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# EFFECT OF SUPPLEMENTED DIFFERENT LEVELS OF VITAMINS E AND C TO LAYERS HEN DIETS ON: 1- PRODUCTIVE AND REPRODUCTIVE PARAMETERS

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***SUMMARY:*** This study was carried out at the Poultry Research Station, El-Azab, Fayoum, to study the effects of two dietary levels of vitamin E (Vit. E) (10 or 20 mg/Kg diet), vitamin C (Vit. C) (200 or 400 mg/Kg diet) and their mixtures on egg performance, egg quality, fertility, hatchability and economic efficiency of El-Salam laying hens. A total number of 243 (216 breeder hens and 27 cocks) birds at 25 weeks of age were used in this experiment. Birds were wing banded and randomly distributed into 9 equal treatment groups of 27 birds each (24 breeder hen and 3 cock each). Each group was equally subdivided into three replicates of 11 (eight ♀ and one ♂/replicate) birds each.

**The experimental treatments were as follows:**

1- Birds were fed control diet (unsupplemented with Vit. E or Vit. C (D1)).
2- Birds were fed D1 supplemented with 10 mg/Kg diet Vit. E (D2).
3- Birds were fed D1 supplemented with 20 mg/Kg diet Vit. E (D3).
4- Birds were fed D1 supplemented with 200 mg/Kg diet Vit. C (D4).
5- Birds were fed D1 supplemented with 400 mg/Kg diet Vit. C (D5).
6- Birds were fed D1 supplemented with Vit. E 10 mg/Kg diet + Vit. C 200 mg/Kg diet (D6).
7- Birds were fed D1 supplemented with Vit. E 10 mg/Kg diet + Vit. C 400 mg/Kg diet (D7).
8- Birds were fed D1 supplemented with Vit. E 20 mg/Kg diet + Vit. C 200 mg/Kg diet (D8).
9- Birds were fed D1 supplemented with Vit. E 20 mg/Kg diet + Vit. C 400 mg/Kg diet (D9).

***Results obtained could be summarized in the following:***

1- Laying hens fed diet containing mixtures of Vit. E and C supplementation had lower feed intake value, while, laying hens fed control diet had higher feed intake value. No significant effect were observed for average egg weight, total egg mass, egg production% and feed conversion during the experimental period.
2- Laying hens fed diet containing 10 mg/kg diet Vit. E had higher shell thickness and shell% while, those fed diet containing 20 mg Vit. E and 400 mg/kg diet Vit. C had lower shell thickness and shell% during the experimental period.
3- Laying hens fed diet containing 20 mg Vit. E and 400 mg/kg diet Vit. C had higher fertility%.
4- El-Salam laying hens fed diet containing 20 mg Vit. E and 200 mg/kg diet Vit. C gave the best economical and relative efficiency values

**In conclusion:** Feeding El-Salam laying hens on diets containing 20 mg Vit. E and 200 mg/kg diet Vit. C improved the productive, reproductive performance and relative economic efficiency values.

**Key words:** El-Salam laying hen, productive and reproductive performance.

Vitamin E (Vit. E ) plays important roles in various biochemical and physiological processes, including antioxidation and signaling transduction **(Brigelius-Flohe *et al.*, 2002 and Ricciarelli *et al.*, 2002).** The addition of $\alpha$-tocopherol to hen diets increases the content of Vit. E in the egg yolk in a dose dependent manner **(Jiang *et al.*, 1994; Surai *et al.*,1997 and Meluzzi *et al.*, 2000).** Tocopherols may also provide health benefits mainly in preventing cancer and coronary diseases **(Diplock, 1991 and Knekt *et al.*, 1991)**, so that

the incorporation of Vit. E to the egg may both increase the oxidative stability and provide a source of tocopherols useful for human nutrition and health.

As poultry fowls are able to synthesize vitamin C (Vit. C) and it is not transferred into the egg. The research attention was mainly focused on the effects of the vitamin on improving the egg-shell quality **(Pardue and Thaxton, 1986).** Even if Vit. C is neither contained nor transferred to the egg, it could play its antioxidative role in regenerating Vit. E in laying hens. Furthermore it is well known that ascorbic acid (AA) is a water-soluble vitamin) is required for the hydroxylation of proline residues necessary for the synthesis of pro-collagen **(Weiser *et al.*, 1990),** also it could be involved in the synthesis of egg proteins. Plasma protein concentration was insignificantly increase with Vit. C **(El-Badry *et al.*, 2011),** the beneficial effect of Vit. C supplementation on plasma protein could be attributed to Vit. C which work as coenzyme playing an important role in the metabolism of amino acid **(Kutlu and Forbes, 1993)** while, **Rice (2000)** reported that Vit. C is effective as antioxidant and it play an important role in metabolic activity.

