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RESPONSE OF LAYING HENS TO DIETARY VITAMINS A, E AND SELENIUM SUPPLEMENTATION DURING SUMMER MONTHS

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SUMMARY

The current study aimed to investigate the effects of extra dietary supplementations of vitamins A, E and Selenium and their interactions on the performance of laying hens during summer months. A total of 243 Bovans laying hens 42 weeks old were randomly distributed into a factorial design experiment (3×3×3); including 3 levels of vitamin A (0, 8000, 16.000 IU/kg diet), 3 levels of vitamin E (0, 250, 500 mg/kg diet) and 3 levels of inorganic-selenium, (0, 0.25, 0.50 mg/kg diet).

Results obtained showed that most values of live body weight and change in live body weight did not significantly differ due to A, E and Se supplementations and their interactions at all ages studied. Increasing the level of supplementations was associated with the decrease in feed intake and improving feed conversion. The effects of supplementations and their interactions were highly significant (P≤0.01) on feed intake and feed conversion. Increasing the level of vitamin A up to 16000 IU/kg diet had the highest (P≤0.05) monthly egg number and egg mass. Vitamin A increased (P≤0.05 and 0.01) each of egg length at 46 and 50 weeks of age and haugh units at 54 weeks of age. The higher level of supplemented dietary vitamin E led to a significant (P≤0.05) decrease in shell thickness and haugh units. Most of the egg quality traits fluctuated significantly (P≤0.05 and 0.01) with the high level of Se. The interactions among supplementations did not significantly affect egg quality traits.

In conclusion, the results of the present study demonstrate that it may be suggested use each of vitamins A and E (together) at extra levels up to 16000 IU/kg diet of vitamin A and 500 mg/kg diet of vitamin E. Se levels need more investigations to detect its suitable level alone or with vitamin E in laying diets to reduce the negative effects of summer months.

Keywords:

INTRODUCTION

Stress, which is the factor that increases the need for vitamins and minerals, has been an important issue. High ambient temperature and relative humidity, as stress factors adversely affect the performance of the domestic fowl, especially their egg production and egg quality traits (Roland, 1988; Grizzle *et al.*, 1992; Mahmoud *et al.*, 1996; Sahin and Kucuk, 2001 and Franco-Jimenez *et al.*, 2007). Whereas, elevated environmental temperature causes disorders of the body-heat regulating mechanism in poultry (Harmeyer and von Grabe, 1981).When the ambient temperature exceeds 30–32 °C, signs of heat stress are likely to appear.

High environmental temperature, in summer, season causes negative effects on the performance of laying hens (Bollengier-Lee *et al.*, 1999 and Kirunda, *et al.*, 2001), in live body weight (Yardibi and Türkay, 2008), feed intake (Marsden and Morris, 1987), egg production, egg weight and shell quality (Andrade De *et al.*, 1977; Deaton *et al.*, 1981). Stress in general increases mineral and vitamin mobilization from tissues and their execration, thus may exacerbate a marginal vitamin and mineral deficiency therefore, increased its requirements (Siegel, 1995 and Sahin *et al.*, 2002).

Several methods were conducted to alleviate the effects of high environmental temperatures on poultry performance. However, using vitamins and minerals together, in layers diets, to alleviate the negative effects of heat stress is a rarely practiced method.

In this respect, vitamin A is involved in several functions in the body including vision, differentiation of epithelial cells, growth, and reproduction (Brody, 1993). In poultry, as well as in other animals, vitamin A deficiency is closely associated with increased susceptibility to infections. The exact manner in which vitamin A deficiency affects the host immune system is attributed to the destruction of mucosal epithelium that act as the first defense barrier (Bains, 1988). The requirements of vitamin A might be changed in heat-stressed hens, and an investigation of the adequate supplemental level of vitamin A under these conditions is needed (Lin *et al.*, 2002). However, vitamin A, being a fat soluble vitamin, can be stored in liver of birds, and storage pools may affect requirements.

Vitamin E supplementation is suggested to be very effective for animals and poultry (Tengerdy, 1989), because vitamin E can reduce the negative effects of corticosterone induced by stress (Whitehead *et al.*, 1998; Bollengier-Lee *et al.*, 1999 and Naziroğlu *et al.*, 2000). Vitamin E is known to be a lipid component of biological membranes and is known to be a major chain-breaking antioxidant (Gallo-Torres, 1980 and McDowell, 1989). Vitamin E is mainly found in the hydrocarbon part of membrane lipid bilayer towards the membrane interface and in close proximity to oxidase enzymes which initiate the production for free radicals (Packer, 1991). Vitamin E protects cells and tissues from oxidative damage induced by free radicals.

The relationship between vitamin A and vitamin E has been proposed in a way that vitamin E appears to have an important effect on the utilization and perhaps absorption of vitamin A, and vitamin E protects vitamin A from oxidative breakdown (Gallo-Torres, 1980). Chickens, cannot synthesize vitamin E; therefore, vitamin E requirements must be met from dietary sources (Chan and Decker, 1994).

Selenium (Se) is an essential element for laying hens. It is essential for proper function of the antioxidant enzyme glutathione peroxidase, which protects the cell by destroying free radicals (Rotruck *et al.*, 1973). Selenium plays an effective and important role in the protection of cells against the damage that originates from free radicals (Rayman, 2002; Sahin *et al.*, 2002; Daniels, 2004). Selenium and vitamin E display a synergic antioxidant activity in the prevention of lipid peroxidasis (Sahin and Kucuk, 2001; Sahin *et al.*, 2002).

The aim of the current study was to investigate the effects of extra dietary supplementations of vitamins A, E and Selenium and their interactions on the performance of laying hens during summer months.

MATERIALS AND METHODS

The present study was carried out for 3 consecutive months (from July to September) at the Poultry Research Farm, Poultry Department, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

A total of 243 42 weeks old of Bovans laying hens were randomly distributed into a factorial design experiment (3× 3× 3) including three levels of vitamin A as vitamin A acetate 100% (0, 8000, 16000 IU/kg diet), three levels of vitamin E as DL-α-Tocopherol acetate 50% (0, 250, 500 mg/kg diet) and three levels of inorganic-Se as sodium selenite 4.5% (0, 0.25, 0.50 mg/kg diet) in order to study the effects of these dietary supplementations (which were mixed with the basal diet) and their interactions on the performance of Bovans laying hens during summer months. Twenty seven treatment groups of 9 hens in each with 3 replicates in each group (3 hens per replicate) were used. Hens of all experimental groups had nearly the same initial average live body weight. Hens were reared during the experimental period in battery cages (40×40×40 cm) in an open house, and there were three hens in each cage.

A basal experimental diet was formulated to cover the nutrients requirements of laying hens at the production period as recommended by NRC (1994). The Composition and calculated analysis of the experimental basal diet is presented in Table 1. The basal diet was supplemented with vitamins A or E or selenium or their combinations at the previously mentioned levels. Dietary supplementations were bought from Multivita Company in Sixth of October City, Egypt.

All hens were kept under the same managerial and hygienic conditions. Hens were exposed to 16 hours of light per day and were fed *ad-libitum* and the fresh water was available during the experimental period. The average indoor ambient temperature (°C) and the average relative humidity (%) during summer months were 31.35, 58.17 during July (42-46 weeks of age), 31.57 and 58.73 during August (47-50 weeks of age) and 30.69 and 52.45 during September (51-54 weeks of age).

Investigated measurements:

Live body weight: Hens were individually weighed at 42 and 54 weeks of age to the nearest 5.00 gram in early morning before feeding and watering. Change in live body weight (g) was calculated.

