AN ATTEMPT TO ALLEVIATE HEAT STRESS AND IMPROVE LAYING HEN PERFORMANCE AND EGG QUALITY DURING SUMMER SEASON BY USING SOME AMINO ACIDS OR VITAMINS.

BY

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Abstract : *A total number of 540 Bovans Brown laying hens at 50 weeks of age were used in this study to determine the possibility of alleviating heat stress by using some amino acids (methionine or lysine) or vitamins (C or E) as well as the effect on laying hen performance, egg quality, nutrients digestibility and economic efficiency of egg production during summer season (the ambient temperature ranged between 29.5 – 35.6 C^o and relative humidity from 50 to 60 %). Three levels of either methionine, lysine, Vit C, or Vit. E were used in this study. Methionine levels were 100% (control), 120 % (M1) or 140 % (M2) and lysine levels were 100% (control), 110 % (L1) or 120 % (L2) of requirement according to the strain recommended catalogue. While, the supplemental levels of Vit. C were 0 mg/kg (control), 1000 mg/kg (C1) and 2000 mg/kg of the diet (C2) and Vit. E levels were 0 mg/kg (control), 250 (E1) and 500 mg/kg of the diet (E2). The 1st diet which contained 100 % of both methionine and lysine requirements without supplemental vitamins represents the control diet. Laying hens were kept in cages of wire floored batteries in an open system house under similar conditions of managements. Water and feed were offered ad-libitum under a total of 16 hours light/day regimen.*

The results indicated that feeding laying hens on diets supplemented with different levels of either methionine, lysine, Vit. C or E recorded higher values of egg production, egg weight and improved feed conversion ratio compared to control group. While, there were no significant (P<0.05) differences in feed intake values due to the different dietary treatments. Also, results showed an improvement in egg shell thickness, digestibility coefficient of organic matter (OM), crude protein (CP), ether extract (EE) and economic efficiency due to experimental treatments compared to control group. In conclusion, using either methionine, lysine, Vit. C or E at the tested levels of this study improved laying hen performance, egg quality,

nutrients digestibility and economic efficiency of egg production during summer season.

INTRODUCTION

During summer season, hot environment represents a stressful time for poultry production in many parts of the world, such as Egypt. The main negative effects of hot environment are a reduction in feed intake, egg production, egg weight and egg quality ***(El-Sheikh, 1997; Pathporgsiriporn et al., 2001; Sahin and Kucuk, 2003; Abou – Ashour et al., 2004 and Metwally, 2005)***. Also, nutrients availability such as amino acids reduced when poultry exposed to heat stress ***(Sahin and Kucuk, 2001)***. Therefore, proper steps should be taken for minimizing the adverse effects of heat stress during summer season on laying hen performance and egg quality. Dietary supplementation of some feed additives such as amino acids or vitamins are normally applied to alleviate the adverse effects of hot climate on laying hen performance and egg quality. Practically, it is commonly known that in poultry feeds, methionine and lysine are the first and second limiting amino acids, respectively. Moreover, the efficiency of protein utilization was increased by supplementation of lysine ***(Uzu and Larbier, 1985)*** or methionine ***(Schutte et al., 1994)*** to laying hen diets. Also, during summer season, supplementing laying hen diets with methionine ***(Abd-Elsamee, 2005)*** or lysine ***(Ghazalah et al., 2007)*** improved laying hen performance and egg quality.

On the other hand, ascorbic acid (Vit. C) synthesized in avian kidney has been demonstrated to protect the birds from heat stress and improve disease resistance in birds by optimizing the function of the immune system ***(Lohakare et al., 2005)***.But, under stress conditions such as low or high environmental temperature the endogenous Vit. C produced is rapidly consumed and it is fall below bird's requirement ***(Sahin et al., 2002)***. Moreover, Vit. C can be considered as a protective management practice to reduce the negative effect of heat stress on laying hen performance and egg quality ***(Whitehead and Keller, 2003; Tollba et al., 2006 and Ghazalah et al., 2007)***.