Vitamin C has been demonstrated to enhance antioxidant activity of Vit. E by reducing the tocopheroxyl radicals back to their active form of Vit. E **(Packer, 1992 and Jacob,1995)** or by sparing available Vit. E **(Retsky and Frei, 1995).** Some reports indicated improvements in the egg production and egg shell quality by Vit. C **(Bell and Marion, 1990; Balnave and Muheereza, 1997 and Al-Shoquiry, 1999).** As well as by adding Vit. E **(Bollengier *et al.*, 1999 and Sahin *et al.*, 2002).** On the other hand, Vit. E serves as a physiological antioxidant through inactivation free radicals, improves egg production, feed intake, egg yolk and albumen solids **(Kirunda *et al.*, 2001),** and improves egg quality **(Puthpongsiriporn, 1998).**

Therefore, the objective of this study was to determine the effects of two dietary levels of Vit. E (10 or 20 mg/Kg diet), Vit. C (200 or 400 mg/Kg diet) separately and their mixtures on egg performance, egg quality, fertility, hatchability, embryonic mortality and economic efficiency of El-Salam laying hens.

## MATERIALS AND METHODS

This study was carried out at the Poultry Research Station, El-Azab, Fayoum, to study the effects of two dietary levels of vitamin E (Vit. E) (10 or 20 mg/Kg diet), vitamin C (Vit. C) (200 or 400 mg/Kg diet) and their mixtures on egg performance, egg quality, fertility, hatchability, embryonic mortality and economic efficiency of El-Salam laying hens.

A total number of 243 (216 breeder hens and 27 cocks) birds at 25 weeks of age were used in this experiment. Birds were wing banded and randomly distributed into 9 equal treatment groups of 27 birds (having nearly similar body weight) each (24 breeder hen and 3 cock each). Each group was equally subdivided into three replicates of 11 (eight ♀ and one ♂/replicate) birds each. Birds were reared under the same management conditions in egg production batteries (open system). The experimental period was lasted for 14 weeks from 25 to 39 weeks of age. Treatment groups were fed a commercial layer ration (16% CP and 2703.34 Kcal ME/Kg diet, Table 1), (control group) supplemented with 10 or 20 mg/Kg diet α-tocopherol acetate (Vit. E), 200 or 400 mg/Kg diet of L-ascorbic acid (Vit. C) and their mixtures. Artificial light was used beside the normal day light to provide 16-hour day photoperiod. Feed and water were provided *ad libitum*.

**The experimental treatments were as follows:**

1- Birds were fed control diet (unsupplemented with Vit. E or Vit. C (D1)).
2- Birds were fed D1 supplemented with 10 mg/Kg diet Vit. E (D2).
3- Birds were fed D1 supplemented with 20 mg/Kg diet Vit. E (D3).
4- Birds were fed D1 supplemented with 200 mg/Kg diet Vit. C (D4).
5- Birds were fed D1 supplemented with 400 mg/Kg diet Vit. C (D5).
6- Birds were fed D1 supplemented with Vit. E 10 mg/Kg diet + Vit. C 200 mg/Kg diet (D6).
7- Birds were fed D1 supplemented with Vit. E 10 mg/Kg diet + Vit. C 400 mg/Kg diet (D7).
8- Birds were fed D1 supplemented with Vit. E 20 mg/Kg diet + Vit. C 200 mg/Kg diet (D8).
9- Birds were fed D1 supplemented with Vit. E 20 mg/Kg diet + Vit. C 400 mg/Kg diet (D9).

Egg production (weight and number) was recorded daily and feed intake for each group was calculated weekly and feed conversion calculated as the amount of feed required for producing a unit of egg mass.

**Table 1: Composition of the basal diets.**

| Items | % |
|---|---|
| **Yellow corn, ground** | 63.50 |
| **Soybean meal (44%CP)** | 24.57 |
| **Wheat bran** | 2.00 |
| **Calcium carbonate** | 7.77 |
| **Sodium chloride** | 0.30 |
| **Vit. and Min. premix**[1] | 0.30 |
| **Di-calcium phosphate** | 1.50 |
| **DL–Methionine** | 0.06 |
| **Total** | 100.0 |
| **Calculated analysis % [2]:** | |
| **Crude protein** | 16.56 |
| **Ether extract** | 2.67 |
| **Crude fiber** | 3.34 |
| **Calcium** | 3.37 |
| **Available phosphorus** | 0.39 |
| **Methionine** | 0.33 |
| **Methionine+Cystine** | 0.61 |
| **Lysine** | 0.84 |
| **ME, kcal./Kg** | 2703 |
| **Cost (£.E./ton)** [3] | 2600.0 |