Feed intake was recorded and feed conversion ratio (g feed: g egg) was also calculated. Feed intake and feed conversion ratio were recorded at the periods; 42 – 46, 46 – 50, 50 – 54 and 42 – 54 weeks of age.

Egg production traits: Egg number was recorded. Egg weight (g) was recorded individually to the nearest 0.05 gram from the beginning of the experiment and for three months. Egg mass (g) was calculated by multiplying egg number by the average egg weight. Egg number and egg mass were recorded at the periods; 42-46, 46-50, 50-54 and 42 – 54 weeks of age.

Egg quality traits were conducted at 46, 50 and 54 weeks of age. Three randomly laid eggs were collected from each treatment each time. Egg quality traits (Egg length, width and egg shape index, shell, yolk and albumen weights, shell thickness and albumen height) were measured as described by Shehata (2000). Economic evaluation was calculated.

Haugh units were calculated by the equation stated by Yalcin *et al.* (1990) and Altan *et al.* (1998) as follows:

Haugh units **(HU)** = 100 log (H + 7.57 – 1.7 $W^{0.37}$).

Where: H = Albumen height (mm) and W = Egg weight (g).

Data were analyzed statistically using the statistical analysis system (SAS, 1998). Duncan's multiple range test (Duncan, 1955) was used to separate the means when significance existed. The statistical model was:

$Y_{ijkl} = \mu + A_i + E_j + Se_k + (AE)_{ij} + (ASe)_{ik} + (ESe)_{jk} + (AESe)_{ijk} + e_{ijkl}$

Where: Y_{ijkl} = any observation, μ = general mean, A_i = fixed effect of i^{th} vit. A level (i = 0, 8000 or 16000 IU/kg); E_j = fixed effect of j^{th} vit. E level (j =0, 250 or 500 mg/kg); Se_k = fixed effect of k^{th} Selenium level (k =0, 0.25 or 0.50 mg/kg), $(AE)_{ij}$ = interaction effect of i^{th} vit. A level with j^{th} vit. E level; $(ASe)_{ik}$ = interaction effect of i^{th} vit. A level with k^{th} Selenium level; $(ESe)_{jk}$ = interaction effect of j^{th} vit. E level with k^{th} Selenium level; $(AESe)_{ijk}$ = interaction effect of i^{th} vit. A level with j^{th} vit. E level and k^{th} Selenium level and e_{ijkl}= error of the model.

RESULTS AND DISCUSSION

Productive performance:

Live body weight and change in live body weight:

Data presented in Table 2 show that there are insignificant differences in live body weight and change in live body weight due to supplementations of vitamin A, vitamin E, Se and their interaction. However, live body weight at 54 weeks of age was significantly (P≤0.05) higher for the group that received vitamin E supplementation in comparison to those received 250 mg/kg feed.

The present findings are in accordance with the results reported by kaya *et al.* (2001) and Desoky (2008) who found insignificant differences in live body weight due to dietary supplementations of vitamins A and E. Abd El-Maksoud (2006) found that the level of Vitamin E supplementation up to 250 mg/kg diet had no significant effect on final (36 week of age) body weight (1931 g) and body weight changes (329.33 g) comparing to the control group (1817 g and 223.33 g, respectively). Abdel Galil and Abdel Samad (2003) found that supplementing diets of laying hens during hot climate conditions with vitamin E and Selenium sustained hens to maintain its body weight higher than control group.

Feed intake and conversion:

Generally, it was noticed that the higher level of supplementations was associated with decrease in feed intake and improve feed conversion at all periods studied (Table 3). The intermediate level of Se (0.25 mg/kg diet) had the lowest values of feed intake at all periods of the experiment. The effects of supplementations and their interactions were highly significant (P≤0.01) on feed intake and feed conversion, except during the whole period from 42 – 54 weeks of age (Table 3). The improvement in feed utilization is attributed to the beneficial effects of these manipulations (Gallo-Torres, 1980; Watson and Petro, 1982 and Daniels, 2004). However, Bollengier-Lee *et al.* (1998) stated that high environmental temperature might cause liver dysfunction through increased membrane lipid peroxidation, cell liver damage and other organs. This effect might reduce nutrient metabolism and feed utilization. They added that, vitamin E might play an important role through the protection of liver or other organs against oxidative damage.

In agreement with the present results, Lin *et al.* (2002 & 2004) found that the supplementation of vitamin A and E was advantageous to the laying performance in feed intake of heat-stressed hens. Also, Osman *et al.* (2010) stated that the treatment with Se (0.1 or 0.2 mg/kg diet) improved (P≤0.01) feed conversion of laying hens.

In contrast, Coşkun *et al.* (1998), Meluzzi *et al.* (2000), Siam *et al.* (2004) and El-Mallah *et al.* (2011) reported no significant differences in feed intake of laying hens fed diets supplemented with vitamins A, E and Se. Abdel Galil and Abdel Samad (2003) found that hens fed diets with Se consumed more feed with high feed efficiency than vitamin E. Abdalla *et al.* (2009) stated that feed intake of Bandarah layers was not significantly affected by vit. A supplementation at 0, 4000, 14000 or 24000 IU/ kg diet during the period from 18 to 48 weeks of age.

Reproductive performance:

Egg number and Egg mass:

An overview of the averages of egg number and egg mass as affected by extra dietary supplementations of A, E and Se, it could be seen from the results found in Table 4. There are no significant differences in egg number and egg mass due to the effects of supplementations of A, E and Se at all ages studied, except for the effect of vitamin A on egg number at 50 - 54 weeks of age and egg mass at 50 - 54 and 42 - 54 weeks of age which was significant (P≤0.05) as presented in Table 4. Increasing the level of vitamin A up to 16000 IU/kg diet had the highest (P≤0.05) monthly egg number and egg mass (from 50-54 weeks of age). Most of interactions did not significantly affect egg number and egg weight. During the whole period (42 54 weeks of age), egg number changed (P≤0.05 and 0.01) due to the interaction between A and Se and the interaction between E and Se, while egg mass was differed (P≤ 0.01) due to the interaction between A and Se and the interaction among A, E and Se at the same period.

Vitamin A supports the viability of the reproductive system (Brody, 1993); so, it is usually added to the commercial layer diets. Coşkum *et al.* (1998) reported that vitamin A levels above the NRC recommendations of 3000 IU/kg had no significant effect on the laying performance of hens under normal conditions. However, when the birds suffered stress, the situation might change. The later authors added that the results of their experiment do not indicate that laying hens do not require dietary vitamin A, but may provide some evidence that the vitamin A content of the ingredients itself, particularly that of corn, can meet the vitamin A requirements of laying hen so that extra supplementation might not be required.

Scheideler (1996), Bollengier-Lee *et al.* (1998) and Siam *et al.*, (2004) demonstrated that vitamin E supplementation at high levels can improve egg production performance in hens exposed to heat stress and overcame a diverse high environmental temperature, during summer season. Heat stress stimulates the release of corticosterone and catecholamines and initiates lipid peroxidation in cell membranes (Freeman and Crapo, 1982). So, vitamin E can reduce the negative effects of corticosterone induced by stress (Watson and Petro, 1982). Vitamin E has been reported as an excellent biological chain-breaking antioxidant that protects cells and tissues from lipoperoxidation damage induced by free radicals (Halliwell and Gutteridge, 1989; Yu, 1994). Chickens, however, cannot synthesize vitamin E; therefore vitamin E requirements must be met from dietary sources (Chan and Decker, 1994). Results of Lin *et al.* (2002 & 2004) showed that the supplementation of vitamin A and E was advantageous to the laying performance in feed intake, egg number and egg weight of heat-stressed hens. The same authors added that for the different responses of the hens, the possible reason might be that the susceptibility of laying performance was different in stressed hens at different laying stages.