It worth noting that, when laying hens exposed to heat stress there was an over oxygen free radicals, OH and O_2 ***(Slater, 1984)***. Free radicals can cause metabolic disturbances, cell injury in many ways, profound change in enzymes activity and damage cells by lipids per oxidation of polyunsaturated fatty acids ***(Halliwell and Gutteridge, 1989)***. Vitamin E (DL-α- tecopheryl acetate) is mainly considering as an antioxidant that scavenges the free radicals generated by heat stress in cell membranes

(Paker, 1991 and Bartov and Frigg, 1992). Therefore, the use of Vit. E in laying hen diets under heat stress conditions improved the performance of laying hens and egg quality ***(Bollengier et al., 1999;Kirunda et al., 2001; Abdel - Galil and Abdel - Samad, 2004; Abd - Elsamee, 2005 and AbdEl - Maksoud, 2006)***.

The purpose of this study was planned to determine the ability of adding some amino acids (methionine or lysine) or vitamins (C or E) in laying hen diets to reduce the negative effects of heat stress on laying hen performance and egg quality during summer season.

MATERIALS AND METHODS

The present work was conducted at the Poultry Nutrition Research Unit, Faculty of Agriculture, Cairo University, during summer season (from June to August). A total number of 540 Bovans Brown laying hens 50 weeks of age were used in this study to explain the effect of different levels of both amino acids (methionine or lysine) and vitamins (C or E) on laying hen performance, egg quality, nutrients digestibility and economic efficiency of egg production under heat stress conditions during summer season (the ambient temperature ranged between 29.5 – 35.6 C° and relative humidity 50 – 60 %). Hens were randomly distributed into 9 treatments, each containing 60 hens in 4 replicates of 15 birds each. Two levels of either methionine (120 % M1 and 140 % M2), lysine (110 % L1 and 120 % L2), vitamin C (1000 mg/kg C1 and 2000 mg/kg C2) or vitamin E (250 mg/kg E1 and 500 mg/kg E2) were used in this study besides control diet which containing 100 % of methionine and lysine requirements according to the strain recommended catalogue without Vit. C or Vit. E supplementation. The commercial Vit. E which used in this study contained 50 % of Vit. E (DL-α- tecopheryl acetate). Therefore, the supplemented levels of Vit. E were 500 g/ton and 1000 g/ton to gave 250 and 500 mg/kg of the diet, respectively. The experimental diets and their chemical composition are presented in Table (1) where all the experimental diets were iso-nutritive value. Hens were kept in cages of wire floored batteries in an open system house under similar conditions of management. Water and feed in mash form were offered *ad – libitum* all over the experimental period (12 weeks, 3 periods of 4 weeks each) under a total of 16 hours light / day regimen.

During the experimental periods, the average daily feed intake, egg production and egg weight were calculated per hen every four weeks intervals. Records of feed intake, egg production and egg weight were used to calculate the values of feed conversion ratio (FCR) according to the following equation :

FCR = (FI / EP X EW) X 100

Where : FI = feed intake (g)

EP = egg production percentage (%)

EW = egg weight (g)

Every four weeks, a total number of 20 eggs were taken from each treatment (5 eggs from each replicate) for testing some of their quality as measured by shell thickness, using a digital dial pipe gauge. After the end of the feeding trial, four hens of each treatment (one from each replicate) were randomly chosen and individually housed in metabolic cages to determine the digestibility of nutrients. The analyses of feed and dried excreta were done according to the official methods (***A. O. A. C,1990)***. Nitrogen – free extract (NFE) was calculated according to ***Abou – Raya and Galal (1971)***. Fecal nitrogen was determined according to ***Jakobson et al. (1960)***. The data obtained were statistically examined by using ***MSTAT – C (1989)*** procedures. Differences among treatment means were separated by Duncan's new multiple – range test ***(Duncan,1955)***. Significance was defined as P<0.05. Finally, all treatments were economically evaluated by calculating the net revenue per unit of total costs.