[1] Each 3.0 Kg of the Vit. and Min. premix contains: Vit. A, 10000000 IU; Vit. $D_3$ 2000000 IU; Vit. E, 1000 mg; Vit. $K_3$, 1000 mg; Vit. B1, 1000 mg; Vit. B2, 500 mg; Vit. B6, 1500 mg; Vit. B12, 10 mg; biotin, 50 mg; folic acid, 1 mg; niacin, 3000 mg; Ca pantothenate, 1000 mg; Zn, 50 g; Cu,4 g; Fe, 30 g; Co, 0.1 g; Se, 0.1 g; I, 0.3 g; Mn, 60 g and anti-oxidant, 10 g, and complete to 3.0 Kg by calcium carbonate.
[2] According to **NRC, 1994**.
[3] According to the local market price at the experimental time.

Mortality was recorded daily (no mortality of birds were recorded during the study period). Egg quality measurements were determined monthly on eggs of the last three days. Representative egg samples from each treatment were collected monthly throughout the experimental period in order to determine egg and shell quality. Egg shell thickness, including shell membranes, was measured using a micrometer at three locations on the egg (air cell, equator, and sharp end). Haugh unit score was applied from a special chart using egg weight and albumen height which was measured by using a micrometer according to **Haugh (1937).** Shell surface area **(Carter, 1975**), shell weight per unit surface area **(Hamilton, 1978)**, egg shape index% **(Carter, 1968)** and yolk

index% **(Well, 1968)** were calculated. The egg yolk visual color score was determined by matching the yolk with one of the 15 bands of the "1961, Roche Improved Yolk Color Fan".

Two batches of eggs (130 egg/treatment) were collected from the 9 treatments at the 38th and 39th weeks of age to study the hatchability and incubated at Chick Master hatchery. Fertility was determined by candling at 7 days of incubated period. The averages of the fertility and hatchability of the two batches were calculated.

Economical efficiency of egg production was calculated from the input-output analysis which was calculated according to the price of the experimental diets and eggs produced. The values of economical efficiency were calculated as the net revenue per unit of total cost.

An ANOVA with the General Linear Models (GLM) procedure of SPSS software **(SPSS, 1999)** included the effect of type and treatment means. Treatment means indicating significant differences ($P \leq 0.01$ and $P \leq 0.05$) were tested using Duncan's multiple range test **(Duncan, 1955)**.

## RESULTS AND DISCUSSION

**Laying hens productive performance:** Effect of supplementing laying hens diets with Vit. E, C and their mixtures on average egg weight (EW), total egg mass (EM), egg production (EP%), daily feed intake (FI) and feed conversion (FC) are shown in Table 2.

As shown in Table 2, type of addition effect was significant only for FI (Table 2), it is clear that laying hens fed diet containing mixtures of Vit. E and C supplementation had lower FI value, while, laying hens fed control diet had higher FI value. No significant effect were observed for EW, EM, EP% and FC during the experimental period. Numerically, laying hens fed diet containing mixtures of Vit. E and C had higher EW value, while, those fed diet containing Vit. C supplementation had higher EM, EP% and the best FC value (the difference is not significant).

**Table 2: Effects of supplementing laying hens diets with vitamin E, C and their mixtures on egg production of El-Salam laying hens.**

