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Impact of Dietary Vitamin E and Selenium on Production Performance in Japanese Quail

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Abstract

The purpose of the current study was to study the impact of dietary supplementation of various levels of vitamin E and inorganic selenium (Sodium selenite) on daily egg weight, egg mass and egg production, accumulative egg per hen per week, final body weight gain for males, and feed conversion in both males and females of Japanese quail birds (C*oturnix coturnix japonica*). The study was conducted in the nutritional laboratory at the Veterinary Techniques Department/ Kalar Technical Institute /Garmian Polytechnic University in Iraqi Kurdistan region for a period of eight weeks from Apr 15 2021 to Jul 15 2021. In this study 128 birds (12 weeks old) were employed, they were raised in a cage system, measuring 50 width inches x 60 lengths inches × 60 height inches. Four supplemented dietary treatments from the experimental birds were designed as different levels of food regimens, then each treatment was subdivided equally into eight replicated cages. The used experimental diets were: 0 = the basal diet (control) with no additions, T1 = 1.0-gram vitamin E and selenium mixture/kg diet, T2 = 1.5-gram vitamin E and selenium mixture/kg diet, T3 = 2-gram vitamin E and Selenium mixture/kg diet. As a result of this study, egg production (HD%/week), egg accumulation (eggs per hen per week), egg mass (gram per day), feed intake (gram per day), and feed conversion ratio (kilogram feed per kilogram egg) were altered significantly ($P<0.01$). Whereas, egg weight (g) and final body weight (g) for males were not significantly impacted ($P>0.01$). In a conclusion, it was obviously shown that vitamin E and sodium selenite were effective supplementary nutrients for enhancing the reproductive performance of Japanese quail hens, so it is recommended to use this diet in the different poultry farms in order to increase some productive and reproductive features levels.

Keywards: *Inorganic selenium, Japanese quail, production performance, Vitamin E*

تأثير فيتامين هـ الغذائي و السلينيوم على الاداء الانتاجي في السمان الياباني

هدفت الدراسة الحالية إلى دراسة تأثير المكملات الغذائية بمستويات مختلفة من فيتامين هـ والسيلينيوم غير العضوي (سيلينيت الصوديوم) على وزن البيض اليومي وكتلة البيض وإنتاج البيض والبيضة التراكمية لكل دجاجة في الأسبوع والزيادة النهائية في وزن الجسم للذكور، والتحويل الغذائي في ذكور وإناث طيور السمان اليابانية (*Coturnix coturnix japonica*). تم في هذه الدراسة استخدام 128 طائرًا (عمرها 12 أسبوعًا)، وتم تربيتها في نظام قفص، بقياس 50 بوصة عرض × 60 بوصة طول × 60 بوصة ارتفاع. تم إنشاء أربع مجموعات علاجية عشوائياً من هذه الطيور وفق أنظمة غذائية مختلفة، ثم تم تقسيم كل مجموعة بالتساوي إلى ثمانية أقفاص مكررة. كانت العلائق التجريبية المستخدمة هي: 0 = العليقة الأساسية (السيطرة) بدون إضافات، T1 = 1.0 جرام فيتامين هـ + خليط السيلينيوم / كجم علف، T2 = 1.5 جرام فيتامين هـ + خليط السيلينيوم / كجم علف، T3 = 2- جرام فيتامين هـ + خليط السيلينيوم/كجم علف. نتيجة لهذه الدراسة، تم تحديد إنتاج البيض (HD%/أسبوع)، وتراكم البيض (بيض لكل دجاجة في الأسبوع)، وكتلة البيض (جرام في اليوم)، وتناول العلف (جرام في اليوم)، ونسبة التحويل الغذائي (كيلو جرام علف/ جرام بيضة) تم تغييرها بشكل ملحوظ ($P <0.01$). حيث أن وزن البيضة (جم) و وزن الجسم النهائي (جم) للذكور لم يتأثر بشكل معنوي ($P > 0.01$). في الختام تبين أن فيتامين هـ وسيلينيت الصوديوم من العناصر الغذائية التكميلية الفعالة لتعزيز الأداء التناسلي لدجاج السمان الياباني، لذا ينصح باستخدام هذا النظام الغذائي في مزارع الدواجن المختلفة لزيادة مستويات بعض الصفات الإنتاجية والإنجابية.

