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EFFECT OF VITAMIN C AND E AS WATER ADDITIVES ON PRODUCTIVE PERFORMANCE AND EGG QUALITY OF HEAT STRESSED LOCAL LAYING HENS IN SIWA OASIS

By

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Abstract: *Seventy five Dokki-4 laying hens 24 weeks of age were used to study the effect of vitamin C and E on productive performance and egg quality of local laying hens reared under Siwa Oasis summer condition. Birds were divided equally into five groups (two levels of vitamin C (400 and 600) mg/L water and two levels of vitamin E (200 and 300) mg/L water), in addition to control group. Birds were fed basal diet containing 2600 Kcal ME/ kg diet and 16.71% CP. Water and feed were provided ad libitum. Feed and water consumption were measured weekly and feed conversion efficiency was calculated. Egg production, egg weight were recorded and egg mass was calculated daily during 24 to 36 weeks of age. Random samples of 5 eggs from each treatment were collected weekly to measure egg quality.*

The obtained results indicated that both levels of vitamin E improved ($P \leq 0.05$) egg number value, egg mass, shell weight and yolk weight as compared to the control, while both levels of vitamin E decreased ($P \leq 0.01$) albumin wt. % as compared to the control.

Both levels of vitamin E and 600 mg vitamin C / L water improved ($P \leq 0.05$) egg weight as compared to the control.

All water additives improved ($P \leq 0.05$) shell thickness and haugh unit score as compared to the control. Both levels of vitamin C did not affect significantly shell wt. % and albumin wt. % as compared to the control.

Feed consumption values were increased by vitamin E supplementation. The best values for feed conversion were for vitamin E (2.12 and 2.48 vs. 2.76 for the control).

Digestion coefficient of DM, OM, CP, CF, EE and NFE were not significantly affected by both levels of vitamins C and E supplementation in drinking water as compared to the control.

The best value for (E.E) and (R.E.E) had been recorded by hens with 400 mg vitamin C or 200 mg vitamin E / liter of drinking water as compared to the control.

In conclusion supplementation both vitamins C by level 400 mg / liter water and E by levels 200 and 300 mg/ liter water could be beneficial for local laying hens under hot summer condition of Egypt to get the best laying performance and egg quality.

INTRODUCTION

Heat stress is well known to reduce the reproductive performance of laying hens by interrupting egg production, not only by a reduction in feed intake, but also by a disruption of hormones responsible for ovulation and a decrease in responsiveness of granulose cells to luteinizing hormone **(Novero *et al.*, 1991 and Franco-Jimenez *et al.*, 2007)**. In addition, heat stress negatively affects the strength, weight, thickness, and ash content of the eggshell **(Miller and Sunde, 1975)**. Environmental stress causes increased free radical production and lowers the concentrations of antioxidants such as vitamins E, C and A and minerals such as Zn and Cr in serum **(Halliwell and Gutteridge, 1989 and Sahin *et al.*, 2002)**. Also, the digestibility of amino acids was decreased by high environmental temperature in broilers **(Wallis and Balnave, 1984)**.

In order to overcome the adverse effect of heat stress, a considerable amount of researches has bean conducted depending upon nutritional conditions, such as feeding timing **(Teeter *et al.*, 1987)**, quantity and quality of feed, and fat supplementation **(Hussein, 1996)**, supplementing critical essential amino acids **(Yanming and Baker, 1993)**, minerals and vitamins **(Moreng, 1980)**.

Vitamin C and vitamin E are used in the poultry diet because of their anti-stress effects and also because their synthesis are reduced during heat stress **(Bollengier-Lee *et al.*, 1998; Gonzalez et *al.*, 1995)**. Vitamin C is a water-soluble vitamin required by the body to maintain normal metabolic activities, and is synthesized in the body to meet physiological requirements in poultry **(Leeson, 2001)**. **Cheng *et al.* (1990)** concluded that vitamin C supplementation had a positive effect on the livability and performance of poultry. Several studies indicated that dietary vitamin C supplementation has a positive effect on different poultry production traits **(Sahin and Kücük, 2001 and Sahin et *al*., 2003 and 2004).**

