EFFECT OF ASCORBIC ACID, ENZYMES MIXTURE, FORM OF FEED, AND THEIR INTERACTIONS ON LAYER HEN PERFORMANCE DURING SUMMER SEASON

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SUMMARY

The present study was conducted to determine whether using a combination between ascorbic acid (AA) , enzymes mixture and form of the feed could alleviate the effect of heat stress (hot summer conditions of Egypt) on layer hen performance. A total number of 112 fifty three weeks old laying hens (LSL) were reared under the same management conditions in egg production batteries. The hens were randomly distributed into 8 groups of 14 birds each. Each group was assigned randomly for one of the following experimental diets in two forms (mash or pellet):

1) Control diet, 2) the control diet supplied with vitamin C (AA) at 100 mg /kg diet; 3) the control diet supplied with enzymes mixture at 0.05% of the diet; and 4) the control diet supplied with both vitamin C at 100 mg /kg diet and enzymes mixture at 0.05% of the diet.

The results of this study showed that introducing the diet in pellet form, for the control group, gave higher egg production value when compared to the mash form and best feed conversion value. Also, the pellet form, regardless the treatments, gave better shell thickness and shell weight values when compared to the mash form. Supplementing the mash form with vitamin C, enzyme mixture or both of them improved egg production, feed conversion, Ca balance (%) and the digestion coefficients of DM and OM when compared to the control diet. Also the additives improved shell weight, shell percentage and the shell thickness when compared to the control diet. In spite of the highest relative economical efficiency values proved for enzymes mixture (163%), vitamin C (154%) and the combination of vitamin C and enzymes mixture (149%), respectively, the last treatment gave the best egg shell quality. Therefore, using the combination of vitamin C and enzymes mixture could be beneficial for laying hens under hot summer conditions of Egypt to get the best laying performance and to reduce the incidence of egg shell breakage, during heat stress.

Keywords: *layer, performance, heat stress, ascorbic acid, enzymes, feed form.*

INTRODUCTION

As domestic egg production becomes more mechanized, increasing number of egg shells get broken as eggs move from the hen to consumer. Hamilton (1982) reported that shell breakage is estimated to cost Canadian egg producers about $10 million annually and United States producers about $100 million. In addition to the economic losses, there is the loss of a high quality foodstuff for humans.

Campos *et al.* (1960) found that the rate at which temperature rises above 70-80 °F (21-27 °C) influences the quality of eggs laid and the amount of feed consumed, but not egg production. They also indicated that shell thickness was found to be more sensitive to rises in ambient temperature than egg production. Whereas egg production and egg weight are influenced to a major extent by the reduction in feed consumption, eggshell quality is influenced primarily by high temperature (Sauveur and Picard, 1987).

Thornton (1962) observed that an increase in environmental temperature to 35 °C brought about a rise in body temperature of both control hens and those given 44 mg ascorbic acid/kg diet. He also found that body temperature increased more in control hens than hens fed vitamin C. The increase in body temperature may affect the activity of some enzymes as reported by Goto *et al.* (1979). They found that the activity of carbonic anhydrase decreased significantly due to high temperature (32 °C) exposure. Mohamed (1997) fed male chicks on mash or pellet diets with ascorbic acid at levels of 0, 100, 200 or 300 mg/kg diet. Temperature was maintained at 32-36 °C. He found an interaction improvement ($P \leq 0.01$), in chicks body weights, between levels of ascorbic acid and pelleting of diets. El-Fiky (1998) found that supplementation with ascorbic acid increased feed intake, he revealed that this may be due to the role of ascorbic acid in activating the thyroid gland which influence the feed intake.

Only a few studies have investigated the effect of the interaction between vitamin C and the form of feed on alleviating the effect of heat stress on poultry production and almost no available information about using a combination between vitamin C, enzymes mixture and the form of feed to alleviate the effect of heat stress on layer hen performance. Therefore, the present study was conducted to determine whether using a combination between ascorbic acid (AA) , enzymes mixture and the form of feed could alleviate the effect of heat stress on layer hen performance under hot summer conditions of Egypt.

