2003)** also reported no difference in gain of broilers fed diets contained 0, 0.05, or 0.15 ppm Se from SS or SM. **Payne and Southern (2005)** showed that the daily gain was not affected by Se source or level of inclusion through different any period of growth.

However, present results do not agree with those of **Cantor *et al.* (1982),** who reported that BW was increased at 28-d-old turkey poults fed SS or SM (0.04 to 0.12 ppm Se) compared with those fed a basal diet. Moreover **Bunk and Combs (1980)** reported an increase in gain of chicks fed diet 0.15 ppm SS containing compared with those fed a basal diet.

Daily feed and Se intakes of the pigeons without or with squabs:

Daily feed and Se intake of pigeons with or without squabs were not significantly ($P \leq 0.05$) affected by different sources of Se where as daily feed and Se intake were significantly ($P<0.05$) affected by Se levels inclusion (Tables 3 and 4). These results indicated that the feed intake by pigeons without or with squabs decreased through all growth period when the Se level was increased from 0.1mg to 0.3mg Se/kg diet. While, Se intake by pigeons without or with squabs were increased with increasing Se level containing experimental diet. In addition, the amount of feed intake was increased with increasing the age of squabs. The hatched squabs were given only crop milk from the first day until 4th day, then the parents will start to give the squabs rations mixed with the crop milk. While the amount of feed intake by pigeons was increased at 14, 21 and 28 days. This may be due to increase body weight of squabs, and crop size, whereas the crop milk produced by parent were decreased with the increase in age of squabs. Then, squabs required a larger amount of feed with advanced ages. There were significant interactions due to studied factors for daily feed and Se intake, where the highest daily FI was attained with the low Se level containing the control diet 0.1mg Se. A significant Se source and levels interaction was observed because Se intake was increased with increasing levels of Se for both studied sources. The differences in the actual Se levels containing diets were minor compared with the related responses of different source of Se.

Utterback *et al.* (2005) showed no differences in feed intake were obtained organic Se inclusion for laying hens. Similar finding was obtained from experiment of **Miller *et al.* (1972)** who reported no difference in feed intake of broilers fed various concentrations (0 to 0.5 ppm) of Se from SS or SM

Cantor *et al.* (1982) reported that feed intake of 28-d-old turkey poults fed SS or SM (0.04 to 0.12 ppm Se) was increased in compared with those fed a basal diet. The present results do not agree with those of **Bunk and Combs (1980),** who reported that SS or SM inclusion increased feed intake in chicks after oral administration compared with chicks received a water sham.

Cantor *et al.* (1984) indicated that the upper limit before feed intake decreases is 4mg of SS per liter of drinking water, which is equivalent to 7 ppm of SS in the diet. The herein results of feed intake and percentage of hen-day production are in agreement with those of **Cantor and Scott (1974), Cantor *et al.* (2000) and Patton (2000),** who indicated that 3 ppm of SS or SM is not toxic to laying hens.

Egg laying cycle length:

Results in (Table 5) indicated that, pigeons fed the lowest dietary Se level (0.1 mg/kg, control diet) put on a significantly ($P \leq 0.05$) longest length of egg cycle (interval between to consecutive egg laying (days)) compared to those fed either level 2 (0.2 mg/kg diet) or level 3 (0.3 mg/kg diet). While, no significant effect due to sources of Se on egg laying cycle of pigeons during 24-30 months of age. A significant interaction was observed between Se source and levels for egg cycle length, where Se source and levels resulted in decrease length of egg laying cycle from 50.75 to 47.37 days. Tr. 3 had the lowest significant length of egg cycle (47.37 day), whereas the differences between Tr.2 and Tr.4 was not significant in length of egg cycle (49.62 and 49.25 days, respectively). Tr.5 recorded (48.25 day), while Tr.1 had the highest significant length of egg cycle (50.75 day). The length of the egg cycle values depended on the activity of parents to rear their squabs and times of environmental conditions. This result is in agreement with that of **Abed Al-Azeem, (2005)** who found that the interval between two consecutive egg laying (cycles) ranged from 45.80 to 54.60 days.

It is worthy to note that pigeons fed the highest dietary level (0.3mg/kg diet) of Se for either Se sources had significantly ($P \leq 0.05$) shorter length of egg cycle compared to other levels. The opposite was true with pigeons fed the lowest dietary level (0.1mg/kg diet) of Se which recorded the longest egg cycle.