Vitamin E serves as a physiological anti-oxidant through inactivation of free radicals. **(Bollengier-Lee *et al.*, 1998)** reported that heat stress impairs the synthesis and release of vitellogenine and that dietary supplementation with Vit-E facilitates release of vitellogenine necessary for yolk formation and can alleviate the detrimental effects of high temperature. Supplementation with high levels of vitamin E in poultry diets, may protect cells from damage of lipid peroxidation stimulated by heat stress, allowing regular yolk precursor formation and ovulation **(Çiftçi *et al*., 2005).** Vitamin E can reduce the negative effects of corticosterone **(Tengerdy, 1989),** improve egg production, feed intake and yolk and albumen solids **(Kirunda *et al.*, 2001)**. and improve egg quality **(Puthpongsiriporn, 1998).** Also, **Puthpongsiriporn *et al.*, (2001)** reported that vitamin E supplementation at 65 IU/Kg diet may enhance production, and antioxidant properties of egg yolk and plasma of White Leghorn hens during heat stress. **Çiftçi *et al.*, (2005)** found that dietary supplementation of laying hens with anti-oxidant vitamins (vitamin E or vitamin C or a combination of the both compounds) can attenuate heat stress induced oxidative damage. **Mohiti *et al.*,(2007)** found that dietary supplementation of laying hens with antioxidant vitamins (vitamin E or vitamin C), probiotics or yeast during heat stress conditions can improve the immune response of birds and can leads to improve performance and egg quality.

This research work was carried out to determine the effects of different levels of vitamin C and E on laying performance and egg shell quality under heat stress conditions of Siwa Oasis.

MATERIALS AND METHODS

The present study was carried out at Siwa Oasis Research Station belonging to Desert Research Center (DRC), Egypt during the period from April-September 2009.

Birds and management:

A total of 75 *Doki*-4 laying hens, 24 weeks of age were divided equally into five treatment groups (two levels of vitamin C (400 and 600) mg/L water and two levels of vitamin E (200 and 300) mg/L water), in addition to control group, each group contains five replicates with 3 birds per replicate. The basal diet was formulated using linear programming, to contain (~2600 Kcal ME /Kg diet) and (~16.71% CP) to meet, at least the nutrient requirements according to **NRC (1994)** as shown in **Table (1). The** birds in each cage were weighed at the beginning and at the end of the trial. The birds were housed in wire cages of triple deck batteries. The hens were exposed to 15 h light /day during the experiment. Feed and water were provided *ad libitum*. The room temperature and humidity were recorded daily and the average was calculated every (28 days) where the average room temperature ranged between 25-38 °C and humidity 40-79%. (Table 2).

Productive performance:

Body weights were recorded at the beginning of the experiment (24 week of age) and monthly till the end of the experiment (36 week of age). Body weight changes were calculated as the difference between the initial and final body weights. Egg weight and egg number were recorded daily to calculate the egg mass (g/hen/day). Feed consumption was recorded biweekly, while feed conversion values (g feed /g eggs) were calculated as the amount of feed consumed divided by egg mass.

Egg quality measurements:

Egg quality parameters were measured using 25 eggs (5 eggs / each treatment group). These involved yolk, albumen and shell weight percentage. Egg shell thickness was measured in mm using a micrometer. Egg shape index was calculated according to **Romanoff and Romanoff (1949)** as an egg diameter divided by an egg length. Yolk index was calculated according to **Funk *et al.*, (1958),** as yolk height divided by yolk diameter. Haugh unit was calculated according to **Eisen *et al.*, (1962)** using the calculation chart for rapid conversion of egg weight and albumen height.

Chemical analysis:

Chemical analysis was conducted at the laboratories of the Animal and Poultry Nutrition Department, Desert Research Center, Cairo, Egypt.

At the end of the experiment, digestibility trials were carried out to calculate the digestibility coefficients of dietary nutrients. In this respect three hens from each treatment groups were used and housed individually in metabolic cages. Feed consumption and excreta output were recorded quantitatively daily. Samples of the experimental diets and dried excreta were analyzed (dry matter, crude protein, crude fiber, ether extract and ash) according to **AOAC (1990)**. Faecal nitrogen was determined following the procedure outlined by **Jakobsen *et al.* (1960)**. Urinary organic matter was calculated according to **Abou-Raya and Galal (1971)**.