Introduction

The Japanese quail (Coturnix coturnix japonica) has been found in many countries especially in East Asia. It was first considered a subspecies of the common quail, it is now considered as a separate species. Since the 12th century, the quail has actively participated in human life and has continued to be important to business and science. Around the world, Japanese quail are grown and used to produce eggs and meat. This particular kind of bird is identified by its quick development and sexual maturity, which occurs in around 42 days. The two essential nutrients for quail birds' excellent growth and reproduction are selenium (Se) and vitamin E. Chicken egg production is regarded as a critical economic concern in the management of poultry and other animals (1).

Numerous studies have shown that adding vitamin E and selenium to drinking water improved and protected certain aspects of semen, which may have been reflected in the male Muscovy ducks' fertility rate (2). Conversely, (3) found that adding supplementary vitamin E increased the hatchability of eggs, their bulk, and the survivability of the embryo in Japanese quail.

The body's enzymatic and non-enzymatic antioxidants scavenge excess free radicals under normal circumstances. On the other hand, oxidative stress can happen if the antioxidant system cannot handle the quantity of oxidants generated (4,5). Oxidative stress has the potential to adversely impact a number of factors, including the productivity and reproductive efficiency of bird species, as well as the pace and features of egg production, hatchability, and fertility.

Many selenoproteins and enzymes involved in DNA repair, fertility, and productive qualities include a significant amount of selenium (6). Both organic and inorganic types of selenium are present in the nature. Seleno-methionine is the primary organic form of selenium, whereas sodium selenite (Na2SeO3) is an inorganic form. Although diets rich in maize and soybean meal frequently meet birds' requirements for selenium, it is generally recommended to supplement diets with 0.5 mg of Se (maximum rate) per kilogram to support bird health and production (7).

(8) Found that neither selenium (0.4 mg/kg) nor vitamin E (160 mg/kg) affected feed consumption, egg size or shell thickness, albumen weight, or the ability of eggs stored for seven days to hatch. However, the results of the study found that the study treatments had no appreciable effect on egg production rate, feed conversion rate, shell-to-yolk ratio, or the percentage of eggs that hatched after 10 days of storage. According to a previous study, adding selenium to the diets of Japanese quail enhanced HU and decreased yolk lipid peroxidation, hence prolonging the shelf life of eggs (9). Vitamin E functions as the primary antioxidant in egg yolk lipids by stabilizing lipid peroxides and interrupting the cycle of lipid peroxidation (5). Studies have indicated that supplementing chicken feed with vitamin E enhances the growth of the meat as well as its nutritional value, including its fatty acid composition and shelf life (10).

(11) investigated how the chemical composition and sensory characteristics of Japanese quail eggs (Coturnix japonica) were affected by organic dietary supplements containing vitamin E and selenium. In Japanese quail, supplementing with selenium and vitamin E has been shown to increase selenium levels, protein, and antioxidant qualities while lowering cholesterol and egg fat.

Administration of 60 IU kg1 of her Vit.E also increases feed consumption, egg production rate and egg quality attributes such as haugh units, egg weight and vitelline membrane thickness (12).

Se and Vit.E work together to protect cells from free radical damage (13). In addition, selenium-deficient birds absorb less vitamin E, so its metabolism is closely related (14,15). In addition, dietary Se increases the vitamin E content of chicken, egg yolk, and plasma (6). Therefore, it is unsurprising that researchers are interested in studying the combination of selenium and vitamin E. It has been demonstrated that vitamin E and selenium have positive effects on the quality characteristics of laying hens' stored and uncooked eggs as well as on the rate at which eggs are produced (16, 17). However, nothing is known about how these antioxidants affect the productivity of Japanese quail in Iraqi Kurdistan region poultry farms and backyard birds. The purpose of this experiment was to demonstrate the effects of different vitamin E levels and inorganic selenium sources on productivity and oviposition traits in Japanese quail.