MATERIALS AND METHOODS

A total number of 112 laying hens (LSL) of 53 weeks old were reared under the same management conditions in egg production batteries. The hens were randomly distributed into 8 groups of 14 birds each. Each group was subdivided into seven replicates (2 hens/replicate) and assigned randomly for one of the following experimental diets in mash or pellet (3 mm diameter) form:

1) Control diet, 2) the control diet supplemented with vitamin C (AA) at 100 mg /kg diet; 3) the control diet supplemented with enzymes mixture at a rate of 0.05% of the diet; and 4) the control diet supplemented with both of vitamin C at 100 mg /kg diet and enzymes mixture at a rate of 0.05% of the diet. Accordingly, a total of 8 experimental treatments were used in (4x2) factorial design.

The composition and chemical analyses of the control diet are shown in Table 1. Molasses was used to substitute 2% of the total feed mixture of each of the experimental diets. Vitamin C (AA) (commercially named vitamin C 20%, where each 100 gm contains 20 gm pure ascorbic acid) was used. The enzymes mixture (Kemzyme) contained alpha-amylase (0.69%), beta-glucanase (0.65%), protease (0.37%), lipase (0.43%), cellulase (0.42%) and bentonite (7.7%). All diets were formulated to satisfy nutrient requirements of laying hens according to NRC (1994). Artificial light was used beside the normal day light to provide 16-hour day photoperiod. Feed and water were provided *ad libitum.* The experiment lasted for two months (60 days).

Table (1) : The composition and chemical analysis of the control diet.

Ingredients	%
Yellow corn	63.50
Soybean meal (44%)	23.50
Corn oil	2.30
Bone meal	2.48
Limestone	7.50
Iodized salt	0.40
Vit.&Min.Mixture[1]	0.25
DL-Methionine	0.07
Total	**100**
Crude protein (%)	16.27
Metabolizable energy (ME Kcal/Kg diet)	2883
Crude fiber (%)	3.11
Ether extract (%)	4.90
Available P (%)	0.68
Calcium (%)	3.67
Lysine (%)	0.84
Methionine (%)	0.35
Methionine + Cystine (%)	0.61
C/P ratio	177

1- Each 2.5 kg of Vit. & Min. Mixture contains: Vit. A 12000,000 IU, Vit. D_3 2000,000 IU, Vit. E 10,000 mg, Vit. k_3 2000 mg, Vit. B_1 1000 mg, Vit. B_2 4000 mg, Vit. B_6 1500 mg, Vit. B_{12} 10 mg, Pantothenic acid 10,000 mg, Niacin 20,000 mg, Folic acid 1000 mg, Biotin 50 mg, Choline chloride 500,000 mg, Manganese 55,000 mg, Zinc 55,000 mg, Copper 10,000 mg, Iodine 1000 mg, Selenium 100 mg.

Table (2) : Performance (Mean ± SE) of LSL laying hens as affected by different feed forms and additives.

Treatments	Egg production (%)	Egg weight (gm)	Feed intake (g/hen/d)	FC (feed/egg mass)
T1 (Control)				
Mash	48.9^{c}±3.1	55.9^{b}±0.4	76.2±3.7	2.92^{a}±0.20
Pellet	60.6^{a}±1.5	57.7^{ab}±0.6	70.9±1.7	2.05^{d}±0.07
Average	54.8±2.0	56.8^{ab}±0.4	73.6±2.1	2.49±0.13
T2 (Vit.C)				
Mash	55.2^{abc}±3.1	56.9^{ab}±0.8	69.9±2.2	2.29^{cd}±0.12
Pellet	48.1^{c}±3.1	58.0^{a}±0.6	73.0±2.6	2.76^{ab}±0.20
Average	51.7±2.3	57.5^{a}±0.5	71.5±1.7	2.52±0.12
T3 (Enz. Mix.)				
Mash	57.9^{ab}±2.0	53.8^{c}±0.6	70.9±2.1	2.30^{cd}±0.06
Pellet	55.1^{abc}±3.8	57.9^{a}±0.6	71.4±1.9	2.40^{bc}±0.22
Average	56.5±2.1	55.9^{bc}±0.6	71.2±1.4	2.35±0.11
T4 (Vit.C+Enz.)				
Mash	53.3^{abc}±2.7	52.6^{c}±1.2	67.9±1.9	2.49^{bc}±0.11
Pellet	51.1^{bc}±2.4	57.5^{ab}±0.8	70.1±2.2	2.45^{bcd}±0.12
Average	52.2±1.8	55.1^{c}±0.9	69.0±1.5	2.47±0.08
Feed form				
Mash	53.8±1.4	54.8^{b}±0.4	71.2±1.3	2.5±0.07
Pellet	53.7±1.5	57.8^{a}±0.3	71.4±1.1	2.42±0.09

a, b ....= Means in the same column within each factor differently superscripted are significantly different ($P \leq 0.05$).