Egg number (EN) and Egg weight (EW):

Results in (Table 5) indicated that dietary Se sources had no significant effect on egg weight (EW), whereas using high level (control diet 0.1mg Se + 0.2mg Se) of supplementation led to significant difference in EN and EW. Selenium source and levels supplementation significantly ($P \leq 0.05$) increased EN (from 6.75 to 8.37 eggs) and EW (from 13.89 to 14.82 g) compared with the other treatments (Table 5). So, the Se source and level interaction was significant for EN and EW. Selenium of treatments improved EN by (27.70%) and EW by (8.78%) compared with that of Tr. 1 (control diet 0.1mg Se). While, high Se level in SY source improved EN by 6.15% and improved EW by 3.92% compared to that of SS source. Also, Pigeons fed diet of treatments 2 and 4 improved EN by 11.11% and 1.77% and improved EW by 3.09% and 2.95%, respectively compared with these fed the control diet, but pigeons fed diet of treatments 3 and 5 improved EN by 27.7% and 20.29% and improved EW by 8.78% and 4.67%, respectively compared with pigeons fed the control diet.

Although egg number and egg weight increased in the presence of Se supplementation; Egg number and egg weight were slightly better in SY diets as compared to those of SS diets. These findings agree with those reported by **Leeson *et al.* (2008)** who showed that egg production was not affected by Se sources containing diets in both breeders and layers. Egg production was greater ($P < 0.01$) in breeder hens fed 0.3 mg/kg of Se than that of layer. Eggs of breeder hens fed organic Se sources inclusion had greater ($P < 0.01$) Se content than those received inorganic source. **Payne *et al.* (2005)** indicated that up to 3 ppm of SS or SY can be used to supplement the diets for laying hens without detrimental effects on percentage hen-day production. Furthermore, SY resulted in a greater deposition of Se in the whole-egg than does of SS. **Zoran *et al.* (2009)** reported that all supplemented treatments accumulated significantly more Se in egg; yet supplementation of SY to hen's diet resulted in a higher egg production than that of SS ($P<0.01$). However, no effects of dietary treatments were observed on egg weight.

On the other hand, **Utterback *et al.* (2005)** found that no significant differences ($P \leq 0.05$) in egg production and egg weight was attained with basal diet plus either sodium selenite or Se yeast. **Arnold *et al.* (1973)** reported a decrease in percentage hen-day production as supplementing diet which had insignificant effect with 8 ppm of SS, whereas the opposite was attained with 2 ppm of SS supplementation. Different result was found by **Ort and Latshaw (1978)** who reported no adverse effects on percentage hen-day production in diets supplemented with 0, 0.1, 1,3, 5, or 7 ppm of SS, but percentage hen-day production was decreased by 9 ppm of SS addition.

Generally, pigeons fed high levels of selenium had higher egg number and egg weight throughout the experiment all period and selenium had a favorable effect on egg production.

Fertility and hatchability treats:

Adding dietary Se sources to basal diet had no significant effect on total fertility, total hatchability, and hatchability in fertile eggs, infertile eggs and dead embryos. While, Se levels addition had a significant effect on total fertility, total hatchability, and infertile eggs. Total fertility and total hatchability were significantly ($P \leq 0.05$) increased when Se levels increased, but infertile eggs was significantly ($P \leq 0.05$) decreased when Se levels increased (Table 5). A significant effect was observed between Se sources and level interaction due to a greater response of SY at high Se levels. Increasing Se of SY up to 0.3mg Se/kg diet had a positive effect and resulted in highest total fertility and total hatchability followed by SS source. This result is in agreement with that of **Leeson *et al.* (2008)** who found that hatchability of eggs obtained from hens fed 0.1 mg/kg of Se was lower ($P < 0.05$) than those fed Se yeast inclusion, whereas it was comparable across treatments as increasing Se up to 0.3 mg/kg. **Hudson and Wilson, (2003)** found that supplementation of male breeder diets with 0.3 mg/kg of Se increased glutathione peroxidase (GSH-Px) activity and enhanced protection against lipid peroxidation in the cockerel semen. On the other hand, **Pappas *et al.* (2006)** reported that supplementation of the hen diets with Se did not affect hatchability**.**

Squab production:

Data of squab production are presented in Table (6). Number of squabs per treatment was significantly ($P \leq 0.05$) increased by increasing Se levels containing. Results indicated that high Se level (0.3mg Se/kg diet) significantly recorded the highest number of weaned squabs than that of the low Se level (0.2 mg Se/kg diet) or (0.1mg Se/ kg diet). While, Se source (SY) recorded significantly the highest number at the end of 1st, 2nd and 3rd

week than the SS ones, but there was no significant effect between Se sources in number of weaned squabs.