On the other hand, adding Se to laying diets improves productivity and can also be a natural way to produce functional food respectively the production of egg enriched with Se (Yaroshenko *et al.*, 2003 and Sara *et al.*, 2008), which represents a commercially valuable use for the future.

Puthpongsiriporn *et al.* (2001), Abdel Galil and Abdel Samad (2003) and Desoky (2008) indicated that laying hens supplemented with vitamin E and Se had higher egg production and heavier egg weight than hens of control groups during heat stress. Recently, El-Mallah *et al.* (2011) reported that supplementing vit. E to laying hens' diet up to 40 mg/kg diet resulted in better values (P≤0.05) of egg weight (60.94 g) as compared to the control group (60.85 gm).

Egg quality traits:

It's evident from the results presented in Tables 5 and 6 that vitamin A significantly (P≤0.05 and 0.01) increased both of egg length (at 46 and 50 weeks of age) and haugh units (at 54 weeks of age). The group of hens received level of 16000 IU/kg diet produced longer eggs at 46 and 50 weeks of age (57.99 and 58.10 mm, respectively). The best values of haugh units were observed at 54 weeks of age. The same level of vitamin A was significantly (P≤ 0.01) associated with the decrease in thin albumen height at 46 weeks of age and egg shape index at 46 and 50 weeks of age.

Vitamin E did not significantly influence any of the egg quality traits, except shell thickness at 50 weeks of age and haugh units at 46 weeks of age. Increasing the level of supplemented dietary vitamin E led to a decrease (P≤0.05) in shell thickness and haugh units. Haugh units are indicative of egg quality, specifically as quality relates to albumen functionality in foods. Se had a significant (P≤0.05 and 0.01) effect on yolk and albumen weights and yolk, albumen and shell percentages at 46 weeks of age, on egg weight, length and width and shell thickness at 50 weeks of age and on egg length, width and haugh units at 54 weeks of age (Table 6). No interactions were observed for egg quality traits.

The insignificant results, in the present study, are similar to those reported by Grobas *et al.* (2002). They confirmed that high dietary vitamin A concentration decreases vitamin E absorption. It has been suggested that the antagonism between vitamin A and E can be attributed to the competition during the digestive processes, as the antagonism is markedly reduced when vitamin E is administered parenterally (Frigg and Broz, 1984). Mezes and Hidas (1992) indicated that during egg shell formation, excess amounts of vitamin E (100 and 200 mg/bird) inhibited prostaglandins biosynthesis. Prostaglandins may regulate ovulation and are correlated with reproduction.

Abdel Galil and Abdel Samad (2003), Radwan *et al.* (2008), Ramalho *et al.* (2008), Yardibi and Turkay (2008), and El-Sheikh and Salama (2010) indicated that diets supplemented with vitamin E and Se improved egg weight, shell weight, yolk weight %, yolk index, egg shape index and shell thickness. They added that supplementing diets with both vitamin E and Se enhanced shell quality parameters.

Economic evaluation (EE):

Data presented in Table 7 showed that, the higher levels of vitamins A and E (16000 and 500, respectively) and 0 level of Se had the highest economic efficiency (89.91%) followed by the level of 8000 of vitamin A and 0 levels of E and Se (88.31%).

In conclusion, the supplementation of vitamins A and E may be advantageous for the laying performance of stressed hens. The results of the present study suggested using each of vitamins A (as vitamin A acetate 100%) and E (DL-α-Tocopherol acetate 50%) together at extra levels up to 16000 IU/kg diet of vitamin A and 500 mg/kg diet of vitamin E. Se levels need more investigations to detect the suitable level either alone or with vitamin E in laying diets to reduce the negative effects under Egyptian summer conditions.

REFERENCES

Abdalla, A.A., Nema A. Mosaad and Y. Elnagdy, Nagdia, 2009. Effect of vitamin A supplementation on the performance and immune response of Bandarah chicken. *Egyptian Poultry Science, 29(I): 221 – 239.*

Abdel Galil, M.A. and Abdel Samad, M.H. (2003). Effect of vitamin E, C, selenium and Zinc supplementation on reproductive performance of two local breeds of chickens under hot climate condition. *Egyptian Poultry Science Journal, 24 (1): 217 - 229.*

Abd El-Maksoud, A.A. (2006). Effect of vitamin E Supplementation on performance of laying hens during summer months under the desert conditions. *Egyptian Poultry Science Journal, 26 (III): 873 -- 889.*

Altan, O., Oguz, I. and Akbas, Y. (1998). Effects of selection for high body weight and age of hen on egg characteristics in Japanese quail (coturnix Japonica). *Turkish Journal of Veterinary and Animal Science, 22: 467 - 473.*

Andrade De, A.N., Rogler, J.C., Featherston, W.R. and Alliston, C.W. (1977). Interrelationships between diet and elevated temperatures (cyclic and constant) on egg production and shell quality. *Poultry Science, 56: 1178 -- 1188.*

Bains, B.S. (1988). Role of vitamins in enhancing immune response in chicken. A review. *Poultry Research Foundation Symposium 1988, The University of Sydney, Sydney, Australia.*

Bollengier-Lee, s., Mitchell, M.A., Utomo, D.B., Williams, P.E.V. and Whitehead, C.C. (1998). Influence of high dietary vitamin E supplementation on egg production in laying hens. *British Poultry Science, 39: 106 - 112.*

Bollengier-Lee, s., Williams, P.E.V. and Whitehead, C.C. (1999). Optimal dietary concentration of vitamin E for alleviating the effect of heat stress on egg production in laying hens. *British Poultry Science, 40: 102 - 107.*

Brody, T. (1993). *Vitamins. Pages 403 - 410 In: Nutritional Biochemistry. Academic Press Inc., San Diego.*

Chan, K.M. and Decker, E.A. (1994). Endogenous skeletal muscle antioxidants. *Critical Reviews in Food Science and Nutrition, 34: 403 - 426.*

Coşkun, B., İnal, F., Çelik, İ., Erganis, O., Tiftik, A.M., Kurtoğlu, F., Kuyucuoğlu, Y. and Ok, Ū. (1998). Effects of dietary levels of vitamin A on the egg yield and immune responses of laying hens. *Poultry Science, 77: 542 - 546.*

Daniels L.A. (2004). Selenium: does selenium status have health outcomes beyond overt deficiency*? Medical Journal of Australia, 180(8): 383 - 386.*

Deaton, J.W., Reece, F.N., McNaughton, J.L. and Lott, B.D. (1981). Effect of differing temperature cycles on egg shell quality and layer performance. *Poultry Science, 60: 733 - 737.*

Desoky, A.A. (2008). Effect of dietary vitamin C and E supplementation on performance of laying hens under high environmental temperature. *Egyptian Poultry Science Journal, 28 (II): 489 - 500.*

Duncan, D.B. (1955). *Multiple range and multiple F test*. *Biometrics*, 11: 1 - 42.

El-Mallah, G.M., Yassein, S.A., Abdel-Fattah, Magda M. and El-Ghamry, A.A. (2011). Improving performance and some metabolic responses by using some antioxidants in laying diets during summer season. *Journal of American Science, 7(4): 217 - 224.*

El-Sheikh, S.E.M. and Salama, A.A. (2010). Effect of vitamin C and E as water additives on productive performance and egg quality of heat stressed local laying hens in Siwa oasis. *Egyptian Poultry Science, 30(III): 679 - 697.*

Franco-Jimenez, D.J, Scheideler, S.E., Kittok, R.J., Brown-Brandle, T.M., Robenson, L.R., Taira, H., and Beck, M.M. (2007). Differential effects of heat stress in three strains of laying hens. *Journal of Applied Poultry Research, 16: 628--634.*

Freeman, B.A. and Crapo, J.D. (1982). Biology of disease: Free radials and tissue injury. *Laboratory Investigation, 47: 412 - 426*.