RESULTS AND DISCUSSION

Laying hen performance:

Egg production (%):

The effect of treatments on egg production is listed in Table (2). Results showed that under heat stress conditions (29.5 – 35.6 C^o and relative humidity 50 – 60 %) during summer season the average values of egg production were significantly (P<0.05) increased with using different levels of methionine, lysine, Vit. C or Vit. E compared to control group throughout the different experimental periods. Data indicated that the use of high levels of methionine (140 % M2), lysine (120 % L2) or Vit. E (500 mg/kg of the diet, E2) increased egg production values comparing to low levels of methionine (120 % M1), lysine (110 % L1) or Vit. E (250 mg/kg of the diet, E1), respectively. While, the use of high level of Vit. C (2000 mg/kg, C2) decreased egg production compared with low level of Vit. C (1000 mg/kg, C1). The positive effect of increasing dietary methionine or lysine on egg production may be explained by that methionine considered as the first limiting amino acid in poultry diets followed by lysine and they can increase the efficiency of dietary protein utilization. These results are in agreement with those found by ***Ravikiran and Devegowda (1998); Abd-Elsamee***

(2005) and ***Ghazalah et al. (2007)*** who reported that egg production significantly increased with supplemental methionine or lysine in laying hen diets under heat stress conditions. ***El-Sheikh (1997)*** found that the hen housed and survivor egg production of the group exposed to 32°C and supplemented with lysine increased significantly by about 9.5 % and 4.2%, respectively, over those of the group exposed to 32 °C without lysine supplementation. Hen housed and survivor egg production of the group supplemented with lysine represents about 91.1 and 93.1% of the control group, while the group which exposed to 32°C without added lysine represents about 83.1 and 89.3%, respectively. The author added that lysine supplementation may reduce the detrimental effect of heat stress on egg production and can be used as an antistress factor. The elevated temperature causes a reduction in feed consumption ***(Huston,1965; Mickelberry et al., 1966; and Adams and Roglller, 1968)***. In an attempt to compensate the reduction in feed consumption, dietary amino acid levels ***(Combs, 1968, 1970)*** or protein levels are normally increased by 5 to 10 %. In addition, ***Pastro et al. (1969)*** indicated that the lysine deficiency increased body temperature and so situation would be of particular concern with warm environmental conditions. ***March and Biely (1972)*** reported that relatively more lysine was required by chicks maintained at higher environmental temperatures than those housed between 18 to 22°C.

On the other hand, feeding laying hens on diets containing different levels of either Vit. C or E significantly (P<0.05) increased egg production values compared to control group. This perhaps due to that Vit. C and E can reduce the negative effects of heat stress on egg production because they can protect the liver and other organs against oxidative damage and this may increase the efficiency of feeding utilization during summer season. These results are in harmony with those of ***Whitehead and Keller (2003); Abou-Ashour et al. (2004); Metwally (2005)*** and ***Tollba et al. (2006)*** who showed that egg production values were increased significantly when they fed laying hens on diets supplemented with Vit. C. ***El-Sheikh (1997)*** reported that Vitamin C supplementation under heat stress (32°C) improved hen housed production by about 9.8% and survivor by about 8.1% more than that of the unsupplemented group. He added that the beneficial effect of vitamin C on egg production is due to its effect in maintaining the normal physical conditions, body temperature and respiration rate. Early studies by ***Thornton (1962)*** found that vitamin C supplementation had no effect on body temperature of laying hens maintained in moderate environment, (*i.e.* 24.4 to 26.1°C), but elevating the ambient temperature to 37.8°C resulted in significantly lower body temperatures than in control. This effect was observed from 1 to 8.5 hours after initiation of heating. The author added that oxygen consumption was also lower in vitamin C supplementated hens than in controls when the highest body temperatures occurred. Also, ***Thornton and Moreng (1959)*** showed that ascorbic acid might have an influence of stimulatory nature on thyroid activity, particularly under the conditions of high environmental temperature. ***Thornton (1961)*** and ***Thornton and Deeb (1961)*** concluded that the levels of ascorbic acid synthesized for physiological needs are sufficient when the environmental temperature is optimum, blood vitamin C decreased with an increase in environmental temperature from 21 to 31°C. This action was postulated to be a result of both partial exhaustion of the endogenous stores and a reduction in the amount of vitamin being synthesized.