Materials And Methods

Management Of Animals And Design Of Experiments:

This investigation was conducted in the nutritional laboratory at the Veterinary Techniques Department/ Kalar Technical Institute/ Garmian Polytechnic University in Iraqi Kurdistan region for a period of eight weeks from Apr 15 2021 to Jul 15 2021. A total of 128 Japanese quail (12 weeks old) were used, and they were raised in a box-like cage pattern, in different dimensions of 50 width x 60 length x 60 height under circumstances of 23-27 oC temperature and 60-70% humidity.

The daily lighting schedule was designed to be 16 hours of light and 8 hours of darkness. The treatment groups had different levels of dietary supplements, with (0) representing the baseline diet (control) with no additions (0 Vit. E+ Selenium), T1 = 1 g vitamin E + selenium/kg diet, T2 = 1.5 grams vitamin E + selenium/kg diet, T3 = 2 grams vitamin E + selenium/kg diet. All birds (96 females and 32 males) were randomized into vertical batteries (3 females per male per cage) in a randomization design with 4 treatment groups and 8 replicates per treatment group. The basic diet is a commercial feed containing 20% crude protein and 2750 ME kcal/kg diet. The imported Vit.E+Selenium was purchased from the veterinary and agricultural products business (VAPCO) based in Jordan. Each gram includes 20 international units of vitamin E and 2 milligrams of sodium selenite. Each experimented group was provided by restricted the dietary feed (30gram/bird).

Positive Qualities

Daily egg production and egg weight were measured in each replicate of treatment groups for 12 weeks, and egg mass and feed conversion were calculated according to (18) three weeks after the start of the experiment. To calculate weekly feed consumption, we calculated the average daily feed intake of chickens in each replicate. The average egg weight and final body weight growth of males were assessed by weighing 10 eggs produced daily in each replicate throughout the course per a week.

Statistical analysis

Data were examined using SPSS version 24 for statistical analysis. The Duncan test (1955) (19) was used to evaluate the completely randomized design (CRD) and significant differences among treatments it means at a 5%

significance level.

Results and Discussion

The Table 1 shows the influence of dietary selenium levels and vitamin E on the reproductive performance, of Japanese quail. Hen day egg production (HD%/week), egg accumulation per hen per week, egg mass (gram/day), feed intake (gram per day), and feed conversion ratio (kg feed/kg egg) were influenced significantly by the treatments (P<0.01). While egg weight (g), body weight increase and ultimate body weight (g) were not impacted in statistical significance (P>0.01). Egg production (HD % week), egg accumulation (eggs/hen/week), and egg mass (g/day) were substantially higher in all treatments supplemented with selenium and vitamin E at all doses (1, 1.5,2 gm/kg diet) than in the control group (without vitamin E and selenium supplemented).

Egg production (HD%/week) and egg accumulation per hen per week were higher in diets supplemented with 1 g/kg vitamin E and selenium compared to the control and T3 (P<0.01). Egg production (HD%/week) and egg accumulation per hen per week were not changed significantly between T1 and T2 (P>0.01). Egg mass (gram per day), feed intake (gram per day), and feed conversion ratio (kilogram feed per kilogram egg) were considerably greater in treatments than in controls, with the exception of the feed conversion ratio, which was significantly lower in treatments. In contrast, among diets there was not significant differences (P > 0.01) supplemented with vitamin E and selenium with relation to the three characteristics listed below. The effect of dietary vitamin E and selenium on productional performance in Japanese quail, as shown in Table 1, was not affected by treatments (P>0.01) for egg weight and body weight gain and final body weight of male Japanese quail, and for these traits, there were no significant differences (P > 0.01) among the treatment groups. According to the findings of current study, the dietary treatments of vit. E and Se have a substantial impact on productive performance features as shown in Table1. However, the impact on egg weight (g) and ultimate body weight growth was not significant for males (Table1).