Number of squabs production was significantly affected by Se source and highly significant with Se levels. Se source and level interactions were significant for number of squabs production, where Se supplementation improved number of weaned squabs (39.36% and 26.31%) in pigeons consumed 0.3mg Se/kg diet with SY and SS sources respectively. Pigeon fed 0.2mg Se/kg diet with SY and SS source improved number of weaned squabs by 10.52% and 5.26% as compared with 0.1mg Se/ kg diet.

Number of weaned squabs was higher in the upper Se level than other levels. Furthermore, the highest number of weaned squabs was attained with the 0.3mg Se/kg diet plus SY source which was superior (6.62 squabs) followed by the diet of 0.3mg Se/kg diet contained SS source (6.00 squabs).While, the lowest number of weaned squabs was found at the 0.1mg Se/kg diet which was junior, 4.75 squabs.

Squabs growth weight SGW (g) through period of 28 days:

Table (6) shows results of squab growth from hatching until 28 days old (males and females) which was not affected by different source of Se inclusion ($P<0.05$). Significant differences were observed in the hatched body weight of squabs, at 7, 14, 21 days or weaned squabs which were fed different levels of Se inclusion. The results indicated that weights of squabs at hatch were similar among experimental groups and ranged from 12.38 to 13.13 g.

Results indicated that increasing dietary Se content of experimental diets significantly increased body weight of squabs, this difference was 7.09% between groups of diets contained lowest and the highest Se content at the market age. A significant interaction was due to Se source and levels, especially Se at high SY levels. When Se supplementation was reduced to 0.2mg Se/kg of diet with SY and SS, it had a positive effect on squabs weights. Pigeon fed diet containing high Se level recorded significantly heavier weight compared with pigeon fed the low Se level from either the two sources.

Body Weight Gain BWG (g) through period of 28 days:

Results indicated that although body weight gain (BWG) was not affected by different sources of Se during periods of (1-7), (8-14) and (21-28) day old, significant increase in BWG of squabs at periods of (15-21) day and (1-28) days was detected. The increases in Se levels in the diets led to a significantly increase BWG of squabs during the experimental period (Table

7). Body weight gain of squabs at 28 days was significantly affected by Se level. Results indicated that increasing dietary Se content in the experimental diets significantly increased body weight gain of squabs, this difference was (7.31%) between the diets contained the lowest and the highest Se content in the market age. A significant interaction was observed between Se source and levels due to a greater response of Se at high levels with SY or SS. Pigeon fed diet containing high Se level in either source recorded significantly heavier weight compared with pigeon fed the low Se level without Se supplement.

Mortality rate:

Mortality rate during the 28 days of age was significantly affected by Se source but not significantly affected by the increasing Se levels in the diet and no significance was found between Se source and levels interaction (Table 7). This result is in agreement with that of **Payne *et al.* (2005)** who observed no difference in mortality due to Se supplementation. Also, **Utterback *et al.* (2005)** showed no differences in mortality as supplementing diet with organic Se in laying hens.

Livability:

The livability percentage of pigeon squabs was not affected by the dietary Se source, Se levels and interaction between them (Table 7).

Net Return (NR) and Economic Efficiency (EE):

The cost of one kg diet was decreased with decreasing dietary Se levels inclusion in the diet (Table 8). The NR of each / pair at the end of the period (180 days) was 0.31, 3.99, 14.34, 2.53 and 10.55 for Tr. 1 Tr. 2 Tr. 3 Tr. 4 and Tr. 5, respectively. Net return recorded the highest values for pigeon fed diets containing 0.3mg Se of both Se sources. It is worth to note that the high Se level recorded more NR and EE than that of other levels.

Therefore, it is evident that comparing Se level in diet on the basis of NR or EE showed that (Tr. 3 followed by Tr. 5 were the most superior than that of the lower Se level (Tr. 1).From economic point of view, it appears that the inclusion of 0.3mg Se /kg of diet or 0.2mg Se/kg of diet in either source for pigeon parents diets is economically effective. Dietary Se level is considered as one of the major factors that affect the productive performance of pigeon.

From the results of this experiment, it can be concluded that the selenium content of pigeon diets plays an important role and significantly affects the most important reproduction traits. Feeding high selenium diets increases number and weight of weaned squabs. This may be due to the increase of alive squabs and decrease of mortality rate in treatment.