Frigg, M. and Broz, J. (1984). Relationship between vitamin A and vitamin E in the chick. *International Journal of Veterinary and Nutrition Research, 54: 125 - 134.*

Gallo-Torres, D.C. (1980). *Absorption, blood transport and metabolism of vitamin E. In: Machlin LJ, editor. A Comprehensive Treatise. New York: Marcel Dekker. pp. 170--267.*

Grizzle, J., Iheanacho, M., Saxton, A. and Broaden, J. (1992). Nutritional and environmental factors involved in egg shell quality of laying hens. *British Poultry Science, 33: 781 - 794.*

Grobas, S., Méndez, J., Lopez Bote, C., De Blas, C. and Mateos, G.G. (2002). Effect of vitamin E and A supplementation on egg yolk α-tocopherol concentration. *Poultry Science, 81: 376 - 381.*

Halliwell, B. and Gutteridge, J.M.C. (1989). *Lipid peroxidation: A radical chain reaction. Pages 188 - 218 in: Free Radicals in Biology and Medicine, 2nd edition, Oxford University Press, New York, NY.*

Harmeyer, J. and Von Grabe, C. (1981). The influence of the level of production on ketogenesis in milking cows and the effect of a niacin supplement. *Dtsch Tierätzt Wochenschr, 88: 401 - 404 (article in German with an abstract in English).*

Kaya, Ş., Umucalilar, H., Haliloĝlu, S. and İpek, H. (2001). Effect of dietary vitamin A and zinc on egg yield and some blood parameters of laying hens. *Turkish Journal of Veterinary and Animal Science, 25: 763 - 769.*

Kirunda, D.F.K., Scheideler, S.E. and McKee, S.R. (2001). The efficacy of vitamin E (DL-α-tocopheryl acetate) supplementation in hen diets to alleviate egg quality deterioration associated with high temperature exposure. *Poultry Science, 80: 1378 - 1383.*

Lin, Y.F., Chang, S.J. and Hsu, A.L. (2004). Effects of supplemental vitamin E during the laying period on the reproductive performance of Taiwan native chickens. *British Poultry Science, 45: 807 - 814.*

Lin, H., Wang, H., Song, J.I., Xie, Y.M. and Yang, Q.M. (2002). Effect of dietary supplemental levels of vitamin A on the egg production and immune responses of heat stressed laying hens. *Poultry Science, 81: 458 - 465.*

Mahmoud, K.Z., Beck, M.M., Scheideler, S.E., Forman, M.F., Andrson, K.P. and Kachman, S.D. (1996). Acute high environmental temperature and calcium-estrogen relationship in the hen. *Poultry Science, 75 1555 - 1562.*

Marsden, A. and Morris, T.R. (1987). Quantitative review of the effects of environmental temperature on food intake, egg output and energy balance in laying pullets. *British Poultry Science, 28: 693 - 704.*

McDwell, L.R. (1989). *Vitamins in Animal Nutrition-Comparative Aspects to Human Nutrition .In: McDwell LR (ed.). Vitamin A and E London: Academic Press. pp., 93 - 131.*

Meluzzi, A., Sirri, F., Manfreda, G., Tallarico, N. and Franchini, A. (2000). Effects of dietary vitamin E on the quality of table eggs enriched with n-3 long-chain fatty acids. *Poultry Science, 79: 539 - 545.*

Mezes, M. & Hidas, A. (1992). Is there lipid peroxidation induced malondialdehyde production during egg shell formation*? Acta Veterinaria Hungarica, 40: 297 - 301.*

Naziroğlu M., Sahin, K., Şimşek, H., Aydilek, N. and Ertaş, O.N. (2000). The effect of feed withdrawal and darkening on lipid peroxidation of laying hens in high ambient temperatures. *Dtsch Tierätzt Wochenschr, 107: 199 - 202.*

NRC (1994). *Nutrient Requirements of Poultry. 9th rev. ed. National Academy Press, Washington, DC.*

Osman, A.M.R., Abdel Wahed, H.M. and Ragab, M.S. (2010). Effects of supplementing laying hens diets with organic selenium on egg production, egg quality, fertility and hatchability. *Egyptian Poultry Science, 30 (III): 893 - 915*.

Packer, I. (1991). Protective role of vitamin E in biological systems. *American Journal of Clinical Nutrition, 53: 1050 - 1055.*

Puthpongsiriporn, U., Scheideler, S.E., Shell, J.L., and Beck, M.M. (2001). Effect of vitamin E and C supplementation on performance, in vitro lymphocyte proliferation and antioxidant status of laying hens during heat stress. *Poultry Science, 80: 1190 - 1200.*

Radwan Nadia, L., Hassan, R.A., Qota, E.M. and Fayek, H.M. (2008). Effect of natural antioxidant on oxidative stability of eggs and prodictive and reproductive performance of laying hens. *International Journal of Poultry Science, 7(2): 134 -150.*

Ramalho, H.M.M., Dias da Silva, K.H., Alves dos Santos, V.V., dos Santos, J. and

Cavalcanti, R. (2008). Effect of retinyl palmitate supplementation on egg yolk retinol and cholesterol concentrations in quail. *British Poultry Science, 49: 475 - 481.*

Rayman, M.P. (2002). The argument for increasing selenium intake. *Proceeding of Nutrition Society, 61: 203 - 215*.

Roland, D.A. (1988). Egg shell problems: estimates of incidence and economic impact. *Poultry Science, 67: 1801 - 1803*.

Rotruck, J.T., Pope, A.L., Ganther, H.E., Swanson, A.B., Hafeman, D.G. and Hoekstra, W.G. (1973). Selenium: Biochemical role as a component of glutathione peroxidase. *Science, 179: 588 - 590.*

Sahin K., Sahin, N., Yaralioglu, S. and Onderci, M. (2002). Protective role of supplemental vitamin E and selenium on lipid peroxidation, vitamin E, vitamin A, and some mineral concentrations of Japanese quail reared under heat stress. *Biological Trace Elements. Research, 85(1): 59 - 70.*

Sahin, K. and Kucuk, O. (2001). Effects of vitamin C and vitamin E on the performance, digestion of nutrients and carcass characteristics of Japanese quails reared under chronic heat stress (34°C). *Journal of Animal Physiology and Animal Nutrition, 85: 335 - 341.*

Sara, A., Bennea, M., Odagiu, A. and Panta, L. (2008). Effects of the organic selenium (Sel-Plex) administered in laying hens' feed in second laying phase on production performance and eggs quality. *Bulletin UASVM Animal Science and Biotechnologies, 65: 1 - 2.*

Scheideler, S.E. (1996). Vitamin E supplementation suppresses egg production drop during heat stress and transportation of laying hens during peak production. *Pages 14 – 15 in: Nebraska Poultry Report, June. Nebraska Poultry Report, University of Nebraska Cooperative Extension, Lincoln, NE*.

Shehata, M. M. (2000). Using some aquatic plants in feeding chicks. *Ph.D. Thesis, Fac. Agric., Zagazig Univ., Egypt*.

Siam, Salwa S., Mansour, K.M., El-Anwer, E.M.M. and El-Warith, A.A. (2004). Laying hens performance, hatchability immune response and some blood constituents affected by vitamin E and Selenium Supplementation under hot condition. *Egyptian Poultry Science Journal, 24: 483 - 496.*

Siegel, H.S. (1995). Stress, Strains and Resistence. *British Poultry Science, 1: 3 - 22.*

SAS User's Guide (1998). *Statistical Analysis System*. Edition 5. SAS Institute Inc., Box 8000, Cary NC 27 511-800, USA.