Throughout the investigation, a high statistical difference (P<0.01) in the hen day egg production (HD %) of this type of bird fed with vit. E and Se between the three groups and the control one. Similar authors' observations of a rise in (HD%) (3, 20, 21, 22). On the other hand, (10) found that during the course of the eight-week trial, there were no appreciable differences in feed intake, egg production, or feed conversion ratio (FCR) when given nutritional dietary supplements containing selenium and vitamin E (p>0.05). Findings from this study that relate to FCR are consistent with those from (16, 23). However, the results of this study are different from those of (23). In terms of feed intake, the result of the present work similar to (24), but they differ in relation to feed conversion ratio. results are also similar to those of (25) in egg production. The findings of the study also support those of (26) about the beneficial impact of selenium supplementation on FCR. Additionally, this study supports (27) conclusions in terms of the control groups with the minimum production of eggs. (28) found that significant differences in egg production between groups caused by adding selenium supplements and vitamin E to the diets of laying hens.

Table (1) Effect of supplemental dietary vitamin E plus selenium on productional performance in

Treat	Egg Production (HD%/ Week)	Accumulation egg per hen per week	Egg mass g/day	Feed intake g/day	Egg weight (g)	Feed Conversion Ratio kg feed /kg egg	Final Body weight gain (males) gm
T0	68.8 a	4.816 a	7.17 a	25.35 b	10.42 a	3.546 b	150 a
T1	83.39 c	5.836 c	9.025 b	22.7 a	10.86 a	2.524 a	165.8 a
T2	80.41 bc	5.628 bc	8.692 b	21.75 a	10.81 a	2.529 a	163.4 a
T3	77.31 b	5.411 b	8.492 b	22.11 a	10.87 a	2.617 a	166.2 a

However, multiple investigations (29, 30) failed to detect a measurable effect of selenium Supplementation on egg weight or daily egg production. According to the research that conducted by (31), feeding turkey birds by organic selenium produced eggs that were generally heavier than those fed inorganic selenium that its lighter in weight. Feeding hens with variations in vitamin E and selenium concentrations, according to (32), had no effect significantly on egg number production or weight of egg. In fact that the current research similar to the result outcome of (29, 30, 32) in egg production and egg weight features. Selenium supplementation decreases FCR and feed intake, according to (33) the action of metabolism and thyroid hormones depend on selenium. (34) claims that supplementing laying hens' diets with vitamin E boosts egg production while minimizing the negative effects of high ambient temperatures in the middle of summer. Additionally, he stated that vitamin E makes a considerable difference in reducing the risk of oxidative damage to the liver and other organs. Meanwhile, (8) found that the study's treatments had no discernible impact on the proportion of the feed conversion ratio (FCR) and generated eggs. It has been shown that intake of vitamin E is correlated with its accumulation in egg yolk, fetal liver, and other organs, significantly decreasing or lowering lipid peroxidation. For the developing fetus to continue receiving antioxidant protection, 100 milligram/kilogram of supplementary vitamin E is enough (35).

The egg yolk and white absorb selenium from the diet as well. Selenium levels in chicken embryos are higher, and lipid peroxidation is associated with lower levels (6). In a study, supplementing diet with selenium increased egg production percent and egg mass, and made to decrease feed conversion ratio more significantly ($P < 0.05$) than the other groups which had no significant changes ($P > 0.05$). After selenium supplementation, the enzymes glutathione peroxidase (GPX) and superoxide dismutase (SOD) were more active. Selenium also increased ($P > 0.05$) blood glucose and the levels of T3, T4. The investigator also came to

the conclusion that supplementing laying Japanese quail with up to 0.4 milligram/kilogram Selenium had no adverse effects on their performance, antioxidant defense, thyroid activity, or functional egg quality (36).

Due to the hen's hormonal changes during the process of developing into a sexually mature bird, dietary supplementation with Selenium and Vit. E may have an impact on egg production (18, 37, 38, 39). Since there is a significant positive correlation between egg production and the blood plasma concentration of these hormones, the increase in egg production in the vitamin E and Selenium treatment groups may be participated in the rising sex hormone concentration in blood plasma (40). When comparing the treatment group to the control group, there was a considerable increase in the cumulative egg number among vitamin E and Selenium. Selenium affects the receptor sites for sex hormones and takes part in their production, secretion and storage (41). This is probably because treatment groups' blood plasma alkaline phosphates activity was much higher than that of the Selenium blood plasma and vitamin E (42). When comparing the treatment group with the control one a considerable increase in the cumulative egg number among vitamin E and Selenium was found. The sex hormones that are produced, secreted and stored, in addition to the sites of their receptors all are affected by selenium (41). This is probably because treatment groups' blood plasma alkaline phosphates (ALP) activity has increased significantly, especially in vit. E and Selenium blood plasma (42).