| Items | Average egg weight (EW,g) | Total egg mass (EM,g) | Egg production (EP)% | Daily feed intake (FI,g) | Feed conversion (FC) |
|---|---|---|---|---|---|
| **Type of addition** | | | | | |
| **Control** | 44.58 | 22765.3 | 68.66 | $106.94^{A}$ | 3.51 |
| **Vitamin (Vit.) E** | 44.55 | 22672.6 | 68.39 | $104.21^{B}$ | 3.44 |
| **Vitamin C** | 45.13 | 23572.3 | 70.06 | $103.36^{BC}$ | 3.29 |
| **Mixed (Vit. E &Vit. C)** | 46.18 | 23365.3 | 68.06 | $102.79^{C}$ | 3.30 |
| **±SEM**[1] | 0.60 | 858.4 | 2.33 | 0.29 | 0.13 |
| **Treatments** | | | | | |
| **Control** | 44.58 | 22765.3 | 68.66 | $106.94^{A}$ | 3.51 |
| **Vit. E 10 mg/Kg diet** | 44.68 | 22367.9 | 67.25 | $104.73^{B}$ | 3.51 |
| **Vit. E 20 mg/Kg diet** | 44.42 | 22977.4 | 69.53 | $103.70^{D}$ | 3.38 |
| **Vit. C 200 mg/Kg diet** | 45.03 | 23187.6 | 69.20 | $103.21^{F}$ | 3.31 |
| **Vit. C 400 mg/Kg diet** | 45.23 | 23957.1 | 70.92 | $103.50^{E}$ | 3.26 |
| **Vit. E 10 mg/Kg diet + Vit. C 200 mg/Kg diet** | 45.71 | 22399.9 | 65.82 | $104.23^{C}$ | 3.52 |
| **Vit. E 10 mg/Kg diet + Vit. C 400 mg/Kg diet** | 45.79 | 22820.2 | 67.25 | $101.77^{H}$ | 3.34 |
| **Vit. E 20 mg/Kg diet + Vit. C 200 mg/Kg diet** | 47.00 | 24301.7 | 69.53 | $102.60^{G}$ | 3.15 |
| **Vit. E 20 mg/Kg diet + Vit. C 400 mg /Kg diet** | 46.22 | 23939.3 | 69.62 | $102.55^{G}$ | 3.19 |
| **±SEM** | 0.93 | 1311.9 | 3.61 | 0.06 | 0.20 |

[1]Pooled SEM

A,… G, values in the same column within the same item followed by different superscripts are significantly different (at $P \leq 0.01$ for A to G).

There were insignificant differences among all dietary treatments in productive performance except, FI. It is clear that laying hens fed diet containing 20 mg Vit. E and 400 mg/kg diet Vit. C had lower FI whereas, those fed control diet had higher FI during the experimental period. Numerically, laying hens fed diet containing 20 mg Vit. E and 200 mg Vit. C/kg diet had higher EW, EM and the best FC value while, those fed diet containing 400 mg Vit. C/kg diet had higher EP% (difference is not significant) during the experimental period (Table 2).

These results are in harmony with some experimental results who demonstrated that egg weight was unaffected by a dietary treatment **(Gebert *et al.*,1998; Meluzzi *et al.*, 2000 and Franchini, *et al.*, 2002).** Similarly**, Puthpongsiriporn *et al.* (2001)** reported that supplemental Vit. E did not affect egg production of White Leghorn hens. While, these results disagree with those

of **Ajuyah *et al.* (1993) and Scheideler and Froning (1996)** reported that laying hens fed diets with high levels of Vit. E (50 IU/kg diet) greatly improved egg production compared with that of laying hens fed the same diets with low levels of Vit. E (27 IU/kg diet). Also, **Whitehead *et al.* (1998)** reported that dietary Vit. E at 250 mg/kg provided for optimum egg production compared to 10 mg/kg fed to control hens by Vit. E promoting the release of vitellogenin from liver by protecting cell membranes of hepatocytes from oxidative damage. **Bartov *et al.* (1991)** reported that Vit. E may minimize the decline in egg production and feed efficiency following the outbreaks of some diseases. **El-Mallah *et al.* (2011)** reported that dietary Vit. E at either level 0.20 or 0.40mg/kg considerably resulted in positive significant effect on EP values and had no effect on EW compared to the control, also, FI did not differ while, FC values were improved due to Vit. E addition compared to the control. Vitamin C supplementation of broiler diets did not affect feed consumption or feed conversion rate **(Abo Elouun and Al-Huminany, 2011).**

As shown in Table 3, type of vitamins (E and C) supplementation had no effect on egg quality except, shell thickness and shell surface area (SSA) throughout the trial. It is clear that laying hens fed control diet had higher shell thickness and SSA, whereas, those fed diet containing mixtures of Vit. E and vitamin C supplementation had lower shell thickness and SSA during the experimental period.

Results presented in Table (3) indicated no significant differences in egg quality among all dietary treatments including the control group except, shell thickness, shell%, SSA and shell weight per unit surface area (SW/SA). Laying hens fed diet containing 10 mg/kg diet Vit. E had higher shell thickness, shell% and SSA while, those fed diet containing 20 mg Vit. E and 400 mg/kg diet Vit. C had lower shell thickness, shell% and SSA during the experimental period.

This result agrees with those of **Cherian *et al.* (1996) and Franchini *et al.* (2002),** who observed no effects of dietary added tocopherols on the Haugh units of eggs.

