Egyptian J. Desert Res., 54, No.1, 63-81 (2004)

EFFECT OF ADDING ASCORBIC ACID EITHER TO THE DIET OR DRINKING WATER OF LAYING HENS DURING SUMMER MONTHS

Khidr, R. E.
Animal and Poultry Nutrition Dept., Desert Research Center, El-Matareya, Cairo, Egypt
Raafatkhidr@hotmail.com

This experiment was conducted at Ras Sudr research station, South Sinai to throw some lights on the effects of ascorbic acid (AA) supplementation either in diet or drinking water with regard to body weight change, egg production, feed utilization, digestibility coefficients, egg quality, and selected of blood parameters in laying hens under desert conditions during summer months.

Sixty laying hens at 24 weeks of age (Hy-Line Brown commercial egg-type) were randomly distributed into 5 experimental groups of 12 hens each, with 3 replicates of 4 hens each. Diet or drinking water were treated with AA at levels of 200 and 400 ppm, in addition to one group serving as a control without supplementation. AA had no significant effects on final body weight and weight gain although, hens in AA supplemented groups showed insignificantly higher final body weight and weight gain compared to the control group.

AA at a level of 200 ppm in drinking water showed the highest rate of egg production (86.96%) which followed by the control group (86.80%). Hen received 200 ppm followed by those of 400 ppm in drinking water laid heavier eggs compared to the other experimental groups. Total egg mass (kg eggs/hen) was significantly ($P<0.05$) better in hen group supplemented with AA at a level of 200 ppm in drinking water, followed by the control group. Values in this respect were 4.320 and 4.277kg egg, for the two groups, respectively. AA supplementation either to diet or drinking water had no significant effects on feed consumption and feed conversion values.

The AA supplementation either to diet or drinking water had no significant effects on digestibility coefficients of nutrients, although digestibility coefficients of OM, CP, EE and NFE showed higher values for hens receiving AA at a level of

200 ppm/liter in drinking water. AA levels had no significant effects on egg quality measurements, except those of egg shell quality where egg shell weight, egg shell%, shell thickness, shell weight per unit surface area and egg shell volume were significantly ($P<0.05$) higher in hens receiving AA at a level of 200 ppm in drinking water.

AA levels either in diet or drinking water caused (particularly at a level of 400 ppm) a significant decrease in each of cholesterol and total lipids of blood serum, while values of Ca and glucose in blood serum were significantly increased by the increase of AA either in diet or drinking water. AA caused a significant increase ($P<0.05$) in Ca of egg shell compared to the control group, while P values were not significantly influenced by AA supplementation. Diets supplemented with AA gave lower economical efficiency than the other treatments, while hens receiving 200 ppm AA in drinking water showed the best value.

Finally, it could be recommended to use AA at a level of 200 ppm in drinking water of laying hens during summer months. This could improve egg production performance, egg shell quality and economical efficiency with some positive physiological reactions.

Keywords: Ascorbic acid, body weight change, egg production, feed utilization, digestibility coefficients, egg quality, blood constituents.

During summer months and particularly under desert conditions, poultry species are exposed to waves of heat stress which, in turn, affects productive performance, feed intake and feed conversion. In order to alleviate the negative effects of heat stress, some nutritional considerations such as feeding time (Teeter *et al.*, 1987), quantity and quality of diet (Daghir, 1995), fat supplementation (Daghir, 1987), limiting essential amino acids (Ait-Tahar and Picard, 1987), minerals and vitamins (Teeter, 1995; Fathi *et al.*, 1999) and feed additives (Abou-Zeid *et al.*, 2000) were studied.

Under normal conditions, the fowl is able to synthesize adequate amounts of ascorbic acid (AA), while under certain stress conditions, the dietary source may be important as the bird is unable to produce amounts sufficient for its metabolic needs (Seemann, 1991). Therefore, AA as anti-stress agent has been supplemented when birds were subjected to stressful conditions, including high temperature, poor nutrition or certain pathogens (Al-Homidan, 2000).

It was reported that blood AA decreases in laying hens with increasing the environmental temperature from 21^{0}C to 31^{0}C (Thornton, 1962). Attia (1976) reported a decline of 23% in blood AA of hens maintained at 15^{0}C and then transferred to a 32^{0}C environment. This action was postulated to be a result of both partial exhaustion of the endogenous AA stores and a reduction of the synthesized amount of AA. It has been shown that with each 1^0 C above 21^0 C there is a reduction of 0.4 g in egg weight, probably due to the reduced live weight of the hen resulting from the reduced intake of energy.