Also, these results confirmed by ***Pathporgsiriporn et al. (2001); Sahin and Kucuk (2003)*** and ***Abdel-Galil and Abdel-Samad(2004)*** who observed an improvement in egg production with adding Vit. E to laying hen diets at levels varied from 65 to 500 mg/kg of the diet during heat stress conditions.

Egg weight (g):

The effect of experimental treatments on egg weight (g) is presented in Table (2). Data observed that when laying hens were fed diets containing different levels of either methionine (M1 or M2) or lysine (L1 or L2), there were significant ($P<0.05$) increase in egg weight values compared to control group. The positive effect of using amino acids on egg weight may be explained by the concentration of yolk precursor proteins and improving the formation of egg during heat stress conditions. These results are in agreement with those of ***Abd-Elsamee (2005)*** and ***Ghazalah et al. (2007)*** who found that egg weight increased either with supplemental methionine or lysine to laying hen diets during heat stress conditions.

On the other hand, there were no significant ($P<0.05$) differences in egg weight values due to adding either Vit. C or E to laying hen diets comparing to control group. Similarly, ***Pathporgsiriporn et al. (2001)*** stated that supplementation of Vit. E to laying hen diets had no significant effect on egg weight. Meanwhile, ***Abdel-Galil and Abdel-Samad (2004)*** observed that supplemental Vit. E to laying hen diets significantly increased egg weight compared with control group.

Feed intake:

The effect of experimental treatments on feed intake (g/hen/day) is shown in Table (3). Results showed no significant ($P<0.05$) differences in feed intake values due to the use of different levels of either methionine, lysine, Vit. C or E in laying hen diets during summer season. In this respect, ***Hai et al. (2003); Abd-Elsamee (2005)*** and ***Ghazalah et al. (2007)*** found similar findings when they supplemented laying hen diets with different levels of amino acids or vitamins under heat stress conditions. However, ***Kirunda et al. (2001)*** and ***Abdel-Galil and Abdel-Samad (2004)*** reported that supplementation of Vit. E to laying hen diets increased feed intake when they exposed laying hens to heat stress.

Feed conversion ratio:

The average values of feed conversion ratio (FCR) were improved significantly (P<0.05) with using different levels of either methionine, lysine, Vit. C or E in laying hen diets compared to control group as shown in Table (3). Also, the best values of FCR were observed with feeding laying hens on diets containing high level of either methionine (140 %, M2) or lysine (120 %, L2) which recorded 2.08 and 2.12, respectively. Such improvement may be due to increasing both egg production and egg weight with increasing dietary level of either methionine or lysine during summer season. In this respect, ***Ravikiran and Devegowda (1998); Abd-Elsamee (2005)*** and ***Ghazalah et al. (2007)*** showed that FCR was improved when they fed laying hens diets supplemented with either methionine or lysine under heat stress conditions. Also, ***Bollengier-Lee et al. (1998)*** and ***Hai et al. (2003)*** found that using different levels of either Vit. C or E in laying hen diets under heat stress conditions improved FCR.

On the contrary, ***Lin et al. (1998)*** and ***Abdel-Galil and Abdel-Samad (2004)*** showed no significant differences in average values of FCR due to supplemental different levels of Vit. C or E to laying hen diets under heat stress conditions.

Egg quality:

Shell thickness:

The effect of dietary treatments on shell thickness (mm) as an indicator of egg quality is listed in Table (4). Data showed that when laying hens were fed diets containing different levels of either methionine, lysine or Vit. E , the average values of shell thickness were slightly increased but without significant (P<0.05) differences comparing to control group. While, adding different levels of Vit. C (C1 or C2) to laying hen diets significantly (P<0.05) increased the average values of shell thickness and recorded the best values (0.42 and 0.43 mm , respectively) compared to control group, which recorded 0.38 mm.This improvement may be due to the positive effect of Vit. C on the utilization of dietary calcium, then improving shell formation. These results are in agreement with those of ***Whitehead and Keller (2003); Abou-Ashour et al. (2004); Metwally (2005); Tollba et al. (2006)*** and ***Ghazalah et al. (2007)*** who reported that egg shell thickness was significantly improved with adding Vit. C to laying hen diets under heat stress conditions. In this connection, ***El-Sheikh (1997)*** concluded that providing vitamin C, lysine, sodium bicarbonate, KCl and cold water during heat stress, improved significantly shell thickness by about 4.2, 4.5, 6, 4.2%, respectively. Such anti-heat stress treatments increased specific gravity of egg.