**Table 3: Effects of supplementing laying hens diets with vitamin E, C and their mixtures on egg quality of El-Salam laying hens.**

| Items | Yolk color | Shell thickness, mm | Albumen % | Yolk % | Shell % | Yolk index % | Shape index% | Haugh unit | SSA[1] | SW/SA[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| **Type of addition** | | | | | | | | | | |
| **Control** | 7.20 | $0.336^{a}$ | 61.44 | 29.68 | 8.67 | 46.24 | 75.48 | 90.54 | $63.29^{A}$ | 69.30 |
| **Vitamin (Vit.) E** | 7.55 | $0.333^{a}$ | 61.32 | 29.55 | 9.14 | 45.11 | 75.13 | 90.20 | $62.26^{AB}$ | 72.25 |
| **Vitamin C** | 7.15 | $0.315^{ab}$ | 61.23 | 29.49 | 9.27 | 45.76 | 75.44 | 89.23 | $59.91^{B}$ | 74.37 |
| **Mixed (Vit. E &Vit. C)** | 6.78 | $0.300^{b}$ | 61.52 | 29.64 | 8.84 | 45.34 | 75.15 | 87.79 | $56.06^{C}$ | 70.56 |
| **±SEM[3]** | 0.24 | 0.01 | 0.67 | 0.52 | 0.34 | 0.57 | 0.69 | 1.66 | 0.94 | 2.53 |
| **Treatments** | | | | | | | | | | |
| **Control** | 7.20 | $0.336^{ab}$ | 61.64 | 29.68 | $8.67^{ab}$ | 46.24 | 75.48 | 90.54 | $63.29^{AB}$ | $69.30^{AB}$ |
| **Vit. E 10 mg/Kg diet** | 7.70 | $0.345^{a}$ | 60.82 | 29.30 | $9.88^{a}$ | 45.70 | 75.40 | 90.75 | $63.82^{A}$ | $78.67^{A}$ |
| **Vit. E 20 mg/Kg diet** | 7.40 | $0.320^{abc}$ | 61.81 | 29.79 | $8.40^{b}$ | 44.52 | 74.86 | 89.66 | $60.70^{ABC}$ | $65.83^{B}$ |
| **Vit. C 200 mg/Kg diet** | 6.90 | $0.300^{bc}$ | 61.64 | 29.68 | $8.67^{ab}$ | 45.94 | 75.48 | 89.10 | $59.64^{BCD}$ | $69.66^{AB}$ |
| **Vit. C 400 mg/Kg diet** | 7.40 | $0.330^{abc}$ | 60.82 | 29.30 | $9.88^{a}$ | 45.57 | 75.40 | 89.35 | $60.19^{ABCD}$ | $79.08^{A}$ |
| **Vit. E 10 mg/Kg diet + Vit. C 200 mg/Kg diet** | 7.20 | $0.300^{bc}$ | 61.81 | 29.79 | $8.40^{b}$ | 44.34 | 74.86 | 88.32 | $57.20^{CDE}$ | $66.18^{B}$ |
| **Vit. E 10 mg/Kg diet + Vit. C 400 mg/Kg diet** | 6.50 | $0.290^{c}$ | 61.64 | 29.68 | $8.67^{ab}$ | 46.13 | 75.48 | 87.73 | $56.27^{DE}$ | $70.02^{AB}$ |
| **Vit. E 20 mg/Kg diet + Vit. C 200 mg/Kg diet** | 6.90 | $0.320^{abc}$ | 60.82 | 29.30 | $9.88^{a}$ | 45.81 | 75.40 | 88.03 | $56.82^{CDE}$ | $79.50^{A}$ |
| **Vit. E 20 mg/Kg diet + Vit. C 400 mg /Kg diet** | 6.50 | $0.290^{c}$ | 61.81 | 29.79 | $8.40^{b}$ | 45.09 | 74.86 | 87.06 | $53.96^{E}$ | $66.52^{B}$ |
| **±SEM** | 0.34 | 0.01 | 0.97 | 0.76 | 0.45 | 0.81 | 1.01 | 2.42 | 1.32 | 3.26 |

**[1] Shell surface area [2] shell weight per unit surface area [3]Pooled SEM**

**a,….c, and A,… E, values in the same column within the same item followed by different superscripts are significantly different (at P ≤0.05 for a to c ; P ≤0.01 for A to E).**

Moreover, **Puthpongsiriporn *et al.* (2001)** found that egg mass of White Leghorn hens was greater with supplementation of 65 IU of Vit. E /kg. Also, egg yolk was significantly increased when hens were fed 45 and 65 IU/kg compared with the control or Vit. E level (25 IU/kg). Haugh units were higher for hens fed 65 IU of Vit. E /kg compared to 25 and 45 IU/kg. Some reports indicated improvements in the egg production and egg shell quality by Vit. C **(Bell and Marion, 1990; Balnave and Muheereza, 1997 and Al-Shoquiry, 1999).** As well as by adding Vit. E **(Bollengier *et al*., 1999; Puthpongsiriporn 1998; Kirunda *et al*., 2001 and Sahin *et al*., 2002).** Vit. E serves as a physiological antioxidant through inactivation free radicals, improves egg production, feed intake, egg yolk and albumen solids **(Kirunda *et al*., 2001),** and improves egg quality **(Puthpongsiriporn, 1998).**