Data on egg production (EP), egg weight (EW) and feed consumption (FC) were recorded during July and August months at the Poultry Farm, Faculty of Agriculture, Cairo University, Giza, Egypt. Representative egg samples (7 eggs) from each treatment were collected three times (at the end of each 20 days) throughout the experimental period in order to determine shell quality. The maximum ambient temperature (at 12 pm) and relative humidity the day before egg collection were ranged between 33-36 °C and 35-41%. Egg shell thickness, including shell membranes, was measured using a micrometer to the nearest 0.01 mm at the equator. At the end of the experimental period, a digestion trial was conducted using four birds from each treatment to determine digestion coefficients of dry matter (DM) and organic matter (OM), ash content of the excreta. Apparent absorption of calcium was calculated as the difference between calcium intake and calcium in excreta expressed as a percentage of calcium intake during the collection period. Calcium was determined by atomic absorption spectrophotometry. 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 produced. The values of economical efficiency were calculated as the net revenue per unit of total cost. Proximate analyses of feed and excreta were carried out following A.O.A.C (1990).

Data from all response variables were subjected to a (4 x 2) factorial analysis using SAS (1990). Variables having a significant differences were compared using Duncan's multiple range test (Duncan, 1955).

Model:

$X_{ij} = \mu + T_i + F_j + (TF)_{ij} + E_{ij}$

Where : X_{ij} = Any observation.

μ =Over all mean.

T_i = Treatments (i=1, 2, 3 and 4).

F_j = Feed forms (j=1 and 2).

$(TF)_{ij}$= Interaction between treatments and feed forms.

E_{ij}= Experimental error.

RESULTS AND DISCUSSION

Laying hen performance:

Egg production was not influenced significantly ($P \leq 0.05$) by any of the treatments or feed form (Table 2). However, the addition of enzyme mixture at 0.05% of the diet gave the highest laying rate (56.5 vs. 54.8% for the control). It was also observed that the control diet in pellet form gave significant higher value than that in mash form (60.6 vs. 48.9%). Egg weight values were influenced significantly ($P \leq 0.05$) by both of the treatments and the feed form, where vitamin C resulted in the best egg weight when compared to the control (57.5 vs. 56.8 gm) and the pellet form gave the better egg weight than the mash form (57.8 vs. 54.8). Table 2 showed that neither treatments nor the form of feed affected the amount of feed consumed (gm/hen/day), however, in most of the cases, hens given the diet in pellet form consumed more feed than those given the mash form. The values of feed conversion were not significantly ($P \leq 0.05$) affected by either the treatments or the feed form. In general, enzyme mixture gave the best feed conversion value and egg laying rate when compared to the control diets (2.35 vs. 2.49 and 56.5 vs. 54.8%, respectively). Specifically, the control diet in pellet form gave the best feed utilization value (2.05). It is, also observed that the control diet in mash form gave the worst feed conversion value and egg laying rate. The results indicated that the pellet form did not give consistent trend, specially in both of egg production and feed conversion. Supplementing the mash form with vitamin C, enzyme mixture or a mixture of both improved the egg production and feed conversion when compared to the control diet. These results were supported by Sahota and Gillani (1995) who found that ascorbic acid supplementation (at 50 or 100 mg/Kg feed) improved egg production, feed intake and feed conversion efficiency. The results were also, supported by Lin PingHung *et al.* (1998) who studied the effects of dietary ascorbic acid (AA) supplementation on the laying performance under high ambient temperature (August to September in Taiwan). They fed White Leghorn hens on basal diets supplemented with AA at 0, 250, 500, 1000 and 2000 mg/Kg, respectively. They observed that AA increased egg production ($P \leq 0.05$) and the supplement of 1000 mg/Kg provided the highest egg weight ($P \leq 0.05$) while, feed intake and feed conversion were not significantly different. Comparing the mash forms, the beneficial effect of vitamin C supplementation on feed conversion ratio was supported by Abou-Zeid *et al.* (2000) who indicated that quail chicks received 200 mg of vitamin C exhibited best feed conversion ratio. This could be attributed to the fact that vitamin C scavenges free oxygen radicals which is important, however, to prevent stress caused by oxidation of cell membrane in the digestive system and restore efficient feed utilization (Jaffe, 1984). Also, Takahashi and Horiguchi (1991) demonstrated that the alleviation of growth retardation brought by AA might result from an improvement in feed utilization rather than by an increase in feed intake. On the contrary to the results of this study, El-Deek *et al.* (1999) found that optizyme (an enzyme mixture) increased egg weight, this may be due to the difference in the enzymes content or their concentrations.