Economical efficiency:

Economical efficiency of egg production was calculated from the input-output analysis which was calculated according to the price of the experimental diets and egg production during the year of 2009.The values of economical efficiency were calculated as the net revenue per unit of total cost.

Statistical analysis:

Data were analyzed by the Computer Program, **SAS (1999)**, using the General Linear Model (GLM) procedure. All the characteristics were performed in conformity by one way analysis model. The significant differences among treatments means were separated by Duncan's Multiple Range-Test **(Duncan, 1955).**

RESULTS AND DISCUSSION

Results in Table (3) showed that the best ($P \leq 0.05$) egg number value was for 200 mg vitamin E followed by 300 mg vitamin E as compared to the control (23.00 and 19.27 vs. 15.68, respectively). Both levels of vitamin E and 600 mg vitamin C / L water improved ($P \leq 0.05$) egg weight as compared to the control during the total period (43.18, 42.52 and 42.37 vs. 36.6 g, respectively). Both levels of vitamin E resulted also in the best values of egg mass as compared with the control (35.60 and 29.27 vs. 21.63 g, respectively). Feed consumption values were increased by vitamin E supplementation. The best values for feed conversion were for vitamin E (2.12 and 2.48 vs. 2.76 for the control). These results were supported by **Sahota and Gillani (1995), Zapata and Gerant (1995) and Attia *et al.*, (1997)** who reported that dietary supplementation with ascorbic acid improved the productive performance. Also, **Lin Ping Hung *et al.*, (1998)** observed that ascorbic acid supplementation at (0, 250, 500, 1000 and 2000 mg/kg) in Leghorn hens diet increased significantly egg production and 1000 mg /kg provided the highest egg weight ($P \leq 0.05$). They found that feed consumption and feed conversion were not significantly different. **El-Gendi *et al.*, (1999)** reported that pullets fed vitamin C had the highest feed consumption, egg mass and egg weight when compared with control. The benefit effect of vitamin C supplementation may be attributed to vitamin C in activating thyroid gland which influenced the feed intake **(El-Fiky, 1998).** Also, vitamin C scavenges free oxygen radicals which are important, however, to prevent stress caused by oxidation of cell membrane in the digestive system and restore efficient feed utilization **(Jaffy, 1984).** As well as effects of vitamin C on feed conversion may be due to that vitamin C helps to control the increase in body temperature and plasma corticosterone concentration. It also, protects immune system (**Roma *et al.*, 2002).**

On the other hand **Bollengier–Lee *et al.*, (1999)** reported that vitamin E supplementation from 250-500 mg/kg in Japanese quail diet reared under heat stress (34°C), resulted in significantly increase in egg production (%) and egg weight. The same results were obtained by **Sahin, *et al.*, (2002) and Addel Galil and Abdel Samad, (2004).**

Ciftci, *et al.*, (2005) reported that dietary supplementation with 125 mg vitamin E plus 200 mg vitamin C/kg in laying hens diet exposed to chronic stress (35°C) increased significantly egg production and improved feed intake and feed efficiency. **Abd El-Maksoud (2006)** reported that vitamin E supplementation increased egg production (%) by alleviating the adverse effects of high ambient temperature on laying hens during summer months. **Hassan *et al.*, (2009)** reported that vitamin E supplementation from 125-250 mg/kg in *Matrouh* laying hens diets improved ($P<0.05$) body weight, feed intake and egg weight.

Table (4) revealed that both levels of vitamin C did not affect significantly shell wt. % as compared to the control, while both levels of vitamin E improved ($P\leq0.05$) shell wt. as compared to the control. Shape index values were not significantly affected by the treatments. All water additives improved ($P\leq0.05$) shell thickness as compared to the control. The values ranged between 0.489 – 0.525 vs. 0.411 mm, respectively.