These results confirmed those of **El-Mallah *et al.* (2011)** who reported that demonstrated that shape index and yolk color which significantly ($P<0.05$) decreased and shell thickness which significantly ($P<0.05$) improved compared to the control. Also, **El-Sheikh and Salama (2010)** reported that Vit E improved shell thickness and haugh unit score as compared to the control but, did not affect significantly shell weight% and albumen weight% as compared to control, Similar results were reported by **Lmann *et al*. (2001), Kirunda *et al.* (2001) and Abdel-Galil and Abdel-Samad (2004)**. In this connection, the achieved improvement in shell-thickness could be due to enhancement of calcium bioavailability by the action of supplemental Vit. E. These facts confirmed the results of increased serum-ca concentration that has been established in the present study **(Abdel-Fattah and Abdel-Azeem, 2007).** Moreover, Vit. E addition was stated to influence the oestradiol dependant mechanisms by exerting a direct effect on oestradiol or indirect effect through maintaining more normal function of cellular processes regulating oestradiol and restoration of estrogen secretion **(Bollengier *et al*., 1998).**

**Fertility and hatchability%:** Fertility, hatchability embryonic mortality at 7 or 18 days and abnormal chicks% as affected by feeding different levels of Vit. E and C to El-Salam laying hens are presented in Table 4.

**Table 4: Effects of supplementing laying hens diets with vitamin E, C and their mixtures on fertility, hatchability, embryonic mortality and abnormal chicks% of El-Salam laying hens.**

| Items | Fertility % | Hatchability % | Embryonic mortality % | | | Abnormal chicks% |
|---|---|---|---|---|---|---|
| | | | at 7 days | at 18 days | Total | |
| **Type of addition** | | | | | | |
| **Control** | 83.98$^{b}$ | 82.59 | 0.694 | 0.694 | 1.389 | 0.000 |
| **Vitamin (Vit.) E** | 94.40$^{a}$ | 91.17 | 0.385 | 2.410 | 2.795 | 1.282 |
| **Vitamin C** | 90.22$^{ab}$ | 88.66 | 1.449 | 0.725 | 2.174 | 0.000 |
| **Mixed (Vit. E &Vit. C)** | 93.83$^{a}$ | 91.27 | 1.649 | 1.506 | 2.793 | 0.669 |
| **±SEM[1]** | 2.21 | 2.31 | 0.71 | 0.73 | 0.94 | 0.49 |
| **Treatments** | | | | | | |
| **Control** | 83.98$^{D}$ | 82.59 | 0.694 | 0.694 | 1.39 | 0.000 |
| **Vit. E 10 mg/Kg diet** | 91.67$^{ABCD}$ | 89.33 | 0.806 | 0.645 | 1.45 | 0.000 |
| **Vit. E 20 mg/Kg diet** | 96.81$^{AB}$ | 92.79 | 0.000 | 4.020 | 4.02 | 2.451 |
| **Vit. C 200 mg/Kg diet** | 86.52$^{CD}$ | 85.25 | 1.905 | 0.476 | 2.38 | 0.000 |
| **Vit. C 400 mg/Kg diet** | 93.92$^{ABC}$ | 91.96 | 0.980 | 0.980 | 1.96 | 0.000 |
| **Vit. E 10 mg/Kg diet + Vit. C 200 mg/Kg diet** | 88.93$^{BCD}$ | 86.82 | 0.571 | 2.381 | 2.95 | 1.667 |
| **Vit. E 10 mg/Kg diet + Vit. C 400 mg/Kg diet** | 93.00$^{ABCD}$ | 92.43 | 1.429 | 0.571 | 0.57 | 0.000 |
| **Vit. E 20 mg/Kg diet + Vit. C 200 mg/Kg diet** | 93.62$^{ABC}$ | 89.78 | 2.313 | 1.524 | 3.84 | 0.952 |
| **Vit. E 20 mg/Kg diet + Vit. C 400 mg /Kg diet** | 100.00$^{A}$ | 96.09 | 2.344 | 1.563 | 3.91 | 0.000 |
| **±SEM** | 3.01 | 3.15 | 1.01 | 1.03 | 1.32 | 0.68 |

**[1]Pooled SEM**

**a,….b, and A,… D, values in the same column within the same item followed by different superscripts are significantly different (at P ≤0.05 for a to b ; P ≤0.01 for A to D).**

Type of addition effect significantly influenced (P≤0.05) fertility%, it is clear that laying hens fed diet containing Vit. E supplementation had higher fertility, while, hens fed control diet had lower fertility%. Insignificant (P≥0.05) effects were observed in hatchability, embryonic mortality at 7 or 18 days and abnormal chicks% during the experimental period (Table 4).