Egg shell quality:

Most of the egg shell quality parameters were not significantly affected by any of the treatments or the feed forms (Table 3). The addition of a mixture of vitamin C and enzymes gave the best values. The pellet form had a clear beneficial effect on egg shell quality. The improvement in shell weight due to vitamin C addition was supported by Cheng *et al.* (1990) who observed that shell weight per unit surface area was increased, under a heat stress of 31.1 C, due to ascorbic acid supplementation (at 100 or 200mg/Kg diet). Also, Lin PingHung *et al.* (1998) found that diets supplemented with AA at 250 mg/Kg had the best egg shell strength, those with 500 mg/Kg gave the highest egg shell thickness and those with 1000 mg/Kg gave highest egg shell weight.

Digestion trials

Supplementing laying hen diets with vitamin C, enzyme mixture or a mixture of both improved the amount of Ca retained (gm/hen/day) and Ca balance (%) and also the digestion coefficients of DM and OM when compared to the control diet (Table 4). Using a mixture of vitamin C and enzymes gave the best values. The pellet form had a beneficial effect in most cases. In this regard Van der Klis *et al.* (1995) and Marsman *et al.* (1997) reported that enzyme treatment improved the dry matter digestibility and enhanced the apparent absorption of calcium. The first related the improvement in nutrient utilization to decreasing the chyme viscosity, while the second indicated that increasing chyme viscosity did not affect apparent ileal nutrient digestibility.

Economical efficiency

Table 5 shows that the economical efficiency and the relative economical efficiency values were ranged between

Table (3) : Means ± S.E. of egg shell quality as affected by different feed forms and additives.

Treatments	Egg weight (gm)	Shell weight (gm)	Shell (%)	Shell thickness (mm)
T1(Control)				
Mash	$55.8^{abc}\pm0.7$	5.57±0.17	9.98±0.28	31.05±0.87
Pellet	$57.6^{a}\pm0.7$	6.18±0.13	10.76±0.23	32.38±0.70
Average	**56.7±0.5**	**5.88±0.12**	**10.37±0.19**	**31.72±0.56**
T2(Vit.C)				
Mash	$57.1^{a}\pm1.1$	5.88±0.17	10.30±0.23	31.86±0.74
Pellet	$56.9^{ab}\pm0.7$	6.08±0.13	10.71±0.23	33.00±0.68
Average	**57.0±0.7**	**5.98±0.11**	**10.51±0.17**	**32.43±0.50**
T3(Enz. Mix.)				
Mash	$53.7^{c}\pm0.8$	5.87±0.21	10.92±0.37	31.43±0.63
Pellet	$58.0^{a}\pm0.8$	6.06±0.15	10.49±0.28	32.71±0.78
Average	**55.9±0.6**	**5.97±0.13**	**10.71±0.23**	**32.07±0.50**
T4(Vit.C+Enz.)				
Mash	$54.6^{bc}\pm0.9$	5.93±0.14	10.89±0.28	32.33±0.72
Pellet	$56.2^{ab}\pm0.6$	6.25±0.16	11.12±0.27	32.90±0.68
Average	**55.4±0.5**	**6.09±0.11**	**11.00±0.19**	**32.62±0.49**
Feed form				
Mash	$\mathbf{55.3^{b}\pm0.5}$	$\mathbf{5.81^{b}\pm0.09}$	**10.52±0.15**	$\mathbf{31.67^{b}\pm0.37}$
Pellet	$\mathbf{57.2^{a}\pm0.4}$	$\mathbf{6.14^{a}\pm0.07}$	**10.77±0.13**	$\mathbf{32.75^{a}\pm0.35}$

a, b ....= Means in the same column within each factor differently superscripted are significantly different (P≤0.05).

Table (4) : Means ± S.E. of digestion coefficients and minerals balance (%) as affected by different feed forms and additives.