In conclusion, supplementing diet with SY recorded a greater result in the productive and reproductive performance than SS ones. The highest dietary Se level for pigeon (0.3mg Se/kg of diet) gave the best performance compared with other Se levels. The diet containing (0.1mg Se/kg of diet) level was suggested to be suitable requirement and had no adverse effects on productive and reproductive performance of local Baladi squabs and pigeons under Egyptian conditions.

Table (1): Composition and calculated analyses of the experimental diet.

Ingredients	**(%)**
Yellow corn	**64.00**
Soybean meal, (44 %CP)	**20.00**
Wheat bran	**11.90**
Limestone	**1.50**
Bone meal	**2.00**
Common salt (NaCl)	**0.30**
Vit. & Min. mix.*	**0.30**
Total	**100**
Calculated values**:	
Crude protein, %	**15.65**
ME, Kcal/kg	**2752.70**
Crude fiber,%	**4.24**
Ether Extract,%	**3.23**
Calcium, %	**1.194**
Available phosphorus, %	**0.401**
Lysine, %	**0.820**
Methionine,%	**0.287**
Methionine + cysteine %	**0.565**
Se, mg/kg	**0.100**
Price of ton (LE)	**1595**

*Vit.& Min. mix:. each 1kg diet contains: 10,000 IU Vit. A; 2,000 IU Vit D_3 10 mg Vit. E;1mg Vit. K; 1mg Vit. B1; 5mg Vit. B2; 1..5mg Vit B6; 0.1mg Vit. B12; 0.3mg; Niacin, 10 mg ; Panatothenic acid, 0.5 mg, Biotin; I mg Folic acid;250 mg choline chloride; 60 mg manganese; 30 mg iron; 50 mg zinc; 4 mg copper;0.3 mg iodine; 0.1 mg Seleinium and 0.1mg cobalt.
** Calculated according to NRC (1994).

Table (2): Effects of different dietary source and levels of selenium inclusion on the growth performance of pigeons for body weight and body weight gain, throughout the experimental period from 24 to 30 months of age.

Items	Initial body weight (g)	Final body weight (g)	Body weight gain (g)
Selenium source:	**NS**	**NS**	**NS**
Se-enriched yeast (SY)	313.65	324.68	11.03
Sodium selenite (SS)	315.27	326.66	11.39
±SEM	4.88	5.25	0.40
Dietary selenium levels :	**NS**	**NS**	**NS**
Level 1 (control diet 0.1mg Se)	317.28	327.09	9.80
Level 2 (control diet 0.1mg Se + 0.1mg Se)	315.89	326.81	10.92
Level 3 (control diet 0.1mg Se + 0.2mg Se)	313.03	324.53	11.50
±SEM	4.25	4.59	0.37
Interaction Se source x Se level	**NS**	**NS**	**NS**
Tr. 1 (control diet 0.1mg Se)	317.28	327.09	9.81
Tr. 2 (control diet 0.1mg Se + 0.1mg Se (SY))	317.17	327.88	10.71
Tr. 3 (control diet 0.1mg Se + 0.2mg Se (SY))	310.12	321.47	11.35
Tr. 4 (control diet 0.1mg Se + 0.1mg Se (SS))	314.60	325.73	11.13
Tr. 5 (control diet 0.1mg Se + 0.2mg Se (SS))	315.93	327.58	11.65
±SEM	4.25	4.59	0.37

NS = Not significant ($P \geq 0.5$).

Table (3): Effects of different dietary source and levels of selenium on the daily feed intake (FI) of pairs (g/day) without or with squabs of pigeons throughout the experimental period from 24 to 30 months of age.