Temperature has also a negative effect on weight of egg shell, thereby adversely affecting thickness and rigidity of the shell (Esmail, 2001). Therefore, under hot environmental conditions AA supplementation increased egg weight and egg production (Zapata and Gernat, 1995), improved egg shell quality and egg specific gravity (Krautmann, 1988 and Bains, 1996) and also improved feed utilization as well as the cost of feed per kg egg (Njoku and Nwazota, 1989).

The AA is involving in calcium metabolism, possibly enhancing intestinal calcium concentration (Orban *et al.*, 1993). Moreover, it has an stimulating influence on the thyroid gland which, in turn, improves feed efficiency (Bains, 1996). A positive relation was reported between AA supplementation and increased oxygen consumption (Ahmed *et al.*, 1967). AA may decrease respiratory quotients emphasizes, increases fatty acid oxidation over an increase in protein-derived gluconeogenesis in heat-stressed birds (McKee *et al.*, 1997).

There are conflicting and inconsistent findings on the effects of AA in laying hens. Most studies were conducted by using AA in diets, while little work is available on using it in drinking water. Hence, the aim of this experiment is to study the effects of AA either in diet or in drinking water under the same conditions of a desert environment throughout summer months. The effects of AA on body weight changes, egg production, feed utilization, digestibility coefficients, egg quality, and selected blood parameters were taken into consideration.

MATERIALS AND METHODS

This experiment was conducted at Ras Sudr research station, South Sinai, Desert Research Center, in an attempt to throw some lights on the effects of two levels of ascorbic acid (AA) either in diet (D) or in drinking water (W). Sixty laying hens at 24 weeks of age (Hy-Line Brown commercial egg-type) were individually weighed and assigned randomly to 5 experimental groups of 12 hens each. Hens of each group were subdivided into 3 replicates of 4 hens each and housed in floor pens. Diet or drinking water were treated with AA at levels of 200 and 400 ppm, in

addition to one group serving as a control without supplementation. Water was exposed to routine change every 24 hours to maintain the stability of AA and to avoid losses by oxidation as much as possible. The experiment started at the beginning of June and was continued over 3 months till the end of August (90 days).

Hens were fed on a conventional diet with 17% CP and 2775 Kcal ME, to meet the minimum N.R.C. recommendations (N.R.C., 1994). The composition and calculated analysis of the diet is presented in table (1). Average ambient temperature (°C) through the experimental period were 22.8 and 36.1 at 8 am and 14 pm, respectively. The birds were offered diets and water *ad lib*. Hens were individually weighed at both the beginning and the end of the experiment and body weight gain between 24 and 36 weeks of age was calculated for each hen and treatment group.

The weight of individual eggs in grams was recorded daily throughout the experiment. Average egg weight, egg production percentage and egg mass were calculated for each interval period. Feed consumption in grams per hen was recorded weekly and average feed consumption was calculated for each treatment. Feed conversion rate (as kg feed/kg eggs) was calculated as kg feed consumed per kg egg produced.

TABLE (1). Composition and calculated analysis of the experimental diet*

Ingredients	%
Yellow corn	65.1
Soybean meal, 44%	13.1
Wheat bran	4
Layer concentrate[1]	10
Salt	0.50
Vit. & Min. premix[2]	0.30
Lime stone	7.00
Total	100
Calculated analysis	
ME, Kcal/Kg	2775
CP	17.00
CF	3.09
Ca	3.54
Av. P	0.55
Lysine	0.87
TSAA	0.63

* Calculated according to N.R.C. (1994)

[1] Layer concentrate contains: 51% CP, 2500 Kcal ME/Kg, 8.0% Ca, 4% av. P., 1.5% Meth., 2% Meth. & Cystine and 2.9% Lysine.

[2] Vit. & Min. premix per kg. of the diet contain: Vit. A 12.000 IU, Vit. D3 2000 IU, Vit. E 10 mg, Vit. K 2 mg, Vit. B1 1 mg, Vit. B2 4 mg, Vit. B6 1.5 mg, Vit. B12 10 mcg, Pantothenic 10 mg, Niacin 20 mg, Folic acid 1 mg, Biotin 50 mcg, Choline 500 mg, Iron 30 mg, Manganese 40 mg, Copper 3 mg, Iodine 0.3 mg, Cobalt 0.2 mg, Zinc 45 mg and Selenium 0.1 mg.