Nutrients digestibility:

Results indicated that using different levels of either methionine, lysine, Vit. C or E, specially high levels in most cases, significantly ($P<0.05$) improved digestibility coefficient of organic matter (OM), crude protein (CP) and ether extract (EE) compared to control group (Table, 5) . While, there were no significant differences in digestibility coefficient values of both crude fiber (CF) and nitrogen free extract (NFE) due to feeding laying hens on diets containing different levels of either methionine, lysine, Vit. C or E. These results were previously confirmed by ***Uzu and Larbier (1985)*** and ***Schutte et al. (1994)*** who stated that the efficiency of dietary protein utilization was increased either by supplemental lysine or methionine to laying hen diets. Also, ***Bartov and Frigg (1992)*** and ***Lohakare et al. (2005)*** found that Vit. C or Vit. E has been demanded as an antioxidant that scavenges the free radicals generated by heat stress in cell membranes and can protect the liver and other organs against oxidative damage. Therefore, supplemental Vit. C or E are necessary to maintain cellular metabolic function that greatly affects digestion and metabolism of nutrients.

Economical efficiency:

Data presented in Table (6) showed the economical efficiency of the different formulated diets and money return per hen at the end of experimental period as affected by different dietary treatments. Egg production (egg No./hen) and feeding cost are generally among the most important factors involved in the achievement of maximum efficiency of egg production. The economical efficiency values were calculated according to the prevailing market (selling) price of an egg, which was 0.35 LE on average during the experimental period. Results indicated that the use of different levels of either methionine, lysine, Vit. C or E increased the average values of both net revenue, economical efficiency and relative economical efficiency during summer season. Similarly, ***Abd-Elsamee (2005)*** showed that the average values of economical efficiency were improved with feeding laying hens on diets supplemented with different levels of methionine and Vit. E during summer season. Also, ***Ghazalah et al. (2007)*** reported that when both lysine and Vit. C had been added to laying hen diets, under heat stress, the average values of economical efficiency were improved compared to control group.

According to all results obtained herein, it could be concluded that feeding laying hen on diets containing either methionine (120 or 140 % of requirement), lysine (110 or 120 % of requirement), Vit. C (1000 or 2000 mg/kg diet) or Vit. E (250 or 500 mg/kg diet) improved laying hen performance, egg quality, nutrients digestibility and economical efficiency during summer season.

Table (1): Composition and calculated analysis of the experimental diets.

Treatments / Ingredients	Cont. T1	Methionine M1 T2	M2 T3	Lysine L1 T4	L2 T5	Vit. C C1 T6	C2 T7	Vit. E E1 T8	E2 T9
Yellow corn	57.40	57.31	57.22	57.30	57.20	57.30	57.20	57.35	57.30
Soybean meal (44 %)	24.20	24.20	24.20	24.20	24.20	24.20	24.20	24.20	24.20
Corn gluten meal (60 %)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Vegetable oil	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
Bone meal	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40
Limestone	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.70	8.70
NaCl	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Vit. & Min. Premix*	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Dl-methionine	0.10	0.19	0.28	0.10	0.10	0.10	0.10	0.10	0.10
L-lysine HCl	-	-	-	0.10	0.20	-	-	-	-
Vit. C	-	-	-	-	-	0.10	0.20	-	-
Vit. E	-	-	-	-	-	-	-	0.05	0.10
Total	100	100	100	100	100	100	100	100	100
Calculated analysis**									
CP %	17.50	17.50	17.50	17.50	17.50	17.50	17.50	17.50	17.50
ME Kcal / kg	2900	2900	2900	2900	2900	2900	2900	2900	2900
EE %	6.12	6.12	6.12	6.12	6.12	6.12	6.12	6.12	6.12
CF %	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28
Ca %	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Avail. P %	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Meth. %	0.42	0.50	0.59	0.42	0.42	0.42	0.42	0.42	0.42
Lys. %	0.86	0.86	0.86	0.95	1.04	0.86	0.86	0.86	0.86
Vit. C mg / kg	-	-	-	-	-	1000	2000	-	-
Vit. E mg / kg	-	-	-	-	-	-	-	250	500
Price / ton (LE) ***	1520	1545	1570	1550	1580	1540	1560	1540	1570