Items	Without squabs	With squabs at 7 days	With squabs at 14 days	With squabs at 21 days	With squabs at 28 days	Total FI without squabs during 28 days	Total FI with squabs during 28 days	Total FI with / without squabs during 180 days
Selenium source:	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Se-enriched yeast (SY)	101.18	112.06	126.75	137.87	156.93	2833.25	3735.37	21555.83
Sodium selenite (SS)	101.06	111.31	124.56	138.03	156.93	2829.75	3717.00	21465.31
±SEM	0.956	0.802	0.678	0.803	0.784	26.780	18.204	120.566
Dietary selenium levels :	*	*	*	*	*	*	*	*
Level 1 (control diet 0.1mg Se)	105.50a	115.50a	129.75a	142.50a	161.50a	2954.00a	3844.75a	22143.26a
Level 2 (control diet 0.1mg Se + 0.1mg Se)	102.75ab	113.00ab	127.81a	139.50ab	158.56ab	2877.00ab	3772.12a	21748.62ab
Level 3 (control diet 0.1mg Se + 0.2mg Se)	99.50b	110.37b	123.50b	136.56b	155.31b	2786.00b	3680.25b	21272.51b
±SEM	0.839	0.704	0.630	0.768	0.770	23.51	17.43	
Interaction Se source x Se level	*	*	**	*	*	*	**	*
Tr. 1 (control diet 0.1mg Se)	105.50a	115.50a	129.75a	142.50a	161.50a	2954.00a	3844.75a	22143.26a
Tr. 2 (control diet 0.1mg Se + 0.1mg Se (SY))	102.75ab	113.50ab	128.50a	139.87ab	158.50ab	2877.00ab	3782.62ab	21773.36ab
Tr. 3 (control diet 0.1mg Se + 0.2mg Se (SY))	99.62b	110.62b	125.00bc	135.87b	155.37b	2789.50b	3688.12b	21338.29b
Tr. 4 (control diet 0.1mg Se + 0.1mg Se (SS))	102.75ab	112.50ab	127.12ab	139.12ab	158.62ab	2877.00ab	3761.62ab	21723.88ab
Tr. 5 (control diet 0.1mg Se + 0.2mg Se (SS))	99.37b	110.12b	122.00c	137.25b	155.25b	2782.50b	3672.37c	21206.73b
±SEM	0.839	0.704	0.630	0.768	0.770	23.512	17.435	108.818

a-b: For each criterion, means in the same column bearing different superscripts differ significantly

** = P ≤ 0.01, * = P ≤ 0.05 and NS = Not significant (P ≥ 0.5).

Table (4): Effects of different dietary source and levels of selenium on daily selenium intake of pairs (g/day) without or with squabs of pigeons throughout the experimental period from 24 to 30 months of age.

Items	Without squabs	With squabs at 7 days	With squabs at 14 days	With squabs at 21 days	With squabs at 28 days	Total Se without squabs	Total Se with squabs
Selenium source:	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Se-enriched yeast (SY)	0.0252	0.0279	0.0316	0.0344	0.0392	0.7061	0.9314
Sodium selenite (SS)	0.0252	0.0278	0.0310	0.0345	0.0392	0.7501	0.9271
±SEM	0.0008	0.0009	0.0010	0.0011	0.0013	0.0242	0.0316
Dietary selenium levels :	**	**	**	**	**	**	**
Level 1 (control diet 0.1mg Se)	0.0106c	0.0116c	0.0130c	0.0143c	0.0161c	0.2954c	0.3844c
Level 2 (control diet 0.1mg Se + 0.1mg Se)	0.0206b	0.0226b	0.0256b	0.0279b	0.0317b	0.5754b	0.7544b
Level 3 (control diet 0.1mg Se + 0.2mg Se)	0.0299a	0.0331a	0.0371a	0.0410a	0.0466a	0.8358a	1.1041a
±SEM	0.0011	0.0013	0.0014	0.0016	0.0018	0.0326	0.0431
Interaction Se source x Se level	**	**	**	**	**	**	**
Tr. 1 (control diet 0.1mg Se)	0.0106c	0.0116c	0.0130d	0.0143c	0.0161c	0.2954c	0.3844c
Tr. 2 (control diet 0.1mg Se + 0.1mg Se (SY))	0.0206b	0.0227b	0.0257c	0.0280b	0.0317b	0.5754b	0.7565b
Tr. 3 (control diet 0.1mg Se + 0.2mg Se (SY))	0.0299a	0.0332a	0.0375a	0.0408a	0.0466a	0.8368a	1.1064a
Tr. 4 (control diet 0.1mg Se + 0.1mg Se (SS))	0.0206b	0.0225b	0.0254c	0.0278b	0.0317b	0.5754b	0.7523b
Tr. 5 (control diet 0.1mg Se + 0.2mg Se (SS))	0.0298a	0..0330a	0.0366b	0.0412a	0.0466a	0.8347a	1.1017a
±SEM	0.0011	0.0013	0.0014	0.0016	0.0018	0.0326	0.0431

a-c: For each criterion, means in the same column bearing different superscripts differ significantly

** = P ≤ 0.01, * = P ≤ 0.05 and NS = Not significant (P ≥ 0.5).

Table (5): Effects of different dietary source and levels of selenium on the productive and reproductive performance of pigeons throughout the experimental period from 24 to 30 months of age.