Egg quality measurements were determined using 60 eggs (12 eggs from each treatment). In this connection, yolk and albumen were weighed and calculated as a percentage of the egg weight. Egg shape index was determined according to Romanoff and Romanoff (1949) as egg diameter divided by egg length. Yolk index was calculated according to Funk *et al.* (1958) as yolk height divided by yolk diameter. Haugh units were calculated according to Eisen *et al.* (1962) using the calculation chart for rapid conversion of egg weight and albumen height. Egg shell quality as affected by ascorbic acid levels received further measurements. In this manner, egg shell weight was determined to the nearest 0.1 g. Egg surface area (ESA) was calculated according to Paganelli *et al.* (1974) as ESA= 4.835 $W^{0.662}$ cm^2 where W= egg mass in grams. Shell weight/ESA (mg/cm^2) representing shell weight per unit surface area (SWUSA) was calculated. Egg shell thickness was measured using a micrometer to the nearest 0.01 mm. Egg shell volume was determined according to Rahn (1981) as ESA (cm^2) x shell thickness (cm).

Digestibility coefficients of nutrients (OM, CP, EE, CF and NFE%) for the experimental diets were determined using 3 hens from each treatment. Chemical analysis of diets and excreta were carried out according to A.O.A.C[4] (1990). The faecal nitrogen was determined according to Jacobsen *et al.* (1960). Urinary organic matter was calculated according to Abou-Raya and Galal (1971).

At the end of the experiment, 3 hens from each treatment were slaughtered. Three blood samples were obtained from each treatment. Blood samples were centrifuged at 4000 rpm for 15 minutes. Clear serum was separated, then stored in a deep freezer at – 20°C until the time of biological analysis. Total lipids were determined according to the method of Zollner and Kirsch (1962). Cholesterol was determined according to Stein (1986). Glucose, Ca and inorganic P were measured according to guidelines and recommendation by specific diagnostic kits (Bio Merieux, France) according to guidelines and recommendation of Bogin and Keller (1987). Globulin was calculated by the difference between total protein and albumin, since the fibrinogen usually comprises a negligible fraction (Sturkie, 1976).

The Ca and total P in egg shell were also estimated. Economical evaluation was estimated depending on the difference between net revenue and total feed cost.

All data were subjected to statistical analysis according to SAS - institute (1994). Significant differences among means were tested by the method of Duncan (1955).

RESULTS AND DISCUSSION

Body Weight Change and Egg Production Performance

Effects of AA supplementation either in diet or drinking water on final body weight and body weight gain of laying hens are described in table (2). It was noticed that AA had no significant effects on final body weight and weight gain. However, hens in AA groups showed not significantly higher values of final body weight and weight gain compared to the control group. Furthermore, hens receiving AA at a level of 200 ppm in drinking water showed the highest value as 1882.5 and 255 g for the same previous traits compared to the other experimental groups. These results were previously confirmed by Bell and Marion (1990) at a level of 400 ppm AA/kg diet, Kassim and Norziha (1995) up to a level of 600 ppm/kg diet, Keshavarz (1996) at a level of 250 ppm AA/kg diet and Al-Shoquiry (1999) at a level of 200 ppm AA/kg diet. Freeman *et al.* (1983) reported also a beneficial effect of AA on body weight of laying hens.

TABLE (2). Body weight gain and egg production% as affected by AA supplementation (Means ± SE)