Results presented in Table (4) indicated no significant differences in hatchability embryonic mortality at 7 or 18 d and abnormal chicks% among all dietary treatments including the control group. Dietary treatments effect was significant (P≥0.05) only for fertility%, hens fed diet containing 20 mg Vit. E and 400 mg/kg diet Vit. C had higher fertility% compared with those fed control diet, while, those fed control diet had lower fertility%. Numerically, there was insignificant increase (P≥0.05) in hatchability percentages in all groups fed Vit. E and C supplementation compared with the control group.

Similar results were observed by **Arscott and Parker (1967)** who found that fertility was rapidly restored when Vit. E supplementation was begun at 28 weeks. Comparable results were observed in hens **(Machlin *et al.*, 1962)** because fertility and hatchability were all drastically restored to normal levels by addition of Vit. E to the diet. Also, some studies have been shown that Vit. E tends to maintain or increase hatchability in heat stressed laying hens **(Tengerdy and Nockels, 1973).**

**Economical efficiency(EEf):** Table 5 show the economical efficiency (EEf) and the relative economical efficiency (relative EEf) values. El-Salam laying hens fed diet containing 20 mg Vit. E and 200 mg/kg diet Vit. C gave the best economical and relative efficiency values being 1.423 and 120.49%, respectively followed by hens fed diet containing 20 mg Vit. E and 400 mg/kg diet Vit. C being 1.384 and 117.22%, respectively, all of which are superior compared to the control diet without supplementation, hens fed control diet had the worst corresponding values, being 1.181 and 100%, respectively. The relative efficiency varied between 0.0 to +20.49% which is of minor importance relative to the other factors of production.

**Table 5: Effects of supplementing laying hens diets with vitamin E, C and their mixtures on economical efficiency.**

| Items | | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Price/ k feed (L.E.)** | **a** | 2.600 | 2.602 | 2.604 | 2.602 | 2.604 | 2.604 | 2.608 | 2.604 | 2.608 |
| **Total feed intake (kg)** | **b** | 79.564 | 77.920 | 77.149 | 76.786 | 77.006 | 77.545 | 75.718 | 76.333 | 76.297 |
| **Total feed cost (L.E.)** | **a x b = c** | 206.866 | 202.748 | 200.897 | 199.798 | 200.525 | 201.927 | 197.471 | 198.772 | 198.982 |
| **Total egg mass (Kg)** | **d** | 22.7653 | 22.3679 | 22.9774 | 23.1876 | 23.9571 | 22.3999 | 22.8202 | 24.3017 | 23.9393 |
| **Price/Kg eggs (L.E.)** | **e** | 19.819 | 19.819 | 19.819 | 19.819 | 19.819 | 19.819 | 19.819 | 19.819 | 19.819 |
| **Total price of eggs (L.E.)** | **d x e = f** | 451.185 | 443.31 | 455.389 | 459.555 | 474.81 | 443.94 | 452.27 | 481.64 | 474.45 |
| **Net revenue (L.E.)** | **f – c = g** | 244.319 | 240.561 | 254.493 | 259.757 | 274.281 | 242.017 | 254.802 | 282.863 | 275.471 |
| **Economical efficiency (E.Ef.)** | **g / c = h** | 1.181 | 1.187 | 1.267 | 1.300 | 1.368 | 1.199 | 1.290 | 1.423 | 1.384 |
| **Relative E.Ef.** | **r** | 100.00 | 100.46 | 107.26 | 110.08 | 115.81 | 101.48 | 109.25 | 120.49 | 117.22 |

**T1**: Control, **T2**: Vit. E 10 mg/Kg diet, **T3**: Vit. E 20 mg/Kg diet, **T4**: Vit. C 200 mg/Kg diet, **T5**: Vit. C 400 mg/Kg diet, **T6**: Vit. E 10 mg/Kg diet + Vit. C 200 mg/Kg diet, **T7**: Vit. E 10 mg/Kg diet + Vit. C 400 mg/Kg diet, **T8**: Vit. E 20 mg/Kg diet + Vit. C 200 mg/Kg diet and **T9**: Vit. E 20 mg/Kg diet + Vit. C 400 mg /Kg diet.