The egg production percentage for the entire time of experimentation was not, significantly, impacted by the amount and source, of selenium, and not by the interaction, of these factors, according to research performed by (43) on the effect of selenium level and/or source on egg production, attributes. Comparatively speaking to chickens fed a control diet, the growing Selenium content reach to 0.40 ppm significantly increased egg weight and egg mass. Both the inorganic and organic types of Selenium supplementation had the same result when compared to the control group.

Between the usage of inorganic and organic selenium supplementation, there were no differences in laying hens' egg, production, egg, weight, and feed intake this is according to (44, 45). The last above researches also support to the conclusions of the current study about the crucial impact of vit. E and Selenium, on egg mass, FCR, and egg production rate.

Conclusions

Combination of these two diets as supplementations in feed of laying Japanese quail significantly ($P<0.01$) improved the majority of productive performance traits which including egg day production percentage (HD%), egg mass, accumulative egg per hen per week, feed intake gram/day, and feed conversion ratio (FCR). More research is recommended to study the combined effects of vitamin E and selenium on various bird species, including Japanese quail, to improve their physiological, productive, and reproductive characteristics. Additionally, further investigations should be conducted on the role of trace elements in poultry farms. Consequently, the use of vitamin E and selenium as supplementary nutrients is advocated to enhance the reproductive performance of Japanese quail layers.

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Conflict of Interest

The Authors declare that there is no conflict of interest.

References

1. Yin,L.,Ran,J.,Lian,T.,Yang,C.,Li,S.,Liu,y.Effect of vitamin E supplementation on serum hormones and gene expression of anti-season breeding xingguo grey gees (Anser cygnoides).Brazilian Journal of poultry science, 2019; 21 (4), 001-010.

2. Ali,S.A.M., E-wardany,I.,Hassan, A.M., Hassan ,A.M. Effect of vitamin E-selenium supplantation on some semen quality traits of Muscovy drakes. Arab Universities Journal of Agricultural Sciences, 2019; 27(2),1627-1636.

3. Abedi,P.,Vakili,S.T.,Mamouei,M., Aghaei,A. Effect of different levels of dietary vitamin E on reproductive and productive performance in Japanese quails (coturnix coturnix japonica). Veterinary Research forum, 2017; 8(4), 353-359.

4. Estévez, M. Oxidative damage to poultry: From farm to fork. Poultry Science, 2015; 94, 1368–1378.

5. Domínguez, R., Pateiro, M., Gagaoua, M., Barba, F.J., Zhang, W., Lorenzo, J.M. A comprehensive review on lipid oxidation in meat and meat products. Antioxidants, 2019; 8, 429.

6. Surai, P.F. Selenium in poultry nutrition 1. Antioxidant properties, deficiency and toxicity. World's Poultry Sciences Journal, 2002b; 58, 333–347.

7. Pavlovic, Z., Mileti´c, I., Joki´c, Ž., Pavlovski, Z., Škrbi´c, Z., Šobaji´c, S. The effect of level and source of dietary selenium supplementation on eggshell quality. Biological Trace Element Research, 2010;133, 197–202.

8. Mobaraki, A., M.,and Shahryar A. H. The Impact of Different Levels of Vitamin E and Selenium on the Performance, Quality and the Hatchability of Eggs from Breeding Japanese Quails. Iranian Journal of Applied Animal Sciences, 2015; 5, 927–932.

9. Ahmadian, H., Nemati, Z., Karimi, A., Safari, R. Effect of different dietary selenium sources and storage temperature on enhancing the shelf life of quail eggs. Animal Production Research, 2019, 8, 23–33.

10. Nemati, Z., Alirezalu, K., Besharati, M., Amirdahri, S., Franco, D., Lorenzo, J.M. Improving the quality characteristics and shelf life of meat and growth performance in goose fed diets supplemented with vitamin E. Foods, 2020; 9, 798.