These findings agreed with those reported by **Chen and Noclels (1973) and Asker (1977)** who found that shell thickness was significantly improved by vitamin C supplementation in laying hen diet. **Orban *et al.*, (1993)** reported that dietary supplementation with ascorbic acid significantly increased plasma ionic calcium. **Cheng *et al.*, (1990)** observed that shell weight per unit surface area was increased, under a heat stress of 31.1C, due to ascorbic acid supplementation at 100 or 200 mg/kg diet. **Zapata and Gerant (1995)** reported an improvement in shell quality due to supplementation of diet with vitamin C. Also, **Lin Ping Hung *et al.*, (1998)** found that dietary supplementation with ascorbic acid at 500 mg/kg gave the best egg shell thickness, while 1000 mg/kg gave highest egg shell weight. **Metwally (2005)** found that vitamin C improved shell thickness and egg yolk when compared to the control. **Sahin, *et al.*, (2002)** found a significant ($P<0.05$) improvement in shell thickness in Japanese quails when the diet contained vitamin E (250 to 500 mg/kg diet) under heat stress. **Engelmann *et al.*, (2001)** showed that, eggshell and shell thickness were significantly influenced by vitamin E of 1000 mg /kg in laying diet under heat stress.

Abdel Galil and Abdel Samad (2004) found that shell quality was improved by vitamin E, Se and Zn supplementation in diets. Vitamin E supplementation was stated to influence the oestradiol dependent mechanisms by exerting a direct effect on oestradiol or an indirect effect through maintaining more normal function of cellular processes regulating oestradiol and restoration of estrogen secretion **(Bolleengier- Lee *et al.*, 1998)**. Oestradiol has an effect on circulating calcium through its control synthesis of 1, 25 dihydroxy cholecalciferol **and** the active cholecalciferol metabolite that regulates calcium absorption **(Taylor and Drake, 1984)**. Circulating calcium and estrogen concentration are highly correlated in laying hens **(Tojo and Huston, 1980)**. The improvements of external egg quality (shell weight, shell weight % and shell thickness) may be attributed to vitamin C or E important role through enhancement of Ca and P absorption and metabolism.

Result in Table (5) showed that both levels of vitamin C did not affect significantly albumin wt. % as compared to the control, while both levels of vitamin E decreased ($P \leq 0.01$) albumin wt. % as compared to the control. Both levels of vitamin E improved ($P \leq 0.01$) yolk wt. % as compared to the control (37.94 and 35.48 vs. 33.89, respectively). The best ($P \leq 0.05$) yolk index values were for 300 mg/ L water vitamin E % as compared to the control (41.52 vs. 36.94, respectively). All water additives improved ($P \leq 0.05$) haugh unit score as compared to the control. The values ranged between 85.94 – 88.87 vs. 82.32, respectively. The present results confirmed those of **Essa (2009), Essa and Madian (2009) and El-Gendi *et al.*, (1999)** who found that eggs were characterized significantly higher (P 0.≤05) absolute and relative weights of albumen, shell and yolk by vitamin C supplementation. Also, **Metwaly (2005)** found that hens fed diet with vitamin C had a good quality of yolk and shell weight when compared to the control. **Ciftci, *et al.* (2005)** found that a combination of 125 mg vitamin E and 200 mg vitamin C /kg diet under heat stress increased yolk weight % significantly. Similar results were found by **Puthpongsiriporn, *et al.*, (2001). Abdel Galil and Abdel Samad, (2004),** reported that vitamin E and C supplementation improved yolk index in diet of local breeds during summer season. **Engelmann, *et al.*, (2001) and Kirunda, *et al.*, (2001)** reported that egg quality as albumen index, yolk index were not influenced by vitamin E supplementation in laying diets under heat stress.

Data presented in Table (6) indicated that digestion coefficient of DM, OM, CP, CF, EE and NFE were not significantly affected by both levels of vitamins C and E supplementation in drinking water as compared to the control. All levels of vitamins C and E numerically improved the digestion coefficient of nutrients compared to the control.

Results of economical efficiency (E.E) and relative economical efficiency (R.E.E) estimated for the different treatments during experiment are shown in Table (7). According to the input-output, economical efficiency and relative economical efficiency were ranged between 2.08 – 2.73 and 94 -123 % for the control and the experimental treatments. The best value for (E.E) and (R.E.E) had been recorded by hens with 400 mg vitamin C or 200 mg vitamin E / liter of drinking water as compared to the control.

It could be concluded that supplementation both vitamins C by level 400 mg / liter water and E by levels 200 and 300 mg/ liter water could be beneficial for local laying hens under hot summer condition of Egypt to get the best laying performance and egg quality.

Further studies on the effects of such supplementation on physiological reaction of hens under Siwa Oasis are still required.