Parameters	Ascorbic acid levels (ppm)					Sig.
	0	200 (D)	400 (D)	200 (W)	400 (W)	
Initial body wt (g)	1624.18±34.3	1618.33±37.6	1630.83±39.2	1627.50±26.4	1627.75±40.1	N.S.
Final body wt (g)	1787.73±44.0	1787.27±55.2	1864.5±43.2	1882.5±49.0	1843.79±53.4	N.S.
Body wt gain (g)	163.55±23.19	168.94±28.11	233.67±39.1	255.00±30.7	216.04±29.2	N.S.
Egg production %						
June	88.39^{a}±1.72	80.54^{b}±1.87	81.11^{b}±2.39	87.50^{a}±2.0	84.61^{ab}±2.05	**
July	87.79±1.92	84.72±3.04	83.93±1.88	88.22±2.3	85.13±1.65	N.S.
August	84.23±1.83	83.09±2.15	82.99±2.11	85.17±2.3	84.72±1.89	N.S.
Overall mean	86.80±2.00	82.78±2.09	82.68±2.33	86.96±1.9	84.82±1.73	N.S.
Egg wt. (g)						
June	56.21±1.31	55.76±1.33	55.92±1.42	56.71±1.44	56.56±1.36	N.S.
July	58.56^{b}±1.43	57.87^{b}±1.30	57.91^{b}±1.20	60.49^{a}±1.11	58.70^{b}±1.21	*
August	58.84^{bc}±1.24	58.51^{c}±1.26	58.67^{bc}±1.34	60.26^{a}±1.44	59.75^{ab}±1.45	*
Overall mean	57.87^{b}±1.73	57.38^{b}±1.73	57.50^{b}±2.10	59.15^{a}±1.80	58.33^{ab}±1.69	*
Egg mass (Kg)						
June	1.391±0.09	1.257±0.06	1.269±0.08	1.389±0.09	1.339±0.07	N.S.
July	1.439±0.10	1.373±0.07	1.361±0.09	1.494±0.08	1.399±0.08	N.S.
August	1.387±0.08	1.362±0.06	1.363±0.07	1.437±0.11	1.417±0.07	N.S.
Total	4.217^{ab}±0.10	3.992^{c}±0.09	3.993^{c}±0.09	4.320^{a}±0.12	4.155^{b}±0.11	*

^{a,b,c} means within a row with different superscripts are significantly different (P< 0.05)
Sig = Significance N.S. = non significant * = (P< 0.05) ** = = (P< 0.01)
D=diet W=water

Egg production traits as affected by AA supplementation either in diet or drinking water are reported in table (2). It was noticed that using AA at 200 or 400 ppm in diet followed by insignificantly lower egg production

rate as 82.78% and 82.68% for 200 (D) and 400 (D) compared to higher value in the control group (86.80%). AA at a level of 200 ppm in drinking water was more beneficial and showed the highest value of egg production rate (86.96%) compared to the other experimental groups.

Egg weight was significantly ($P<0.05$) influenced by the level of AA, particularly when AA supplemented to drinking water. In this respect hens receiving 200 ppm followed by those received 400 ppm in drinking water laid heavier eggs compared to the other experimental groups.

Total egg mass (kg/hen) was 4.320 and was significantly ($P<0.05$) higher for treatment 200 (W) as compared to the other AA treatments. The control group produced significantly more egg mass (4.217 kg) than both treatments D.

It is worth to note that hens in control group showed an egg production rate of 86.80% with a lower egg weight of 57.87 g, in contrast to the 200 (W) group which reached a higher value in egg production (86.96%) and attained the highest value in egg weight (59.15 g). However, total egg mass showed no pronounced variation between the two groups.

The findings of the present study compared to those reported by different authors concerning egg production traits brought some disagreement. However, under normal or moderate environmental conditions, supplementary AA has given inconsistent results. For instance, El-Deek *et al.* (1988) up to 900 ppm AA/kg diet, Bell and Marion (1990) up to 400 ppm AA/kg diet and El-Fiky (1998) at a level of 1 g AA/ liter observed no significant beneficial effects on egg production traits of laying hens under normal conditions. On the other hand, Zapata and Gernat (1995) reported that egg production was increased by about 5% with AA at dietary levels of 250 and 500 ppm. In the same way, Al-Shoquiry (1999) observed a significant increase in egg number and egg mass at a level of 200 ppm AA in Leghorn and Norfa layers.

The improvement in egg production traits during the summer months in the present study agrees with the findings of Mann (1991) who reported that dietary AA up to 200 ppm under higher environmental temperature gave positive effects on egg production. In the same way, Merat *et al.* (1994) noticed that naked neck hens responded to supplementary AA (400 ppm) and recorded a higher laying rate (+13%) and a reduction of laying intervals. Ubosi and Gandu (1995) noted that the daily egg production was increased in hens given AA 200 ppm in the diet. Also, Balnave and Muheereza (1997) reported a significant influence on egg mass output from hens receiving 0.04% of dietary AA at high temperature. However, under the higher environmental temperature, Thim *et al.* (1990), Kassim and Norziha (1995), Keshavarz (1996) and El-Gendi *et al.* (1999) failed to record significant improvements in egg production traits due to AA supplementation in layer diets.