Items	Egg cycle (day)	Egg number	Egg weight (g)	Total fertility	Total hatchability	Hatchability in fertile eggs	Infertile egg	Dead embryos
Selenium source:	**NS**	*	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Se-enriched yeast (SY)	48.50	8.06	14.71	94.39	89.27	94.45	6.43	5.54
Sodium selenite (SS)	48.75	7.50	14.42	91.02	85.91	94.80	10.75	5.19
±SEM	0.209	0.160	0.116	1.330	1.703	1.539	1.657	1.539
Dietary selenium levels :	**	*	*	*	*	**NS**	*	**NS**
Level 1 (control diet 0.1mg Se)	50.75a	6.75b	13.89b	88.91b	81.69b	92.26	13.03a	7.73
Level 2 (control diet 0.1mg Se + 0.1mg Se)	49..43b	7.18b	14.31b	89.84ab	84.67ab	94.49	12.17a	5.50
Level 3 (control diet 0.1mg Se + 0.2mg Se)	47.81c	8.37a	14.82a	95.57a	90.51a	94.76	5.02b	5.23
±SEM	0.220	0.154	0.112	1.184	1.456	1.356	1.460	1.356
Interaction Se source x Se level	**	**	**	**	**	**NS**	*	**NS**
Tr. 1 (control diet 0.1mg Se)	50.75a	6.75d	13.89b	88.91b	81.69b	92.26	13.03a	7.73
Tr. 2 (control diet 0.1mg Se + 0.1mg Se (SY))	49.62b	7.50bc	14.32b	90.17b	85.49ab	94.64	11.30a	5.35
Tr. 3 (control diet 0.1mg Se + 0.2mg Se (SY))	47.37d	8.62a	15.11a	98.61a	93.05a	94.27	1.56b	5.72
Tr. 4 (control diet 0.1mg Se + 0.1mg Se (SS))	49.25b	6.87cd	14.30b	89.50b	83.85ab	94.34	13.03a	5.65
Tr. 5 (control diet 0.1mg Se + 0.2mg Se (SS))	48.25c	8.12ab	14.54ab	92.53ab	92.53ab	95.26	8.48ab	4.73
±SEM	0.220	0.154	0.112	1.184	1.456	1.356	1.460	1.356

a-d: For each criterion, means in the same column bearing different superscripts differ significantly
** = P ≤ 0.01, * = P ≤ 0.05 and NS = Not significant (P ≥ 0.5).

Table (6): Effects of different dietary source and levels of selenium on the squabs production of pigeons throughout the experimental period from 24 to 30 months of age.

Items	Squab production (squabs number)					Squabs growth at 28 days of age (g)				
	Hatch number	Number in7 days	Number in14 days	Number in21 days	Weaning number	Hatch weight (g)	Weight in 7 days(g)	Weight in 14 days(g)	Weight in 21 days(g)	Weaning weight (g)
Selenium source:	*	*	*	*	NS	NS	NS	NS	NS	NS
Se-enriched yeast (SY)	7.18	6.93	6.50	6.18	5.93	12.75	76.56	158.31	231.76	282.60
Sodium selenite (SS)	6.43	6.06	5.62	5.56	5.50	12.59	76.61	155.95	232.64	282.55
±SEM	0.187	0.200	0.195	0.178	0.169	0.138	0.929	1.458	0.743	1.071
Dietary selenium levels :	**	**	*	*	*	NS	**	*	**	**
Level 1 (control diet 0.1mg Se)	5.50c	5.12c	5.00b	4.75b	4.75b	12.61	68.22c	148.67b	225.60c	267.41c
Level 2 (control diet 0.1mg Se + 0.1mg Se)	6.06b	5.81b	5.50b	5.31b	5.112b	12.42	72.78b	149.84b	229.22b	278.77b
Level 3 (control diet 0.1mg Se + 0.2mg Se)	7.56a	7.18a	6.62a	6.43a	6.31a	12.93	80.39a	164.41a	235.18a	286.38a
±SEM	0.175	0.187	0.177	0.166	0.156	0.117	0.946	1.294	0.750	1.316
Interaction Se source x Se level	**	**	**	**	*	NS	**	**	**	**
Tr. 1 (control diet 0.1mg Se)	5.50d	5.12d	5.00c	4.75c	4.75b	12.61	68.22c	148.67c	225.60c	267.41c
Tr. 2 (control diet 0.1mg Se + 0.1mg Se (SY))	6.37c	6.12bc	5.87bc	5.50bc	5.25b	12..38	71.16bc	149.22c	227.43c	277.38b
Tr. 3 (control diet 0.1mg Se + 0.2mg Se (SY))	8.00a	7.75a	7.12a	6.87a	6.62a	13.13	81.97a	167.41a	236.08a	287.82a
Tr. 4 (control diet 0.1mg Se + 0.1mg Se (SS))	5.75cd	5.50cd	5.12c	5.12c	5.00b	12.45	74.41b	150.47c	231.10b	280.15b
Tr. 5 (control diet 0.1mg Se + 0.2mg Se (SS))	7.12b	6.62b	6.12b	6.00b	6.00a	12.73	78.80a	161.42b	234.28a	284.94a
±SEM	0.175	0.187	0.177	0.166	0.156	0.117	0.946	1.294	0.750	1.316