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

Ingredient	%
Yellow corn	53.4
Soybean meal (44) %	13.0
Corn gluten meal (60) %	6.0
Wheat bran	16.0
vegetable oil	1.0
Dicalcium phosphate	1.5
Limestone	8.4
Premix*	0.35
NaCl	0.35
Total	100
Determined analyses %	
Crude protein%	16.71
Crude fiber%	4.97
Ether extract%	2.39
Ash%	13.42
Calculated analyses %	
Metabolizable energy (kcal/kg diet)	2600
Calcium%	3.59
Available P.%	0.44
Lysine%	0.68
Methionine%	0.30

* Vit. and Min. Premix per Kg of diet: 12000 IU. Vit. A. 2000 IU. Vit. D3. 10 mg Vit. E. 4 mg Niboflavin. 10mg Pantothenic acid. 0.01 mg Vit. B12. 500 mg Choline chloride. 2 mg Vit. K. 1 mg. Vit. B1. 1.5 mg Vit. B6 1 mg Folic acid. 20 mg Niacin. 0.05 mg Biotin. 10 mg Cu. 1 mg I. 30 mg Fe. 55 mg Mn. 55 mg Zn and 0.1 mg Se.

Table (2): Ambient temperature and relative humidity during experimental period

Month	Ambient temperature			Relative humidity		
	Maximum	Minimum	Average	Maximum	Minimum	Average
June	32.89±0.69	25.86±0.69	29.38±0.6	72.00±1.82	40.34±1.59	56.17±1.32
July	36.12±0.52	27.79±0.52	31.96±0.5	70.50±1.21	45.35±1.48	57.93±1.52
August	38.32±0.69	26.20±0.52	32.26±0.6	78.85±1.02	52.48±1.47	65.67±1.27

Table (3): Effect of vitamin C and E supplementation on egg production parameters (M± SE) during summer months of Siwa Oasis.

Parameter	Control	Vit.C		Vit. E		Sig.
		400 mg/L. wate	600 mg/ L. water	200 mg/ L. water	300 mg/ L. water	
Initial body wt.	1363 ± 32.90	1367 ± 20.01	1354 ± 16.05	1362 ± 15.67	1363 ± 16.67	NS
Final body wt.	1490 ± 57.69	1486 ± 42.29	1466 ± 77.65	1503 ± 100.82	1492 ± 63.11	NS
B.W. Changes	138 ± 46.82	97 ± 44.33	116 ± .81.63	141 ± 97.97	121 ± 68.14	NS
Egg number June	17.40^{b}± 1.28	17.20^{b} ±0.73	17.40^{b} ±1.28	24.60^{a} ±2.64	18.80^{b} ± 1.39	*
July	15.00^{c} ± 0.95	17.40^{b} ±0.51	18.40^{b} ±0.68	21.60^{a} ±0.67	19.20^{b} ±0.73	**
August	14.60^{c} ± 0.81	19.00^{ab} ±2.61	17.00^{bc} ±0.71	22.80^{a} ±0.37	19.80^{ab} ±0.80	**
Overall mean	15.68^{c} ± 0.49	17.86^{b} ±0.75	17.62^{bc} ±0.50	23.00^{a} ±1.05	19.28^{b} ±0.45	**
Egg wt. (g) June	38.66± 1.85	36.42 ±1.71	41.50 ±1.00	39.10 ±1.60	40.16 ±1.71	NS
July	36.88 ±1.84	39.50 ±1.53	41.00 ±1.71	39.80 ±1.77	41.00 ±1.87	NS
August	40.30^{c} ±1.89	46.18^{ab} ±0.89	44.62^{bc} ±0.90	50.66^{a} ±2.67	46.40^{ab} ±0.62	*
Overall mean	38.61^{b} ±1.06	40.69^{ab} ±0.84	42.37^{a} ±0.89	43.18^{a} ±0.99	42.52^{a} ±1.05	*
Egg mass (g/hen/ day) June	23.90^{b}±1.64	20.51^{b}±1.99	22.14^{b}±3.08	34.74^{a}±4.69	27.11^{ab}±2.62	*
July	19.61^{c}±1.15	23.36^{bc}±1.20	26.94^{ab}±1.55	30.86^{a}±2.29	28.18^{ab}±1.84	**
August	20.88^{c}±1.01	25.98^{bc}±5.77	24.50^{bc}±0.68	41.28^{a}±2.46	32.76^{ab}±1.08	**
Overall mean	21.63^{c}±1.04	22.84^{c}±2.65	24.59^{bc}±1.61	35.60^{a}±2.35	29.27^{b}±1.05	**
Feed consumption (g/day) June	58.11±3.76	65.22±3.19	66.72±2.83	74.08±6.68	70.60±3.44	NS
July	57.22±4.77	59.87±6.15	63.88±5.39	68.06±3.30	74.56±1.52	NS
August	60.44±6.75	71.24±2.16	74.68±2.41	79.32±6.91	71.34±7.58	NS
Overall mean	58.60^{b}±4.65	65.40^{ab}±2.85	68.50^{ab}±3.12	73.84^{a}±4.06	72.16^{a}±3.01	*
Feed conversion(g feed/g egg) June	2.43±0.30	3.36±0.49	3.28±0.45	2.38±0.52	2.74±0.32	NS
July	2.96±0.34	2.68±0.38	2.42±0.29	2.26±0.26	2.68±0.16	NS
August	2.92±0.34	3.28±1.54	3.16±0.17	1.98±0.24	2.18±0.24	NS
Overall mean	2.71±0.29	3.24±0.52	2.92±0.25	2.12±0.24	2.48±0.14	NS