11. Łukaszewicz, E., Korzeniowska, M., Kowalczyk, A., Bobak, L. Effect of feed supplementation with organic selenium and vitamin e on chemical composition and sensory characteristics of japanese quail (coturnix japonica) eggs. Polish Journal of Food and Nutrition Sciences, 2007; 57, 371–377.

12. Kirunda, D.F., Scheideler, S.E., McKee, S.R. The efficacy of vitamin E (DL-alpha-tocopheryl acetate) supplementation in hen diets to alleviate egg quality deterioration associated with high temperature exposure. Poultry Sciences, 2001; 80, 1378–1383.

13. Surai, P.F. Selenium in poultry nutrition 2. Reproduction, egg and meat quality and practical applications. World's Poultry Sciences Journal, 2002a; 58, 431–450.

14. Skˇrivan, M., Marounek, M., Dlouhá, G., Ševˇcíková, S. Dietary selenium increases vitamin E contents of egg yolk and chicken meat. British Poultry Sciences, 2008; 49, 482–486.

15. Skˇrivan,M., Bubancova, I., Marounek, M., Dlouha, G. Selenium and α-tocopherol content in eggs produced by hens that were fed diets supplemented with selenomethionine,sodium selenite and vitamin E. Czech Journal of Animal Sciences, 2010;55,(9),388-397.

16. Mohiti-Asli, M., Shariatmadari, F., Lotfollahian, H., Mazuji, M.T. Effects of supplementing layer hen diets with selenium and vitamin E on egg quality, lipid oxidation and fatty acid composition during storage. Canadian Journal of Animal Sciences, 2008; 88, 475–483.

17. Urso, U.R.A., Dahlke, F., Maiorka, A., Bueno, I.J.M., Schneider, A.F., Surek, D., Rocha, C. Vitamin E and selenium in broiler breeder diets: Effect on live performance, hatching process, and chick quality. Poultry Sciences, 2015; 94, 976–983.

18. Amen, M.H.M. Effect of Dietary Zinc on reproductive and physiological performance of Cobb500 Broiler Breeders. Doctoral dissertaion (Ph.D.), College of agriculture, University of Bagdad, Iraq; 2011.

19. Duncan , D.B. Multiple range and multiple F-test. Biometrics; 1955; 11, 1-42.

20. Chitar,P., Edwin, S.C., Moorthy,M. Dietary inclusion of vitamin E and selenium on egg production ,egg quality and economics of Japanese quail layers. Tamilandu.Journal of Veterinary and Animal Sciences, 2013; 9 (1), 51-60.

21. Chitra,P., Edwin,S.C., Moorthy,M. Studies on production of vitamin E and selenium enriched in Japanese quail egg, Indian Journal of Poultry Sciences, 2016; 51(1), 60-64.

22. Jiang W, Zhang L, Shan A. The effect of vitamin E on laying performance and egg quality in laying hens fed corn dried distillers grains with solubles. Poultry Sciences, 2013; 92, 2956-2964.

23. Sahin,K., Kucuk,O. Effect of Vitamin E and selenium on performance, digestibility of nutrients and carcass characteristics of Japanese quails reared under heat stress. Journal of Animal Physiology and Animal Nutrition, 2001; 85(11-12),342-348.

24. Adebiyi, O.A. Tocopherol supplementation on stocking density of broiler: effect of performance characteristics and serum enzymes.Trop.Subtrop. Groecosyst, 2011;14, 623-628.

25. Payne,R.L., Lavergne,T.K., Southern ,L.L. Effect of inorganic versus organic selenium on hen production and egg selenium concentration, Poultry Sciences, 2005; 84,232-237.

26. Edens.F.W. Practical applications for selenomethionine: broiler breeder reproduction. Alltech's Annu.Symp.Nottingham,UK ,2002.

27. Tengerdy ,R.P., Nockles,C.F. The effect of vitamin Eon egg production ,hatchability and humoral immune response of chicken .Poultry Sciences, 1973;52(2),778-783.

28. Adebiyi, O.A, Aliu, O.T., Majekodunmi B.C., Adeniji,O.A Effect of vitamin E and selenium on fertility, hatchability and survivability of turkey. Journal of Animal Sciences Advanced, 2014; 4(7), 955-961.