**a**…… (based on average price of diets during the experimental time)**.**
**e**……..…….....(according to the local market price at the experimental time**).**
**g /c** ……..……...(net revenue per unit feed cost).
**r**…….……(assuming that economical efficiency of the control groups equals 100).

**In conclusion**, the results of this study indicated that feeding El-Salam laying hens on diets containing 20 mg Vit. E and 200 mg/kg diet Vit. C improved the productive, reproductive performance and relative economic efficiency values of laying hen.

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## تأثير إضافة مستويات مختلفة من فيتامين ج ،هـ لعلائق الدجاج البياض على 1- تحسين بعض الصفات الإنتاجية و التناسلية

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اجريت هذه الدراسة بمحطة بحوث الدواجن بالعزب-الفيوم- مصر لدراسة تأثير استخدام مستويين من فيتامين هـ (١٠ او ٢٠ ملليجرام/كجم عليقة) و فيتامين ج (٢٠٠ او ٤٠٠ ملليجرام/كجم عليقة) وخليطهما علي كفاءة البيض، جودة البيض، الخصب، الفقس، والكفاءة الاقتصادية لدجاج السلام البياض. استخدم عدد ٢٤٣ (٢١٦ أنثي و٢٧ ديك) طائر عمر 25 أسبوع قسمت عشوائياً إلي 9 معاملات متساوية ٢٧ طائر /كل معاملة (٢٤ أنثي و٣ ذكر) ثم قسمت كل معاملة إلي ٣ مكررات 11 طائر/مكرر(٨ إناث و 1 ذكور).

وكانت المعاملات التجريبية كما يلي :

١- تغذية الطيور علي عليقة الكنترول (م١).
٢- م١ مضاف إليها ١٠ ملجم/كجم عليقة فيتامين هـ.
٣- م١ مضاف إليها ٢٠ ملجم/كجم عليقة فيتامين هـ.
٤- م١ مضاف إليها ٢٠٠ ملجم/كجم عليقة فيتامين ج.
٥- م١ مضاف إليها ٤٠٠ ملجم/كجم عليقة فيتامين ج.
٦- م١ مضاف إليها ١٠ ملجم/كجم عليقة فيتامين هـ+٢٠٠ ملجم/كجم عليقة فيتامين ج.
٧- م١ مضاف إليها ١٠ ملجم/كجم عليقة فيتامين هـ+٤٠٠ ملجم/كجم عليقة فيتامين ج.
٨- م١ مضاف إليها ٢٠ ملجم/كجم عليقة فيتامين هـ+٢٠٠ ملجم/كجم عليقة فيتامين ج.
٩- م١ مضاف إليها ١٠ ملجم/كجم عليقة فيتامين هـ+٤٠٠ ملجم/كجم عليقة فيتامين ج.

**وتتلخص أهم النتائج المتحصل عليها فيما يلي:-**

١- كان للدجاج المغذي علي عليقة مضاف إليها خليط من كل من فيتامين هـ ، ج أقل استهلاك للعليقة، بينما كان للدجاج المغذي علي عليقة المقارنة أعلي استهلاك للعليقة، لم يكن هناك أي تأثير معنوي علي كل من متوسط وزن البيض، كتلة البيض، إنتاج البيض، كفاءة تحويل الغذاء خلال فترة التجربة.

٢- كان للدجاج المغذي علي عليقة تحتوي علي١٠ ملجم/كجم عليقة فيتامين هـ اعلي سمك للقشرة ونسبة القشرة، بينما كان للدجاج المغذي علي عليقة المقارنة أقل سمك للقشرة ونسبة القشرة خلال فترة التجربة.

٣- كان للدجاج المغذي علي عليقة تحتوي علي٢٠ ملجم/كجم عليقة فيتامين هـ و٤٠٠ ملجم/كجم عليقة فيتـامين ج اعلي نسبة الخصب.
٤- أعطي الدجاج المغذي علي عليقة تحتوي علي٢٠ ملجم/كجم عليقة فيتامين هـ و٢٠٠ ملجم/كجم عليقة فيتـامين ج أحسن كفاءة اقتصادية واعلي كفاءة اقتصادية نسبية.

ومن ذلك يمكن استنتاج أن تغذية دجاج السلام علي عليقة تحتوي علـي٢٠ ملجم/كجم عليقـة فيتـامين هـ و٢٠٠ ملجم/كجم عليقـة فيتـامين ج أدي إلـي تحسين الأداء الإنتـاجي والتناسـلي وأعطـي اعلـي كفـاءة اقتصـادية ونسبية.