a, b ....= Means in the same row in each classification bearing different letters differ significantly ($P \leq 0.05$)

NS = not significant *= ($P \leq 0.05$) **=$P \leq 0.01$)

Table (4): Effect of vitamins C and E supplementation on external egg quality (M± SE) during summer months of Siwa Oasis.

Parameter	Control	Vitamin C 400 mg/L. water	Vitamin C 600 mg/ L. water	Vitamin E 200 mg/ L. water	Vitamin E 300 mg/ L. water	Sig.
Egg wt. (g) June	39.20^{c} ± 1.77	38.40^{c} ±1.20	45.00^{b}± 1.38	50.70^{a}± 2.16	48.04^{ab} ±2.18	**
July	42.36 ± 2.69	41.84± 2.08	45.14± 1.09	48.30 ± 2.84	50.30 ±2.94	NS
August	44.10^{a} ± 0.85	46.17^{a} ±0.90	43.43^{a} ± 0.75	38.58^{b} ± 0.96	39.94^{b} ± 1.25	**
Overall mean	41.89^{c} ± 1.12	42.14^{bc}± 0.91	44.52^{abc}± 0.71	45.86^{ab}± 1.79	46.10^{a} ± 1.25	*
Shell wt.% June	10.77± 0.67	11.44 ±0.67	9.86± 0.10	9.86 ± 0.25	9.48± 0.74	NS
July	9.71^{b} ± 0.67	9.74^{b} ±0.55	8.84^{b} ± 0.75	14.48^{a} ±0.93	15.17^{a} ±0.98	**
August	9.51^{b} ± 0.52	10.94^{b} ±0.55	11.09^{b} ± 0.54	13.28^{a} ± 0.44	13.47^{a} ± 0.53	**
Overall mean	10.00^{b} ± 0.34	10.71^{b} ± 0.40	9.93^{b} ±0.40	12.54^{a} ±0.43	12.71^{a} ± 0.25	**
Shape index June	82.70 ±2.99	78.09± 0.79	78.14± 0.50	77.51± 1.41	77.42± 1.69	NS
July	73.68± 2.70	78.50± 1.27	75.49± 10.24	75.61 ±1.55	77.73 ±2.22	NS
August	80.81^{a}± 1.47	79.28^{a} ± 1.26	75.82^{b} ± 0.41	78.56^{ab}± 1.19	75.57^{b} ±0.81	*
Overall mean	79.06 ±1.09	78.62 ±0.68	76.49± 0.38	77.23± 1.13	76.91±1.84	NS
Shell thickness (mm) June	0.411^{b} ± 0.02	0.525^{a} ± 0.01	0.489^{a} ± 0.01	0.523^{a} ± 0.02	0.508^{a} ± 0.2	*
July	0.419^{b} ± 0.03	0.499^{ab}± 0.02	0.442^{b} ± 0.01	0.546^{a} ± 0.04	0.498^{ab} ± 0.2	*
August	0.403^{b} ± 0.02	0.550^{a} ± 0.01	0.535^{a} ± 0.02	0.499^{a} ± 0.02	0.516^{a} ±0.02	**
Overall mean	0.411 ± 0.02	0.525^{a} ± 0.01	0.489^{a} ± 0.01	0.523^{a} ± 0.02	0.508^{a} ± 0.02	*

a, b ....= Means in the same row in each classification bearing different letters differ significantly ($P \leq 0.05$)