Tengerdy, R.P. (1989). Vitamin E, immune response and disease resistance. *Annals of the New York Academy of Science, 76: 1405 - 1417.*

Watson, R.R. and Petro, T.M. (1982). Cellular immune response, corticosteriod levels and resistance to Listeria monocytogenes and murine leukemia in mice fed a high vitamin E diet. *Annals of the New York Academy of Science, 393: 205 - 208*.

Whitehead C.C., Bollengier-Lee, S., Mitchell, M.A. and Williams, P.E.V. (1998). Vitamin E can alleviate the depression in egg production in heat stressed laying hens. *In: Proc. Of spring meeting, WPSA-UK Branch. 55--56. Scarborough*.

Yalcin, S., Ergun, A., Coplan, I. and Sehu, A. (1990). Yumurta tavugu rasyonlarinda findik ici kabugunum kullanilma olanaklarinin arastirilmasi. *Veterinary Journal of Ankara University, 27: 171 - 176.*

Yardibi, H. and Türkay, G. (2008). The effects of vitamin E on the antioxidant system, egg production, and egg quality in heat stressed laying hens. *Turkish Journal of Veterinary and Animal Science, 32(5): 319 - 325*.

Yaroshenko, F.A., Dvorska, J.E., Surai, P.F. and Sparks, N.H.C. (2003). Selenium/Vitamin E enriched egg: Nutritional quality and stability during storage. *Poster Presented at Alltechs 19th Annual Symposium on Nutritional Biotechnology in the Feed and Food Industries Lexington KY 12- 14. ROM-CD*.

Yu, B.P. (1994). Cellular defense against damage from reactive oxygen species. *Physiological Reviews, 74: 139 - 162*.

Table 1. Composition and calculated analysis of the experimental basal diet

Ingredient	Quantity %
Yellow corn	63.14
Soybean meal (44 % CP)	27.10
Di-Calcium phosphate	1.50
Limestone	7.60
Vitamins and Minerals mixture*	0.30
NaCl (salt)	0.30
Dl-Methionine	0.06
Total	100.00
Calculated analysis**	
Crude protein, %	16.82
Metabolism energy, (kcal / kg diet)	2721.70
Ether extract, %	2.81
Available phosphorus, %	0.41
Calcium, %	3.27
Lysine, %	0.95
Methionine, %	0.36
Methionine + Cystine, %	0.64

* One kilogram of feed contained the following according to the premix supplier (BASU-Mineralfutter GmbH, Bad Sulza, Germany): vitamin A (retinol acetate) 12,000 IU, vitamin D (cholecalciferol) 0.008 mg, vitamin E (dl-α-tocopherol acetate) 42 IU, vitamin K3 (menadione) 2 mg, vitamin B1 (thiamine) 2 mg, vitamin B2 (riboflavin) 6.6 mg, vitamin B6 (pyridoxine) 5 mg, vitamin B12 (cyanocobalamin) 0.02 mg, biotin 0.15 mg, folic acid 1 mg, niacin 99 mg, calcium d-pantothenate 15 mg, choline chloride 0.7 g, Ca 2.3 g, Cu 5 mg, Zn 51 mg, Fe 60 mg, Mn 71 mg, I 0.6 mg, Se 0.2 mg.
**Calculated analysis according to NRC (1994).

Table 2. Average ($\overline{X}$ ±SE) Live body weight and Chang in live body weight of Bovans laying hens as affected by dietary supplementation of vit. A, vit E and Se.

Variable	Level	Live Body weight at (g)		Chang in live body weight (g)
		42 weeks	54 weeks	from 42 to 54 weeks of age
Vit. A	IU/kg	NS	NS	NS
	0	١٧٩٧.٥٩±٢٩.٩٥	١٧٠٢.٩٦±30.16	-94.63
	8000	١٧٠٠.٠٠±37.92	١٦٩١.٤٨±34.17	-126.47
	16000	١٧٦٦.٨٤±30.59	١٦٤٠.٣٧±30.48	±10.36-٦.٤٧
Vit. E	mg/kg	NS	*	NS
	0	١٧٦٠.٩٣±32.93	١٧٤٤.٠٧^{a} ±30.03	-16.86
	250	١٧١٥.١٩±34.78	١٦٢٦.٤٨^{b} ±29.58	-88.71
	500	١٧٨٧.٩٦±32.53	1664.26^{ab} ±32.23	-123.7
Se	mg/kg	NS	NS	NS
	0	١٧١١.٢٩±31.09	١٦٨٦.٤٨±29.98	-23.81
	0.25	١٧٧٦.٢٩±35.81	١٦٧٨.٨٩±34.92	-97.40
	0.50	1776.48±33.32	١٦٦٩.٤٤±31.19	-107.04
Interaction				
A×E		NS	NS	NS
A×Se		NS	NS	NS
E×Se		NS	NS	NS
A×E×Se		NS	NS	NS

Means in the same column within each classification bearing different letters are significantly different (P ≤ 0.05).
NS = not significant and * (P ≤ 0.05).

Table 3. Feed intake and feed conversion ($\bar{X}$ ± SE) of Bovans laying hens as affected by the dietary supplementation of vit. A, vit. E and Se and their interactions

Variable	Level	Feed intake (g/day)				Feed conversion (g feed/g egg)			
		42-46 weeks	46-50 weeks	50-54 weeks	42 – 54 weeks	42-46 weeks	46-50 weeks	50-54 weeks	42 – 54 weeks
Vit. A	IU/kg	**	**	**	*	**	**	**	**NS**
	0	95.04^{b}±2.08	113.24^{a}±2.97	117.95^{b}±2.02	99.80^{b}±1.80	2.06^{a}±0.025	2.60^{a}±0.033	2.69^{a}±0.061	2.26±0.06
	8000	91.36^{c}±1.48	113.96^{a}±1.37	119.86^{a}±2.23	99.34^{b}±0.69	1.98^{b}±0.054	2.49^{b}±0.025	2.70^{a}±0.052	2.18±0.05
	16000	96.44^{a}±2.04	110.63^{b}±1.77	117.23^{b}±0.98	100.12^{a}±1.06	2.07^{a}±0.030	2.49^{b}±0.047	2.57^{b}±0.041	2.13±0.04
Vit. E	mg/kg	**	**	**	**	**	**	**	**NS**
	0	100.40^{a}±1.51	116.35^{a}±2.36	118.56^{b}±1.93	103.69^{a}±1.28	2.11^{a}±0.034	2.59^{a}±0.028	2.76^{a}±0.056	2.27±0.05
	250	93.50^{b}±1.15	111.26^{b}±1.84	120.37^{a}±2.01	99.06^{b}±1.04	2.11^{a}±0.034	2.50^{b}±0.021	2.65^{b}±0.058	2.18±0.04
	500	88.94^{c}±2.24	110.22^{b}±2.06	116.12^{c}±1.43	96.51^{c}±1.05	1.90^{b}±0.035	2.49^{b}±0.053	2.56^{c}±0.037	2.12±0.05
Se	mg/kg	**	**	**	**	**	**	**	**NS**
	0	95.46^{a}±2.01	114.93^{a}±2.74	118.72^{b}±1.96	101.95^{a}±1.21	1.97^{b}±0.042	2.52^{b}±0.053	2.60^{c}±0.064	2.23±0.07
	0.25	93.24^{b}±1.25	111.09^{b}±2.15	116.42^{c}±1.53	98.45^{b}±1.01	2.07^{a}±0.017	2.55^{a}±0.026	2.67^{b}±0.043	2.25±0.05
	0.50	94.13^{b}±2.35	111.81^{b}±1.27	119.90^{a}±2.06	98.86^{b}±1.44	2.08^{a}±0.048	2.51^{b}±0.027	2.70^{a}±0.048	2.24±0.04
Interaction									
A×E		(92.07)**	(112.71)**	(120.73)**	**	(1.99)**	(2.46)**	(2.64)**	*
A×Se		(94.67)**	(113.85)**	(120.52)**	**	(2.09)**	(2.54)**	(2.71)**	**
E×Se		(90.30)**	(110.70)**	(119.05)**	**	(2.03)**	(2.51)**	(2.65)**	NS
A×E×Se		(92.36)**	(115.27)**	(123.19)**	**	(2.04)**	(2.53)**	(2.70)**	NS

Means in the same column within each classification bearing different letters are significantly different ($P \leq 0.05$).
NS = not significant, * ($P \leq 0.05$) and ** ($P \leq 0.01$).