* Vitamin and Mineral Premix at 0.3 % of the diet supplies the following per Kg of the diet : Vit.A 10000 IU; Vit D_3 3000 IU; Vit. E 20 mg; Vit. K_3 3 mg; Vit. B_1 2 mg; Vit. B_2 6mg ; Vit. B_6 5mg; Vit. B_{12} 20 mcg ; Niacin 66 mg; Pantothenic acid 10mg ; Folic acid 1mg ; Biotin 0.5 mg ; Choline chloride, 500mg; Mn,100 mg; Cu, 8 mg; Fe ,100 mg ; Zn, 75mg ; I_2, 45 mcg ; Co, 10 mcg; and Se, 10 mcg.

According to **NRC , 1994.

*******According to prices of the used ingredients at the experimental time (2004).

Table (2): Effect of dietary treatments on egg production and egg weight.

Treatments		Egg production (%)				Egg weight (g)			
		Experimental periods				Experimental periods			
No.		1	2	3	overall	1	2	3	overall
1	Cont.	82.2^{d}	78.7^{c}	73.2^{d}	78.0^{d}	61.8^{bc}	62.6^{c}	64.1^{b}	62.8^{c}
2	M1	84.5^{bcd}	82.5^{b}	81.0^{bc}	82.5^{c}	62.8^{ab}	63.8^{ab}	64.5^{ab}	63.7^{bc}
3	M2	89.2^{a}	84.2^{ab}	84.5^{a}	86.2^{a}	63.6^{a}	64.6^{a}	65.5^{a}	64.6a
4	L1	84.0^{cd}	83.1^{ab}	81.8^{b}	82.9^{bc}	62.5^{ab}	64.0^{ab}	65.3^{a}	64.0^{ab}
5	L2	87.0^{ab}	84.5^{ab}	82.3^{a}	84.5^{abc}	62.5^{ab}	64.0^{ab}	65.3^{a}	64.0^{ab}
6	C1	87.0^{ab}	85.3^{a}	83.5^{a}	85.5^{ab}	61.0^{c}	62.5^{c}	63.3^{b}	62.5^{c}
7	C2	85.8^{bc}	82.0^{b}	82.5^{a}	83.8^{abc}	61.8^{bc}	63.3^{bc}	63.8^{b}	63.0^{bc}
8	E1	85.2^{bc}	82.2^{b}	78.5^{c}	82.0^{c}	61.8^{bc}	62.4^{c}	64.2^{b}	62.9^{c}
9	E2	85.7^{bc}	83.0^{ab}	80.5^{bc}	83.2^{bc}	61.3^{c}	62.5^{c}	64.0^{b}	62.6^{c}
L.S.D		2.5	2.5	2.6	2.3	1.10	1.0	1.0	1.0

a, b, c…. Means in each column bearing the same superscripts are not significantly different ($P < 0.05$).

Table (3): Effect of dietary treatments on feed intake and feed conversion ratio.