Feed Consumption and Feed Conversion

The AA supplementation either in diet or drinking water had no significant effects on both feed consumption and feed conversion (Table 3). These results agree with the findings of El-Deek *et al.* (1988) and Al-Shoquiry (1999) who observed no significant effects of AA addition on feed utilization under normal conditions. Under high environmental temperature, Thim *et al.* (1990), Zapata and Gernat (1995) and Keshavarz (1996) came also to the same conclusion. On the other hand, El-Gendi *et al.* (1999) recorded a significant increase in feed intake of laying hens at 300 ppm AA/kg diet, while the best value of feed conversion was recorded at a dietary level of 200 ppm AA during the summer months.

TABLE (3). Effect of AA supplementation on feed consumption and feed conversion (Means ± SE)

Parameters	Ascorbic acid levels (ppm)					Sig.
	0	200 (D)	400 (D)	200 (W)	400 (W)	
Feed consumption[1]						
June	108.71±1.93	106.80±1.70	108.00±1.83	107.30±1.60	106.99±2.09	N.S.
July	111.43±2.1	110.00±2.00	110.40±1.73	110.70±2.10	111.00±2.20	N.S.
August	115.10±1.90	116.30±1.98	115.70±2.40	114.9±2.33	116.20±2.40	N.S.
Overall mean	111.74±2.0	111.03±2.03	111.37±1.77	110.97±1.87	111.40±2.00	N.S.
Feed conversion[2]						
June	2.34±0.08	2.30±0.10	2.42±0.08	2.56±0.10	2.53±0.11	N.S.
July	2.32±0.11	2.20±0.10	2.36±0.10	2.42±0.11	2.45±0.12	N.S.
August	2.48±0.12	2.43±0.09	2.45±0.11	2.53±0.13	2.56±0.10	N.S.
Overall mean	2.38±0.07	2.31±0.08	2.41±0.09	2.50±0.10	2.51±0.13	N.S.

[1]) g/hen/day [2]) kg feed/ kg eggs D=diet W=water

Digestibility Coefficients of Nutrients

Digestibility coefficients of nutrients (OM, CP, EE, CF and NFE) for the experimental diets are shown in table (4). AA supplementation either in diet or drinking water had no significant effects on digestibility coefficients of nutrients. However, digestibility coefficients of OM, CP, EE and NFE showed to some extent slightly higher values for hens which received AA at a level of 200 ppm in drinking water. These results are in harmony with the findings of Salem *et al.* (2003) who reported that dietary supplementation with AA in growing rabbits positively affected all digestibility coefficients values of nutrients.

Egg Quality Measurements

Effects of AA supplementation either in diet or drinking water on egg quality measurements are summarized in table (5). It was noticed that AA had no significant effects on egg quality measurements, except for egg shell weight%, where it was significantly ($P<0.05$) higher for hens which

received 200 ppm AA either in feed (14.43%) or drinking water (14.40%). Furthermore, albumen weight% as well as Haugh units were higher although not significantly with 200 AA in drinking water compared to the other experimental groups. These results were in harmony with the findings of Keshavarz (1996) and El- Gendi *et al.* (1999) who noticed an improvement in albumen quality (as measured by Haugh units) under high environmental temperature. El-Fiky (1998) and Al-Shoquiry (1999) came also to the same conclusion under mild environmental conditions.

TABLE (4). Digestibility coefficients for the experimental diets as affected by AA supplementation (Means ± SE)

Parameters	Ascorbic acid levels (ppm)					Sig.
	0	200 (D)	400 (D)	200 (W)	400 (W)	
OM%	76.13 ±0.65	76.91 ±0.57	77.15 ±0.50	77.42 ±0.59	76.77 ±0.60	N.S.
CP%	88.90 ±1.01	88.73 ±0.93	89.01 ±0.85	90.30 ±1.00	89.20 ±1.12	N.S.
EE%	78.9 ±0.85	78.10 ±0.80	78.8 ±0.79	79.05 ±0.91	78.00 ±0.71	N.S.
CF%	22.23 ±0.70	21.80 ±0.75	22.9 ±0.70	22.00 ±0.73	21.93 ±0.68	N.S.
NFE%	76.83 ±0.74	77.00 ±0.65	76.11 ±0.53	77.34 ±0.60	76.93 ±0.70	N.S.