Table 4. Egg number and egg mass ($\overline{X}$ ± SE) of Bovans laying hens as affected by dietary supplementation of vit. A, vit. E and Se and their interactions

Variable	Level	Egg number				Egg mass (g)			
		42-46 weeks	46-50 weeks	50-54 weeks	42 – 54 weeks	42-46 weeks	46-50 weeks	50-54 weeks	42 – 54 weeks
Vit. A	IU/kg	NS	NS	*	NS	NS	NS	*	*
	0	25.11±0.39	23.26±0.57	21.52^{b} ±0.52	69.89±1.08	1455.55±29.40	1357.14±41.53	1284.81^{b}±38.10	4099.31^{b}±82.18
	8000	25.93±0.45	24.44±0.34	21.63^{b} ±0.52	72.00±1.17	1519.30±31.23	1429.60±31.80	1278.14^{b}±35.81	4230.20^{ab}±86.72
	16000	25.81±0.53	24.37±0.48	22.89^{a} ±0.43	73.07±1.22	1516.41±39.15	1460.25±35.33	1376.71^{a}±29.06	4355.57^{a}±86.74
Vit. E	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS
	0	26.19±0.43	23.59±0.53	21.44±0.47	71.22±1.17	1543.92±30.04	1411.53±38.62	1301.00±36.52	4258.66±84.73
	250	25.19±0.52	24.19±0.43	22.44±0.58	71.81±1.17	1467.50±39.71	1417.89±35.77	1326.93±36.94	4215.65±90.75
	500	25.48±0.42	24.30±0.53	22.15±0.43	71.93±1.21	1497.84±29.39	1417.55±37.79	1311.73±33.18	4210.75±86.86
Se	mg/kg	NS	NS	NS	NS	NS	NS	NS	NS
	0	26.04±0.42	23.96±0.60	22.07±0.47	72.07±1.18	1507.99±36.10	1410.47±37.44	1342.82±35.10	4268.12±87.93
	0.25	25.30±0.55	23.89±0.43	21.56±0.51	70.74±1.20	1466.59±34.90	1373.19±35.99	1278.95±38.88	4120.63±89.73
	0.50	25.52±0.39	24.22±0.46	22.40±0.52	72.15±1.16	1516.69±29.95	1463.33±36.68	1317.89±31.44	4296.32±80.90
Interaction									
A×E		$(25.70)^{NS}$	$(24.72)^{NS}$	$(23.17)^{NS}$	NS	$(1504.48)^{*}$	$(1462.12)^{NS}$	$(1329.55)^{NS}$	NS
A×Se		$(25.50)^{NS}$	$(24.25)^{NS}$	$(22.06)^{**}$	**	$(1504.44)^{*}$	$(1437.79)^{*}$	$(1301.56)^{**}$	**
E×Se		$(25.09)^{**}$	$(24.11)^{NS}$	$(22.19)^{*}$	*	$(1469.85)^{NS}$	$(1403.84)^{NS}$	$(1298.98)^{NS}$	NS
A×E×Se		$(25.42)^{*}$	$(24.50)^{**}$	$(22.25)^{NS}$	NS	$(1497.82)^{*}$	$(1450.52)^{**}$	$(1306.68)^{*}$	**

Means in the same column within each classification bearing different letters are significantly different (P ≤ 0.05).
NS = not significant, * (P ≤ 0.05) and ** (P ≤ 0.01).

Table 5. External egg quality traits ($\overline{X}$ ± SE) of Bovans laying hens as affected by dietary supplementation of vit. A, vit. E and Se and their interactions

Variable	Level	Egg weight (gm)	Egg length (mm)	Egg width (mm)	Egg shape index
			At 46 weeks of age		
Vit .A	IU/kg	**NS**	**	**NS**	**
	0	57.95±0.749	56.48^{b}±0.341	42.75±0.195	0.757^{a}±0.0042
	8000	58.56±0.527	56.78^{b}±0.218	42.78±0.145	0.754^{a}±0.0052
	16000	58.66±0.745	57.99^{a}±0.325	42.62±0.170	0.735^{b}±0.0035
Vit. E	mg/kg	**NS**	**NS**	**NS**	**NS**
	0	58.95±0.627	57.17±0.384	42.98±0.145	0.749±0.0046
	250	58.16±0.781	56.99±0.385	42.71±0.201	0.750±0.0049
	500	58.06±0.619	57.10±0.341	42.66±0.163	0.784±0.0046
Se	mg/kg	**NS**	**NS**	**NS**	**NS**
	0	57.82±0.839	56.46±0.409	42.64±0.209	0.756±0.0048
	0.25	57.93±0.558	57.19±0.287	42.59±0.159	0.745±0.0043
	0.50	59.83±0.577	57.61±0.394	42.92±0.130	0.746±0.0047
			At 50 weeks of age		
Vit. A		**NS**	*	**NS**	**
	0	58.24±0.831	56.96^{b}±0.371	42.68±0.195	0.750^{a}±0.0039
	8000	58.40±0.681	57.06^{b}±0.310	42.74±0.185	0.749^{a}±0.0035
	16000	59.90±0.743	58.10^{a}±0.308	42.60±0.177	0.733^{b}±0.0031
Vit. E	mg/kg	**NS**	**NS**	**NS**	**NS**
	0	59.77±0.735	57.55±0.346	42.97±0.202	0.747±0.0044
	250	58.50±0.824	57.45±0.381	42.56±0.183	0.741±0.0037
	500	58.26±0.708	57.11±0.360	42.49±0.157	0.744±0.0032
		**	*	**	**NS**
	0	58.87^{ab}±0.593	57.50^{ab}±0.285	42.64^{ab}±0.160	0 .742±0.0034
	0.25	57.35^{b}±0.856	56.69^{b}±0.375	42.32^{b}±0.194	0.747±0.0040
	0.50	60.32^{a}±0.720	57.93^{a}±0.325	43.06^{a}±0.174	0.744±0.0038

Table. 5 (Continued)

		At 54 weeks of age			
Vit. A		**NS**	**NS**	**NS**	**NS**
	0	59.61±0.808	57.57±0.272	42.73±0.239	0.743±0.0043
	8000	59.08±0.885	57.87±0.368	42.60±0.220	0.737±0.0038
	16000	60.13±0.587	57.74±0.250	42.79±0.199	0.724±0.0044
Vit. E	mg/kg	**NS**	**NS**	**NS**	**NS**
	0	60.54±0.760	57.91±0.329	42.91±0.185	0.741±0.0038
	250	59.17±0.833	57.74±0.302	42.58±0.242	0.783±0.0051
	500	59.11±0.691	57.52±0.268	42.64±0.223	0.742±0.0034
Se	mg/kg	**NS**	*	**	**NS**
	0	60.76±0.752	58.38^{a}±0.271	43.20^{a}±0.189	0.740±0.0035
	0.25	59.15±0.774	57.57^{b}±0.333	42.42^{b}±0.219	0.737±0.0054
	0.50	58.91±0.746	57.23^{b}±0.250	42.50^{b}±0.219	0.743±0.0033
		Overall mean			
Vit. A					
	0	58.60	57.00	42.72	0.750
	8000	58.68	57.24	42.71	0.747
	16000	59.56	57.94	42.67	0.731
Vit. E					
	0	59.75	57.54	42.95	0.746
	250	58.61	57.39	42.62	0.758
	500	58.48	57.24	42.60	0.757
Se					
	0	59.15	57.45	42.83	0.746
	0.25	58.14	57.15	42.44	0.743
	0.50	59.69	57.59	42.83	0.744

Means in the same column within each classification bearing different letters are significantly different ($P \leq 0.05$).
NS = not significant, * ($P \leq 0.05$) and ** ($P \leq 0.01$).