Treatments		Feed intake (g/hen/day)				Feed conversion ratio (FCR)			
		Experimental periods				Experimental periods			
No.		1	2	3	overall	1	2	3	overall
1	Cont.	109.5	113.5	119.5	114.2	2.15^{a}	2.30^{a}	2.55^{a}	2.33^{a}
2	M1	110.5	114.0	121.5	115.3	2.08^{ab}	2.17^{cd}	2.33^{bc}	2.19^{bc}
3	M2	112.3	113.8	120.5	115.8	1.98^{c}	2.09^{d}	2.18^{d}	2.08^{d}
4	L1	112.0	114.3	121.3	115.9	2.13^{a}	2.15^{cd}	2.27^{c}	2.18^{bc}
5	L2	110.0	114.5	120.3	114.9	2.02^{bc}	2.12^{d}	2.24^{cd}	2.12^{cd}
6	C1	110.5	115.5	121.0	115.7	2.08^{ab}	2.17^{cd}	2.29^{c}	2.16^{bc}
7	C2	107.8	116.8	122.0	115.5	2.03^{bc}	2.27^{ab}	2.32^{c}	2.19^{bc}
8	E1	110.3	113.6	121.5	115.1	2.09^{ab}	2.21^{bc}	2.41^{b}	2.23^{b}
9	E2	110.3	112.8	120.5	114.3	2.09^{ab}	2.17^{cd}	2.34^{bc}	2.19^{bc}
L.S.D		2.9	4.6	3.2	3.1	0.08	0.08	0.08	0.08

a, b, c…. Means in each column bearing the same superscripts are not significantly different ($P < 0.05$).

Table (4): Effect of dietary treatments on shell thickness.

Treatments		Shell thickness (mm)			
		Experimental periods			
No.		1	2	3	overall
1	Cont.	0.39^{b}	0.38^{c}	0.37^{c}	0.38^{c}
2	M1	0.42^{ab}	0.39^{bc}	0.39^{abc}	0.40^{abc}
3	M2	0.39^{bc}	0.38^{c}	0.37^{c}	0.38^{c}
4	L1	0.42^{ab}	0.38^{c}	0.37^{c}	0.39^{bc}
5	L2	0.42^{ab}	0.41^{abc}	0.40^{abc}	0.41^{abc}
6	C1	0.43^{a}	0.42^{ab}	0.41^{ab}	0.42^{ab}
7	C2	0.44^{a}	0.43^{a}	0.42^{a}	0.43^{a}
8	E1	0.41^{ab}	0.39^{bc}	0.38^{bc}	0.39^{bc}
9	E2	0.41^{ab}	0.40^{abc}	0.39^{abc}	0.40^{abc}
L.S.D		0.03	0.03	0.03	0.03

a, b, c…. Means in each column bearing the same superscripts are not significantly different ($P < 0.05$).

Table (5): Effect of dietary treatments on nutrients digestibility.

Treatments		Digestibility (%)				
No.		OM	CP	EE	CF	NFE
1	Cont.	79.2^{b}	84.2^{d}	72.5^{d}	24.5^{a}	82.1^{a}
2	M1	80.2^{ab}	84.5^{cd}	74.2^{bc}	25.5^{a}	82.5^{a}
3	M2	81.5^{a}	86.0^{bc}	74.5^{abc}	25.7^{a}	83.0^{a}
4	L1	81.5^{a}	85.7^{bc}	74.3^{abc}	25.3^{a}	83.7^{a}
5	L2	81.5^{a}	87.8^{a}	75.2^{ab}	24.6^{a}	83.4^{a}
6	C1	81.3^{a}	86.3^{ab}	74.2^{bc}	24.5^{a}	83.5^{a}
7	C2	81.5^{a}	87.0^{ab}	75.8^{a}	24.8^{a}	83.3^{a}
8	E1	80.2^{ab}	84.5^{cd}	73.5^{cd}	24.7^{a}	82.5^{a}
9	E2	80.5^{ab}	85.7^{bc}	74.2^{bc}	25.2^{a}	82.2^{a}
L.S.D		1.5	1.5	1.5	1.8	2.5

a, b, c…. Means in each column bearing the same superscripts are not significantly different ($P < 0.05$).

Table (6): Effect of dietary treatments on economical efficiency.