Treatments	DM (%)	OM (%)	Ash % of excreta	Ca retained (g/hen/day)	Ca balance (%)
T1(Control)					
Mash	$60.2^{d}\pm0.1$	$64.7^{e}\pm0.5$	$23.3^{c}\pm0.9$	1.19±0.08	$44.45^{c}\pm3.05$
Pellet	$60.3^{d}\pm0.1$	$70.2^{c}\pm0.1$	$35.3^{a}\pm0.3$	1.00±0.02	$37.41^{d}\pm0.84$
Average	$\mathbf{60.3^{b}\pm0.1}$	$\mathbf{67.5^{c}\pm1.6}$	**29.3±3.5**	$\mathbf{1.10^{b}\pm0.06}$	$\mathbf{40.93^{c}\pm2.41}$
T2 (Vit.C)					
Mash	$64.3^{c}\pm0.9$	$68.0^{b}\pm0.4$	$22.5^{c}\pm2.9$	1.19±0.10	$44.68^{bc}\pm2.50$
Pellet	$66.2^{ab}\pm0.0$	$75.1^{a}\pm1.0$	$36.5^{a}\pm2.5$	1.34±0.02	$47.66^{bc}\pm0.76$
Average	$\mathbf{65.3^{a}\pm0.7}$	$\mathbf{71.6^{b}\pm2.1}$	**29.5±4.4**	$\mathbf{1.27^{a}\pm0.06}$	$\mathbf{46.17^{b}\pm1.37}$
T3 (Enz. Mix.)					
Mash	$65.6^{ab}\pm0.1$	$71.5^{bc}\pm0.5$	$28.7^{b}\pm1.2$	1.41±0.13	$49.74^{bc}\pm1.03$
Pellet	$65.4^{bc}\pm0.2$	$71.7^{bc}\pm0.3$	$29.5^{b}\pm0.3$	1.33±0.03	$50.58^{bc}\pm0.85$
Average	$\mathbf{65.5^{a}\pm0.1}$	$\mathbf{71.6^{b}\pm0.2}$	**29.1±0.6**	$\mathbf{1.37^{a}\pm0.06}$	$\mathbf{50.16^{ab}\pm0.60}$
T4(Vit.C+Enz.)					
Mash	$65.3^{bc}\pm0.2$	$73.0^{ab}\pm0.9$	$32.8^{ab}\pm2.0$	1.27±0.04	$50.87^{b}\pm1.08$
Pellet	$66.5^{a}\pm0.1$	$73.4^{ab}\pm1.2$	$31.4^{ab}\pm3.2$	1.47±0.03	$57.06^{a}\pm1.25$
Average	$\mathbf{65.9^{a}\pm0.4}$	$\mathbf{73.2^{a}\pm0.6}$	**32.1±1.6**	$\mathbf{1.37^{a}\pm0.06}$	$\mathbf{53.97^{a}\pm1.91}$
Feed form					
Mash	$\mathbf{63.9^{b}\pm0.8}$	$\mathbf{69.3^{b}\pm1.5}$	$\mathbf{26.8^{b}\pm1.7}$	**1.27±0.05**	**47.44±1.35**
Pellet	$\mathbf{64.6^{a}\pm1.0}$	$\mathbf{72.6^{a}\pm0.8}$	$\mathbf{33.2^{a}\pm1.3}$	**1.29±0.07**	**48.18±2.70**

a, b ....= Means in the same column within each factor differently superscripted are significantly different (P≤0.05)

Table (5) : Input output analysis and economical efficiency of different treatments during the experimental period .

Items	Control			Vit.C			Enz. Mix.			Vit.C+Enz			Feed form	
	M	P	Av.	M	P	Av.	M	P	Av.	M	P	Av.	M	P
Price/ kg feed (L.E.)	0.80	0.85	0.83	0.81	0.86	0.84	0.81	0.86	0.84	0.82	0.87	0.85	0.81	0.86
Total feed intake/hen (kg)	4.57	4.26	4.41	4.20	4.38	4.29	4.26	4.28	4.26	4.08	4.21	4.14	4.28	4.28
Total feed cost/hen (L.E)	3.66	3.62	3.66	3.40	3.77	3.6	3.45	3.68	3.58	3.35	3.66	3.52	3.47	3.68
Total number of eggs/hen	29.34	36.3	32.8	33.13	28.8	30.98	34.73	33.04	33.65	31.99	30.65	31.48	32.30	32.21
Total price of eggs /hen (L.E.)[1]	6.16	7.63	6.90	6.96	6.06	6.51	7.29	6.94	7.07	6.72	6.44	6.61	6.78	6.76
Net revenue / hen (L.E.)	2.50	4.01	3.24	3.56	2.29	2.91	3.84	3.26	3.49	3.37	2.78	3.09	3.31	3.08
Economical efficiency (E.E.)[2]	0.68	1.11	0.89	1.05	0.61	0.81	1.11	0.89	0.97	1.01	0.76	0.88	0.95	0.84
Relative EE[3]	100	163	131	154	90	119	163	131	143	149	112	129	140	124

1- The price of the egg = 21 P.T.