Table 6. Internal egg quality traits ($\overline{X}$ ± SE) of Bovans laying hens as affected by dietary supplementation of vit. A, vit. E and Se and their interactions

Variable	Level	Thick albumin height (mm)	Thin albumin height (mm)	Yolk height (mm)	Yolk weight (gm)	Albumin weight (gm)	Shell weight (gm)	Shell thickness (mm)	Haugh units	Shell %	Albumin %	Yolk %
						At 46 weeks of age						
Vit .A	IU/kg	**NS**	**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
	0	10.70±0.198	2.80^{a}±0.165	15.05±0.207	14.04±0.29	37.10±0.50	6.81±0.15	0.39±0.010	72.73±2.29	11.75	64.04	24.20
	8000	10.57±0.104	2.54^{ab}±0.087	14.72±0.171	14.43±0.20	37.20±0.48	6.93±0.18	0.38±0.008	72.88±2.19	11.83	63.50	24.67
	16000	10.31±0.163	2.21^{b}±0.121	14.74±0.203	14.70±0.20	37.27±0.69	6.69±0.13	0.41±0.011	69.70±2.12	11.41	63.42	25.17
Vit. E	mg/kg	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	*	**NS**	**NS**	**NS**
	0	10.68±0.177	2.68±0.170	14.93±0.195	14.64±0.26	37.52±0.46	6.80±0.14	0.39±0.008	74.77^{a}±2.96	11.53	63.64	24.83
	250	10.43±0.149	2.43±0.108	14.84±0.221	14.22±0.22	37.06±0.68	6.88±0.18	0.41±0.011	73.21^{ab}±1.10	11.81	63.65	24.54
	500	10.47±0.157	2.44±0.117	14.75±0.145	14.32±0.22	37.00±0.52	6.75±0.14	0.37±0.008	67.33^{b}±2.14	11.65	63.68	24.67
Se	mg/kg	**NS**	**NS**	**NS**	*	**	**NS**	**NS**	**NS**	**	**	*
	0	10.54±0.192	2.53±0.175	14.96±0.220	14.91^{a}±0.28	35.86^{c}±0.62	7.05±0.17	0.37±0.008	73.88±2.23	12.19^{a}	61.99^{b}	25.82^{a}
	0.25	10.48±0.154	2.67±0.125	14.67±0.182	14.07^{b}±0.17	37.19^{b}±0.51	6.71±0.14	0.38±0.010	70.67±2.12	11.57^{ab}	64.10^{a}	24.33^{b}
	0.50	10.45±0.136	2.36±0.089	14.89±0.181	14.19^{b}±0.22	38.52^{a}±0.41	6.66±0.15	0.38±0.010	70.76±2.25	11.22^{b}	64.88^{a}	23.89^{b}
						At 50 weeks of age						
Vit. A	IU/kg	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
	0	10.57±0.358	3.23±0.502	14.91±0.212	14.54±0.33	37.45±0.58	6.25±0.14	0.38±0.008	72.20±1.74	10.71	64.31	24.98
	8000	10.49±0.091	2.86±0.366	14.85±0.151	15.12±0.11	36.98±0.58	6.30±0.13	0.38±0.008	76.79±1.62	10.77	63.26	25.97
	16000	10.77±0.183	2.44±0.153	15.12±0.195	15.41±0.18	36.54±1.71	7.95±1.64	0.39±0.006	75.49±1.51	13.26	60.97	25.76
Vit. E	mg/kg	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	*	**NS**	**NS**	**NS**	**NS**
	0	10.51±0.356	3.43±0.613	15.10±0.199	15.20±0.23	36.52±1.72	8.05±1.64	0.39^{a}±0.006	77.60±1.54	13.44	61.08	25.49
	250	10.65±0.164	2.48±0.109	14.85±0.216	15.06±0.23	37.15±0.57	6.28±0.11	0.38^{ab}±0.006	74.28±1.40	10.74	63.51	25.75
	500	10.68±0.130	2.62±0.115	14.93±0.141	14.81±0.23	37.29±0.59	6.16±0.13	0.37^{b}±0.008	72.61±1.51	10.57	63.96	25.47
Se	mg/kg	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	*	**NS**	**NS**	**NS**	**NS**
	0	10.68±0.166	2.38±0.124	15.03±0.202	14.90±0.27	37.67±0.54	6.31±0.14	0.38^{ab}±0.006	76.78±2.09	10.70	63.94	25.36
	0.25	10.29±0.329	3.40±0.594	14.76±0.187	14.92±0.24	36.22±0.61	6.21±0.11	0.37^{b}±0.008	73.08±1.10	10.82	63.13	26.05
	0.50	10.87±0.171	2.74±0.180	15.09±0.171	15.25±0.19	37.08±1.71	7.98±1.64	0.39^{a}±0.006	74.63±1.06	13.23	61.47	25.31

Table. 6 (Continued)

						At 54 weeks of age						
Vit. A	IU/kg	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	*	**NS**	*	**NS**
	0	10.65±0.142	2.40±0.112	15.05±0.160	15.21±0.13	38.24±0.62	6.16±0.12	0.37±0.008	71.37^{b}±0.70	10.33	64.09^{ab}	25.58
	8000	10.78±0.128	2.53±0.109	15.13±0.183	15.29±0.11	37.57±0.68	6.23±0.14	0.38±0.008	73.56^{ab}±0.98	10.51	63.51^{b}	25.98
	16000	10.62±0.094	2.52±0.082	14.99±0.155	15.15±0.11	38.71±0.41	6.26±0.14	0.38±0.008	75.54^{a}±1.88	10.39	64.38^{a}	25.23
Vit. E	mg/kg	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
	0	10.84±0.122	2.49±0.102	15.13±0.162	15.26±0.13	38.93±0.58	6.35±0.13	0.38±0.008	73.45±1.39	10.47	64.26	25.27
	250	10.73±0.142	2.55±0.125	15.01±0.174	15.26±0.11	37.69±0.64	6.22±0.14	0.37±0.008	73.45±1.26	10.49	63.63	25.87
	500	10.47±0.091	2.41±0.072	15.02±0.162	15.13±0.11	37.89±0.52	6.08±0.13	0.37±0.008	73.57±1.35	10.27	64.08	25.65
Se	mg/kg	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**	**NS**	**NS**	**NS**
	0	10.88±0.137	2.57±0.131	15.16±0.142	15.33±0.10	38.98±0.58	6.45±0.13	0.39±0.008	76.53^{a}±1.79	10.59	64.11	25.30
	0.25	10.59±0.104	2.79±0.082	14.83±0.173	15.11±0.12	37.87±0.59	6.16±0.13	0.37±0.008	72.18^{b}±0.63	10.40	63.98	25.62
	0.50	10.58±0.118	2.39±0.084	15.18±0.174	15.21±0.12	37.66±0.56	6.04±0.14	0.37±0.008	71.76^{b}±1.10	10.23	63.89	25.88
						Overall mean						
Vit. A	IU/kg											
	0	10.64	2.81	15.00	14.60	37.60	6.43	0.38	72.10	10.93	64.15	24.92
	8000	10.61	2.64	14.90	14.95	37.25	6.50	0.38	74.41	11.04	63.42	25.54
	16000	10.57	2.39	14.95	15.09	37.51	6.97	0.39	73.58	11.69	62.92	25.39
Vit. E	mg/kg											
	0	10.68	2.87	15.05	15.03	37.66	7.02	0.39	75.27	11.81	62.99	25.20
	250	10.60	2.49	14.90	14.85	37.30	6.41	0.39	74.17	11.01	63.60	25.39
	500	10.54	2.49	14.90	14.75	37.39	6.33	0.37	73.65	10.83	63.91	25.26
Se	mg/kg											
	0	10.70	2.49	15.05	15.05	37.50	6.51	0.38	76.03	11.16	63.35	25.49
	0.25	10.47	2.95	14.75	14.70	37.09	6.32	0.38	74.79	10.93	63.74	25.33
	0.50	10.66	2.50	15.05	14.88	37.75	4.88	0.39	75.31	11.56	63.41	25.03