NS = not significant *= ($P \leq 0.05$) **=$P \leq 0.01$)

Table (5): Effect of vitamins C and E supplementation on internal egg quality (M± SE) during summer months of Siwa Oasis

Parameter	Control	Vitamin C		Vitamin E		Sig.
		400 mg/L. water	600 mg/ L. water	200 mg/ L. water	300 mg/ L. water	
Albumen wt.% June	52.55^{b}±1.30	52.72^{b} ± 1.42	56.90^{a} ±0.54	57.09^{a} ±0.87	57.88^{a} ±1.11	*
July	62.73^{a}± 2.26	61.05^{a} ±1.69	58.33^{a} ±0.59	53.15^{b} ±0.90	52.16^{b} ±1.64	**
August	52.12^{a} ± 2.50	56.46^{a} ±0.22	54.78^{a} ±1.09	39.89^{c} ±2.06	46.16^{b} ±1.37	**
Overall mean	55.80^{a} ± 0.97	56.74^{a} ±0.68	56.67^{a} ±0.61	50.04^{b} ±0.40	52.06^{b} ±0.66	**
Yolk wt.% June	36.73^{a}± 1.06	36.46^{a} ±1.51	33.24^{b} ±0.61	33.04^{b} ±0.66	32.64^{b} ±0.86	*
July	27.55± 1.93	29.21 ±1.48	32.82 ±0.42	33.95 ±2.69	33.43 ±1.61	NS
August	37.37^{bc} ± 2.17	32.97^{c} ±0.17	33.65^{c} ±1.26	46.82^{a} ±2.09	40.37^{b} ±0.92	**
Overall mean	33.89^{bc} ± 0.72	32.88^{c} ±0.74	33.24^{bc} ±0.46	37.94^{a} ±1.14	35.48^{b} ±0.85	**
Yolk index June	35.49^{b} ± 1.75	29.26^{c} ±2.93	32.68^{bc} ±2.37	43.10^{a} ±1.26	43.97^{a} ±0.88	**
July	39.71 ± 1.15	44.38 ±2.13	42.09 ±0.44	40.53 ±2.12	42.30 ±0.92	NS
August	36.08^{bc} ± 1.02	40.99^{ab} ±0.58	44.36^{a} ±1.90	32.65^{c} ±2.87	38.29^{bc} ±1.02	*
Overall mean	36.94^{b} ± 0.74	38.21^{b} ±0.76	39.71^{ab} ±0.63	38.77^{b}±1.46	41.52^{a} ±0.41	*
Haugh unit score June	77.88^{b} ±4.13	87.39^{a} ±1.40	86.26^{a} ±0.97	78.43^{b} ±2.42	83.43^{ab} ±1.32	*
July	84.68 ± 2.90	89.99 ±1.18	86.35 ±1.19	86.94 ±1.41	88.79 ±0.90	NS
August	84.40^{b} ± 1.82	82.74^{b} ±1.00	85.21^{b} ±0.41	93.09^{a} ±1.80	94.37^{a} ±1.99	**
Overall mean	82.32^{b} ± 1.87	86.71^{a} ±1.04	85.94^{a} ±0.19	86.15^{a} ±1.39	88.87^{a} ±0.55	*

a, b ....= Means in the same row in each classification bearing different letters differ significantly ($P \leq 0.05$)

NS = not significant   *= ($P \leq 0.05$)   **-($P \leq 0.01$)

Table (6): Digestion coefficients (%) of nutrients as affected by vitamins C and E supplementation (M± SE)