Treatments No.		Fixed cost/hen (LE)[a]	Feed cost/hen (LE)	Total cost/hen (LE)	Egg. P No. / hen	Price of egg/hen (LE)	Net revenue L.E/hen	EEf[b]	Relative EEf[c] %
1	Cont.	1.5	14.58	16.08	65.5	22.92	6.84	0.425	100.0
2	M1	1.5	14.96	16.46	69.3	24.25	7.79	0.473	111.3
3	M2	1.5	15.27	16.77	72.4	25.34	8.57	0.511	120.2
4	L1	1.5	15.09	16.59	69.6	24.36	7.77	0.468	110.1
5	L2	1.5	15.25	16.75	70.9	24.81	8.06	0.481	113.2
6	C1	1.5	14.97	16.47	71.8	25.13	8.66	0.526	123.8
7	C2	1.5	15.13	16.63	70.4	24.64	8.01	0.482	113.4
8	E1	1.5	14.89	16.39	68.9	24.11	7.72	0.471	110.8
9	E2	1.5	15.07	16.57	69.9	24.46	7.89	0.476	112.0

a) Rearing cost per hen.
b) Net revenue per unit cost.
c) Assuming that the group number 1 represent the control.

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الملخص العربى

محاولة لتخفيف الاجهاد الحرارى وتحسين الأداء الإنتاجى للدجاج البياض وجودة البيضة خلال فصل الصيف عن طريق استخدام بعض الأحماض الأمينية أو الفيتامينات.

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تم استخدام عدد 540 دجاجة بياضة من نوع البوفانز البنى عمر 50 أسبوع فى هذه التجربة لدراسة تأثير استخدام بعض الأحماض الأمينية (مثيونين أو ليسين) أو الفيتامينات (ج أو هـ) على الأداء الإنتاجى ، جودة البيضة ، معاملات الهضم ، الكفاءة الإقتصادية لإنتاج البيض خلال فصل الصيف حيث كانت درجة الحرارة المحيطة بالطيور تتراوح بين 29.5 – 35.6 5م وكانت نسبة الرطوبة النسبية ما بين 50 ألى 60 % . تم استخدام مستويين من الحامض الأمينى المثيونين هما 120 ، 140 % أما مستويات الحامض الأمينى الليسين فكانت 110 ، 120 % (من الإحتياجات الغذائية الموصى بها للمثيونين والليسين تبعا لكتالوج السلالة المستخدمة) . أما مستوى إضافة فيتامين ج فكان 1000 أو 2000 ملجم / كجم من العليقة وكان مستوى إضافة فيتامين هـ 250 أو 500 ملجم / كجم من العليقة . وكانت مجموعة المقارنة هى التى تغذت على العليقة المحتوية على 100 % من كل من المثيونين والليسين وبدون إضافة فيتامين ج أو هـ . تم تربية الطيور تحت نفس الظروف من الرعاية والمعاملات البيطرية طوال فترة التجربة التى استمرت لمدة 12 اسبوع .

أوضحت نتائج هذه التجربة أن تغذية الدجاج البياض على علائق تحتوى على مستويات أعلى من الموصى بها سواء من المثيونين أو الليسين أو إضافة مستويات مختلفة من فيتامين ج أو هـ أدى إلى زيادة إنتاج البيض ، زيادة وزن البيضة كما حسن معنويا الكفاءة التحويلية للغذاء مقارنة بمجموعة المقارنة. بينما لم يكن هناك تأثير معنوى للمعاملات الغذائية على قيم الغذاء المأكول . أيضا كان هناك تحسن فى قيم كل من سمك القشرة ، معامل هضم المادة العضوية ، معامل هضم البروتين الخام ، معامل هضم مستخلص الإثير ، فضلا عن تحسن الكفاءة الإقتصادية نتيجة للمعاملات الغذائية موضع الدراسة مقارنة بمجموعة المقارنة .

من خلال نتائج هذه الدراسة يمكن التوصية بزيادة مستوى أى من الحامض الأمينى المثيونين أو الليسين أو إضافة أى من فيتامين ج أو هـ فى علائق الدجاج البياض خلال فصل الصيف حيث أدى ذلك إلى تحسن الأداء الإنتاجى ، صفات جودة البيضة ، الكفاءة الإقتصادية .