Means in the same column within each classification bearing different letters are significantly different (P ≤ 0.05).
NS = not significant, * (P ≤ 0.05) and ** (P ≤ 0.01).

Table 7. Economic evaluation of Bovans laying hens as affected by the interaction of dietary supplementations of vit. A, vit .E and Se during 42-54 weeks of age

Levels			Total feed intake (kg)	Cost of kg feed (LE)	Total feed cost (LE)[A]	Total egg mass (kg)	Egg market price (LE)[B]	Net return (LE)[C]	Economic efficiency (%)[D]
Vit.A	**Vit.E**	**Se**							
(0)	(0)	(0)	12.06	2.40	28.94	3.846	38.458	9.518	32.89
		(0.25)	9.93	2.45	24.33	4.162	41.617	17.287	71.05
		(0.50)	10.28	2.50	25.70	4.631	46.308	20.608	80.19
(0)	(250)	(0)	9.53	2.50	23.83	4.465	44.648	20.818	87.36
		(0.25)	7.92	2.55	20.20	3.673	36.733	16.533	81.85
		(0.50)	9.78	2.60	25.43	4.301	43.009	17.579	69.13
(0)	(500)	(0)	10.32	2.60	26.83	3.743	37.427	10.597	39.50
		(0.25)	8.88	2.65	23.53	4.033	40.247	16.801	71.40
		(0.50)	8.13	2.70	21.95	4.025	40.250	18.297	83.36
(8000)	(0)	(0)	9.75	2.50	24.38	4.591	45.911	21.531	88.31
		(0.25)	8.91	2.55	22.72	4.064	40.636	17.916	78.85
		(0.50)	9.11	2.60	23.69	3.792	37.920	14.230	60.07
(8000)	(250)	(0)	9.92	2.60	25.79	4.701	47.013	21.223	82.29
		(0.25)	10.06	2.65	26.66	3.926	39.262	12.602	47.27
		(0.50)	9.80	2.70	26.46	4.222	42.220	15.760	59.56
(8000)	(500)	(0)	8.83	2.70	23.84	4.469	44.690	20.850	87.46
		(0.25)	10.20	2.75	28.05	3.844	38.442	10.392	37.05
		(0.50)	9.63	2.80	26.96	4.434	44.341	17.381	64.47
(16000)	(0)	(0)	9.39	2.60	24.41	4.193	41.935	17.525	71.79
		(0.25)	10.55	2.65	27.96	4.632	46.322	18.362	65.67
		(0.50)	9.98	2.70	26.95	4.398	43.975	17.025	63.17
(16000)	(250)	(0)	9.42	2.70	25.43	3.750	37.497	12.067	47.45
		(0.25)	8.90	2.75	24.48	4.077	40.773	16.293	66.56
		(0.50)	10.00	2.80	28.00	4.796	47.956	19.956	71.27
(16000)	(500)	(0)	8.64	2.80	24.19	4.594	45.939	21.749	**89.91**
		(0.25)	9.82	2.85	27.99	4.657	46.571	18.581	66.38
		(0.50)	9.08	2.90	26.33	4.084	40.837	14.507	55.10

A: Total feed cost= Feed intake*Cost of kg.
B: Egg market price= Total egg mass* Cost of kg egg (10 LE).
C: Net return= Difference between egg market price and total feed cost.
D: Economic efficiency= (Net return/ total feed cost)* 100.

إستجابة الدجاج البياض للإضافات الغذائية من فيتامينات أ، هـ، وعنصر السلينيوم خلال شهور الصيف

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هدفت هذه الدراسة إلى معرفة تأثير الإضافات العالية من فيتامينات أ، هـ وعنصر السلينيوم على أداء الدجاج البياض خلال شهور الصيف. تم استخدام عدد ٢٤٣ دجاجة من دجاج البوفانز البياض على عمر ٤٢ أسبوع، وُزعت عشوائياً في تجربة عاملية ٣×٣×٣ لدراسة تأثير إضافة كلاً من فيتامين أ (صفر، ٨٠٠٠، ١٦٠٠٠ وحدة دولية/ كجم علف)، فيتامين هـ (صفر، ٢٥٠، ٥٠٠ ملجم/ كجم علف) و السلينيوم (صفر، ٠.٢٥، ٠.٥٠ ملجم / كجم علف) والتداخل بينهم على الأداء الإنتاجي لدجاج البوفانز البياض خلال شهور الصيف.

أظهرت النتائج المتحصل عليها أن معظم قيم وزن الجسم والتغير في وزن الجسم لم تختلف معنوياً نتيجة إضافة كل من فيتامين أ، هـ و السلينيوم وكذلك التداخل بينهم عند الأعمار المدروسة. يلاحظ من النتائج وبشكل عام أنه عند زيادة مستوى إضافة فيتامين أ، هـ و السلينيوم فإنها تكون مصحوبة بانخفاض في استهلاك العلف وكذلك تحسن في معامل التحويل الغذائي. وقد كان تأثير هذه الإضافات والتداخل بينها عالي المعنوية (٠.٠١) على كل من معدل استهلاك الغذاء وكذلك معامل التحويل الغذائي. إضافة فيتامين أ أدت إلى زيادة معنوية في عدد البيض وكتلة البيض. أدت المعاملة بفيتامين أ إلى زيادة طول البيضة عند عمري ٤٦ و ٥٠ أسبوع كما أدت إلى زيادة ملحوظة في قيم وحدات هاف عند ٥٤ أسبوع من العمر. أدى المستوى العالي من فيتامين هـ إلى انخفاض معنوي (٠.٠٥) في سمك القشرة وكذلك قيم وحدات هاف. تغيرت معظم صفات جودة البيضة معنوياً (٠.٠٥ أو ٠.٠١) مع المستوى العالي من السلينيوم. وقد آلت تأثيرات التداخل بين الإضافات المستخدمة إلى عدم المعنوية في معظم صفات جودة البيضة المدروسة.

من نتائج هذه الدراسة يمكن اقتراح استخدام كل من فيتامين أ بمستويات عالية حتى ١٦٠٠٠ وحدة دولية لكل كجم علف وكذلك فيتامين هـ بمستوى ٥٠٠ ملليجرام/كجم علف مع بعضهما كمركب واحد. أما عنصر السلينيوم فيحتاج للمزيد من الدراسات لتحديد المستوى المطلوب إضافته منفرداً أو مع فيتامين هـ وذلك للتغلب على التأثيرات الضارة لشهور الصيف الحارة.