29. Chantiratikul A., Chinrasri O., Chantiratikul P. Effect of sodium selenite and Zinc-L-selenomethionine on performance and selenium concentrations in eggs of laying hens. Asian-Australian Journal of Animal of Sciences, 2008; 21(7), 1048-1052.

30. Mohiti-Asli M., Shariatmadari F., Lotfollahian H. The influence of dietary vitamin E and selenium on egg production parameters, serum and yolk cholesterol and antibody response of laying hen exposed to high environmental temperature. Arch. Geflu" gelk, 2010, 74, 43-50.

31. Stępińska M., Mróz E. and Jankowski J. The effect of dietary selenium source on

embryonic development in turkeys Folia Biologica (Krakow), 2012, 60(3), 235-241.

32. Zduńczyk Z., Drażbo A., Jankowski J., Juśkiewicz J., Czech A. and Antoszkiewicz Z. The effect of different dietary levels of vitamin E and selenium on antioxidant status and immunological markers in serum of laying hens. Polish Journal of Veterinary Sciences, 2013; 16(2), 333-339.

33. Naylor A.J., Choctand M., Reinke N. Selenium supplementation affects broiler growth performance, meat yield and feather coverage. British Poultry Sciences, 2004; 45, 677-683.

34. Abd-El-Maksoud A.A.A. Effect of vitamin E supplementation on performance of laying hens during summer months under the desert conditions. Egyptian Poultry Science Journal, 2006; 26, 873-889.

35. Surai, P.F., Fisinin,V.I. Antioxidant system of the body: from vitamin E to polyphenols and beyand.Proceddings of the 35th Western Nutrition Conference,September; 2014; 24-25,Edmonton AB,Page 265.

36. Nassef,E., Saker ,O., Shukry ,M. Effect of Se sources and concentrations on performance, antioxidant defense, and functional egg quality of laying Japanese quail (Coturnix japonica). Environmental Science and Pollution Research, 2020; 27, 37677–37683.

37. Renema, R., F.E. Robinson, J.A. Proudman , M. Newcombe, and R.I. Mckay. Effects of body weight and feed allocation during sexual maturation in broiler breeder hens. 2- Ovarian morphology and plasma hormone profiles. Poultry Sciences, 1999;78 : 629-639.

38. Renema,R.A.2004.Reproductive response to Sel-Plex organic selenium in male and female broiler breeders:impact on production traits and hatchability, 81-91 in Proceeding of.20th Alltech's Annual Symposium, Nottingham,UK.

39. Renema,R.A., Sefton,A.E. Dietary selenium source can effect egg production ,shell quality and fertility traits of broiler breders. Book of Abstracts XXII World's Poultry Congress, 2004;8-13 June, Istanbul,Turkey,p.521.

40. Durmus , I., C. Atasoglu , C. Mizrak , S. Ertas , M. Kaya. Effect of increasing zinc concentration in the diets of Brown parent stock layers on various production and hatchability traits. Arch – Tierz., Dummerstorf, 2004; (47) 5 : 483-489.

41. McDowell , L.R. Minerals in Animal and Human Nutrition. Academic Press , Inc., San Diego. 1992.

42. Al-Daraji,H.J., M.H.M.Amen. Effect of dietary zinc on certain blood traits of broiler breeder chickens.International Journal of Poultry Sciences, 2011;10(10):807-813.

43. Attia,Y.A.,A.A.Abdalah,H.S.Zewell,F. Bovera,A.A.TagEl-Din, and M.A.Arafat . Effect of inorganic or organic selenium supplementation on productive performance, egg quality and some physiological traits of dual -purpose breeding hens. Czech Journal animal Sciences, 2010;55,(11):505-519.

44. Utterback,P.L.,C.M.Parsons,I.Yoon ,and J.Butler. Effect of supplementation selenium yeast in diets of laying hens on egg selenium content. Poultry Sciences, 2005; 84:1900-1901.

45. Leeson,S.,Namkug, H., Caston, L., Durosoy, S.P., Schlegel. Comparison of selenium levels and sources and dietary fat quality in diets for broiler breeders and layer hens. Poultry Science, 2008;