Treatments	Control	Vitamin C		Vitamin E		Sig.
		400 mg/L. water	600 mg/ L. water	200 mg/ L. water	300 mg/ L. water	
DM	45.32	57.72	54.55	50.98	49.55	NS
OM	67.71	74.31	69.68	76.64	72.00	NS
CP	83.54	84.61	83.66	83.37	83.74	NS
CF	32.37	36.15	39.73	43.82	33.11	NS
EE	88.59	90.34	90.68	93.19	85.25	NS
NFE	65.21	77.19	70.67	76.71	70.89	NS

Table (7): input and output analysis and economical efficiency of different treatments during the experimental period

Items	Control	Vitamin C		Vitamin E	
		400 mg/L. water	600 mg/ L. water	200 mg/ L. water	300 mg/ L. water
Price/kg feed (L.E.)	162.57	164.1	164.1	164.1	164.1
Total feed intake / hen (kg)	4.922	5.494	5.754	6.202	6.061
Total feed cost / hen (L.E.)[1]	8.02	9.02	9.44	10.18	9.95
Total number of eggs/hen	47.0	53.58	52.86	69.00	57.84
Total price of eggs/hen (L.E.)[2]	25.85	29.47	29.07	37.95	31.81
Net revenue/hen (L.E.)	17.83	20.44	19.63	27.77	21.86
Economical efficiency (E.E.)[3]	2.22	2.26	2.08	2.73	2.20
Relative EE (%)[4]	100	102	94	123	99

1- Price of vitamin C or E 15 L.E.
2-The price of one egg = 55 P.T.
3-Net revenue per unit of total feed cost.
4-Relative economical efficiency% of the control. assuming that relative EE of the control = 100.

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الملخص العربي

تأثير فيتامينات C و E كإضافات مائية على الأداء الإنتاجي وجودة البيضة فى الدجاج المحلى المجهد حراريا بواحة سيوة

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أجريت هذه الدراسة بمحطة بحوث سيوة لدراسة تأثير فيتامينات C وE كإضافات مائية على الاداء الإنتاجى وجودة البيضة فى الدجاج المحلى المعرض للإجهاد الحرارى.

أستخدم فى هذه الدراسة ٧٥ دجاجة بياضة محلى (دقى٤) عمر ٢٤ اسبوع قسمت الى ٥ مجاميع بكل مجموعة ١٥ دجاجة كل منها فى ٥ مكررات بكل مكرر ٣ دجاجات غذيت جميعا على عليقة أساسية تحتوى على ٢٦٠٠ ك كالورى/كجم طاقة ممثلة و ١٦.٧١% بروتين خام. وتم اضافه فيتامين C الى الماء فى المجموعتين الثانية والثالثة بمستويات ٤٠٠ و٦٠٠ملجم/لتر ماء وفى المجموعه الرابعه والخامسة تم اضافة فيتامين E بمستويات ٢٠٠و٣٠٠ ملجم/ لتر ماء. أما المجموعة الأولى فتمثل مجموعة المقارنة بدون أى إضافات

اظهرت النتائج المتحصل عليها ما يلى:

- حسنت معنويا كل مستويات فيتامين E عدد البيض وكتلة البيض ووزن القشرة ووزن الصفار بينما حدث انخفاض معنوى فى وزن البياض مقارنة بالكنترول.
- حسنت معنويا كل مستويات فيتامين E ومستوى ٦٠٠مجم / لتر ماء من فيتامين C وزن البيضة مقارنة مع الكنترول.
- حسنت معنوياً كل مستويات فيتامين E و C سمك القشرة ووحدة هاو مقارنة مع الكنترول
- لم يتأثر معنويا معامل هضم NFE, CF , DM, OM, CP, EE بأى مستوى من مستويات فيتامين C أوE .
- سجلت المجاميع التى تناولت ماء شرب به فيتامين C بمستوى ٤٠٠ وفيتامين E بمستوى ٢٠٠ ملجم/ لتر ماء افضل عائد أقتصادى وكفاءة أقتصادية مقانة بالكنترول.

خلصت هذه الدراسه الى أن اضافة فيتامين C بمستوى ٤٠٠ ملجم/لتر ماء او فيتامين E بمستوى ٢٠٠ملجم/ لتر ماء خلال اشهر الصيف اعطى افضل اداء انتاجى وجودة بيض واعلى عائد اقتصادى تحت الظروف المناخية بواحة سيوة.