a-d: For each criterion, means in the same column bearing different superscripts differ significantly
** = P ≤ 0.01, * = P ≤ 0.05 and NS = Not significant (P ≥ 0.5).

Table (7): Effects of different dietary source and levels of selenium on the squabs production of pigeons throughout the experimental period from 24 to 30 months of age.

Items	Body Weight Gain in squabs (BWG)					Mortality rate %	Livability %
	Gain 1-7 day (g)	Gain 8-14 day (g)	Gain 15-21 day (g)	Gain 21-28 day (g)	Total gain 1-28 day (g)		
Selenium source:	**NS**	**NS**	*****	**NS**	*****	*****	**NS**
Se-enriched yeast (SY)	63.80	81.74	73.44a	50.84	269.84a	1.62a	64.54
Sodium selenite (SS)	64.01	79.33	69.60b	53.72	273.77b	1.12b	66.07
±SEM	0.886	0.941	1.123	1.015	1.130	0.140	2.283
Dietary selenium levels :	******	******	******	*****	*****	**NS**	**NS**
Level 1 (control diet 0.1mg Se)	55.61c	80.44b	76.93a	41.81b	254.80b	1.00	61.30
Level 2 (control diet 0.1mg Se + 0.1mg Se)	60.36b	77.05c	72.28b	53.37a	270.17a	1.31	61.13
Level 3 (control diet 0.1mg Se + 0.2mg Se)	67.45a	84.02a	70.76b	51.20a	273.45a	1.43	69.49
±SEM	0.912	0.787	0.982	1.092	1.437	0.119	1.954
Interaction Se source x Se level	******	******	******	******	******	**NS**	**NS**
Tr. 1 (control diet 0.1mg Se)	55.61c	80.44bc	76.93ab	41.81c	254.80c	1.00	61.30
Tr. 2 (control diet 0.1mg Se + 0.1mg Se (SY))	58.77bc	78.05cd	78.21a	49.95b	264.99b	1.62	58.33
Tr. 3 (control diet 0.1mg Se + 0.2mg Se (SY))	68.84a	85.43a	68.67cd	51.73ab	274.69a	1.63	70.75
Tr. 4 (control diet 0.1mg Se + 0.1mg Se (SS))	61.95b	76.05d	66.35d	56.79a	275.34a	1.00	63.92
Tr. 5 (control diet 0.1mg Se + 0.2mg Se (SS))	66.07a	82.61ab	72.85bc	50.66b	272.21a	1.25	68.22
±SEM	0.912	0.787	0.982	1.092	1.437	0.119	1.954

a-d: For each criterion, means in the same column bearing different superscripts differ significantly

** = P ≤ 0.01, * = P ≤ 0.05 and NS = Not significant (P ≥ 0.5).

Table (8): Effects of different dietary source and levels of selenium on the economic efficiency of pigeons throughout the experimental period from 24 to 30 months of age**.**

Items	Tr. 1 (control diet 0.1mg Se)	Tr. 2 (control diet+ 0.1mg Se (SY))	Tr. 3 (control diet + 0.2mg Se (SY))	Tr. 4 (control diet + 0.1mg Se (SS))	Tr. 5 (control diet + 0.2mg Se (SS))
Feed intake of pairs (kg) during 180 days	22143.26	21773.36	21338.29	21723.88	21206.73
Price of ton (LE)	1595	1625	1655	1610	1625
Price of feed cost during 180 days	35.31	35.38	35.31	34.97	34.45
Number of squabs /pair	4.75	5.25	6.62	5.00	6.00
Sale price of squabs/ pair (LE)	35.62	39.37	49.65	37.50	45.00
Net return*	0.31	3.99	14.34	2.53	10.55
Economic efficiency (%)**	0.87	11.27	40.61	7.23	30.62