2- Net revenue per unit of total feed cost.

3- Relative economic efficiency % of the control, assuming that the relative EE of the control in the mash form = 100.

M= Mash P= Pellet Av.= Average.

0.61-1.11 and 90-163% for the diet supplemented with vitamin C in pellet form and both of the control diet in pellet form and the diet supplemented with enzymes mixture in mash form, respectively. Regardless of the treatments, the mash form gave the best relative economical efficiency when compared to the pellet form (140 vs. 124%). Among the mash forms, addition of vitamin C, enzyme mixture or a mixture of both improved the economical efficiency and the relative economical efficiency values when compared to the control diet. In spite of the highest relative economical efficiency values determined for enzymes mixture (163%), vitamin C (154%) and the combination of vitamin C and enzymes mixture (149%), respectively, the last treatment gave the best egg shell quality. Therefore, using the combination of vitamin C and enzymes mixture could be beneficial for laying hens under hot summer conditions of Egypt to get the best laying performance and to reduce the incidence of egg shell breakage.

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تأثير حمض الاسكوربيك و الإنزيمات و شكل العليقة و التداخل بينهم على الأداء الإنتاجي للدجاج البياض خلال فصل الصيف

عادل زكى محمد سليمان

قسم الإنتاج الحيواني – كلية الزراعة – جامعة القاهرة

أجري هذا البحث بهدف دراسة تأثير حمض الاسكوربيك و الإنزيمات و شكل العليقة علي الأداء الإنتاجي للدجاج البياض لتخفيف آثار الإجهاد الحراري خلال فصل الصيف.
استخدم في هذه الدراسة عدد ١١٢ دجاجة بياضة عمر ٥٣ أسبوع تم توزيعها عشوائيا إلي ٨ مجاميع بكل منها ١٤ دجاجة في بطاريات. و غذيت الطيور علي العلائق التالية في الصورة الناعمة أو المحببة:
١- العليقة الأساسية.
٢- العليقة الأساسية مضافا إليها حمض الاسكوربيك بمستوي ١٠٠ مجم /كجم.
٣- العليقة الأساسية مضافا إليها مخلوط الإنزيمات بمستوي ٠,٠٥%.
٤- العليقة الأساسية مضافا إليها كل من حمض الاسكوربيك بمستوي ١٠٠ مجم /كجم و مخلوط الإنزيمات بمستوي ٠,٠٥%.
أوضحت نتائج هذه الدراسة أن تقديم العلائق في صورة محببات إلي الدجاج البياض أدي إلي زيادة إنتاج البيض و معامل التحويل الغذائي لمجموعة الكنترول عند مقارنتها بالصورة الناعمة. كما أن الصورة المحببة (بغض النظر عن المعاملات) أدت إلي تحسين كل من سمك و وزن قشرة البيض مقارنة بالصورة الناعمة. إلا أنه من الناحية الاقتصادية (بغض النظر عن المعاملات) أعطت الصورة الناعمة عائد اقتصادي أعلي من الصورة المحببة. و بمقارنة الصور الناعمة نجد أن إضافة كل من حمض الاسكوربيك و الإنزيمات إلي علائق الدجاج البياض خلال فصل الصيف أدت إلي تحسين كل من إنتاج البيض و معامل التحويل الغذائي و ميزان الكالسيوم و جودة القشرة و كذلك معاملات هضم كل من المادة الجافة و المادة العضوية بالمقارنة بعليقة الكنترول. و بالرغم من أن أفضل النتائج كانت في حالة العلائق المحتوية علي سواء الإنزيمات أو حمض الاسكوربيك إلا أن العلائق المحتوية علي المخلوط (الإنزيمات + حمض الاسكوربيك) أعطت أفضل النتائج من حيث جودة القشرة كما أعطت عائد اقتصادي نسبي أفضل من عليقة الكنترول و بنا عليه فان إضافة مخلوط الإنزيمات مع حمض الاسكوربيك إلي علائق الدجاج البياض في فصل الصيف قد تؤدي إلي الحصول علي أفضل أداء إنتاجي و تقليل الخسائر الناتجة عن كسر قشرة البيضة.