During the course of study the sale price per squab was 7.5 L.E
* Net return = Price of squabs of pair during 180 day - Price of feed cost during 180 days
** Economic efficiency = (Net return / Price of feed cost during 180 dayX100

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الملخص العربي

دراسات غذائية ورعائية على الحمام

تأثير مصادر ومستوى السيلينيوم على معدل الآداء فى الحمام

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أجريت هذة التجربة لدراسة تاثير مصادر ومستويات السيلنيوم على معدل الآداء فى الحمام البلدى تحت الظروف المصرية حيث استخدمت خميرة السيلنيوم كمصدر للسيلنيوم العضوى وسلينات الصوديوم كمصدر للسيلنيوم الغير لعضوى. تم عمل التجربة خلال فترة الانتاج حيث قسم عدد 40 زوج حمام بالغ عمر(24 شهرا) الى 5 معاملات بكل معاملة 8 أزواج ، قسمت المعاملة الى 4مكررات بكل مكررة زوجين (النسبة الجنسية 1:1) غذيت المعاملة الاولى على عليقة المقارنة التى تحتوى على 15,5% بروتين خام 2753 كيلوكالورى طاقة ممثلة و0,1مجم سلينيوم / كجم عليقة وقسمت المعاملات الاخرى وفقا لمصدر السيلنيوم (خميرة السيلنيوم وسيلينات الصوديوم) وتحت كل مصدر مستويان من السيلنيوم (0,1 و 0,2 محم سلينيوم / كجم عليقة) بالاضافة لكمية السلينيوم فى عليقة المقارنة ويتم تقديم العلائق والماء بصورة حرة حتى الشبع خلال فترة التجربة.

وكانت اهم النتائج كما يلى :

1- وجد تاثيرا معنويا موجبا على وزن الجسم للزغاليل عمر 28 يوما ونسبة النفوق والكفاءة الأقتصادية مع الحمام الذى تناول عليقة خميرة السيلينيوم.

2- كمية الغذاء المتناول لآباء الحمام مع أو بدون الزغاليل يقل معنويا بزيادة مستوى السيلنيوم فى العليقة خلال مدة التجربة.

3- بزيادة مستوى السيلنيوم فى العليقة فى العليقة يزيد معنويا المتناول من السيلنيوم يوميا خلال مدة التجربة.

4- تاثرت معنويا طول دورة البيض و عدد البيض الناتج و وزن البيض و نسبة الحصوبة ونسبة الفقس بالزيادة ويقل البيض غير المخصب بزيادة مستوى السيلنيوم فى العلائق.

5- بزيادة مستوى السيلنيوم فى العلائق ذاد معنويا عدد الزغاليل الناتجة وكذلك وزن الجسم للزغاليل خلال 28 يوم مقارنة بالكنترول.

6- ترتفع الكفاءة الأقتصادية مع ارتفاع مستوى السيلنيوم خلال فترات التجربة.

7- وجد تداخل معنوى موجب بين مصادر ومستويات السيلنيوم على كل من كمية الغذاء المتناول و السيلنيوم المتناول يوميا و طول دورة البيض و عدد البيض الناتج و وزن البيض و نسبة الحصوبة ونسبة الفقس (أى ترتفع نسبة الخصوبة) ويقل البيض الغير مخصب و عدد الزغاليل الناتجة وكذلك وزن الجسم للزغاليل خلال 28 يوما.

نستخلص من هذة الدراسة امكانية استخدام خميرة السيلنيوم كمصدر للسيلنيوم فى علائق الحمام ، اذ سجلت أعلى النتائج لمعدلات الاداء الانتاجية والتناسلية مقارنة بسيلينات الصوديوم كمصدر للسيلنيوم ، وان التغذية على مستوى (0,3 سلينيوم / كجم عليقة) فى علائق الجمام كان الافضل للحصول على اعلى اداء انتاجى مقارنة بالمستويات الأخرى وان كان مستوى (0,1 سلينيوم / كجم عليقة) يغطى الاحتياجات الغذائية للحمام دون اى تاثير عكسى على الآداء الانتاجى والتناسلى للحمام البلدى المصرى تحت الظروف المصرية.