N.S. = not significant D=diet W=water

TABLE (5). Egg quality traits as affected by AA supplementation (Means ± SE)

Traits	Ascorbic acid levels (ppm)					Sig.
	0	200 (D)	400 (D)	200 (W)	400 (W)	
Egg weight, g	56.20±1.73	56.33±1.84	56.00±1.33	57.00±1.57	56.02±1.83	N.S.
Albumen wt.%	62.04±1.20	61.41±1.27	63.25±1.85	63.56±1.71	62.48±1.41	N.S.
Yolk wt.%	24.54±1.12	24.16±1.03	23.61±1.76	22.04±1.00	24.95±1.82	N.S.
Egg shell wt. %	13.42^{ab}±1.96	14.43^{a}±1.2	13.14^{bc}±1.66	14.40^{a}±1.83	12.57^{bc}±1.76	*
Shape index%	75.27±1.20	75.51±1.70	77.60±1.74	75.93±1.88	75.39±1.33	N.S.
Yolk index%	47.23±2.59	50.02±1.93	48.14±1.37	48.51±1.06	49.70±1.32	N.S.
Haugh unit	78.49±2.97	79.99±3.17	77.48±3.09	80.26±4.00	76.38±3.88	N.S.

^{a,b,c} means within a row with different superscripts are significantly different ($P< 0.05$)
Sig = Significance N.S. = not significant * = ($P< 0.05$) D=diet W=water

Further measurements for egg shell quality (Table 6) were carried out. It could be concluded that the effect of AA supplementation at a level of 200 ppm in drinking water had positive effects on the absolute shell weight, shell thickness, shell weight per unit surface area (SWUSA) and egg shell volume.

The improvement in egg shell quality in the present work with 200 ppm AA as indicated by shell weight, shell thickness, SWUSA and egg shell volume was confirmed by Zapata and Gernat (1995), El-Fiky (1998) and Al-Shoquiry (1999), while Kassim and Norziha (1995) revealed that AA up to 600 ppm/kg diet under high environmental temperature improved egg shell quality. Faria *et al.* (1999) added that AA supplementation at levels of 200 and 400 ppm in the diet improved egg shell quality during summer months. Moreover, El-Gendi *et al.* (1999) recorded an improvement in shell weight% and SWUSA when AA was supplemented up to 400 ppm in the diet during summer months. On the other hand, Keshavarz (1996) indicated that AA up to 1000 ppm in laying hen diets under heat stress had no beneficial effects on shell quality.

TABLE (6). Egg shell measurements as affected by AA supplementation (Means ± SE)

Traits	Ascorbic acid levels (ppm)					Sig.
	0	200 (D)	400 (D)	200 (W)	400 (W)	
Egg shell, wt g	7.54^{ab}±0.15	8.13^{a}±0.20	7.36^{b}±0.12	8.21^{a}±0.18	7.04^{b}±0.12	*
Shell thickness (um)	314^{b}±11.91	329^{ab}±12.13	333^{a}b±10.5	339^{a}±12.00	322^{ab}±10.10	**
Egg surface area (cm^2)	69.62±2.00	69.72±2.30	69.45±1.70	70.27±1.79	69.47±2.43	N.S.
SWUSA (mg/cm^3)*	108.30^{b}±3.90	116.61^{a}±2.7	105.98^{bc}±4.09	116.84^{a}±3.1	101.34^{c}±2.88	*
Egg shell volume (cm^3)	21.86^{b}±1.50	22.90^{ab}±1.05	23.13^{a}±1.97	23.82^{a}±1.32	22.37^{ab}±1.75	*

* Shell wt per unit surface area

^{a,b,c} means within a row with different superscripts are significantly different (P< 0.05)

Sig. = Significance N.S. = not significant * = (P< 0.05) ** = (P< 0.01)

D=diet W=water

The positive improvement in shell quality due to AA supplementation probability resulted from the increasing of blood calcium concentration which could be deposited in the shell. In this connection, Volker and Weiser (1993) reported that AA may be involved in the hydroxylation of 25-dihydroxycholicalciferol to its function form (1,25-dihydroxycholicalciferol), as well as hydroxylation of proline and lysine that are amino acids involved in collagen biosynthesis.

Generally, the positive effects of AA on egg quality are due to its physiological functions related to minerals, amino acids and polysaccharides metabolism as well as to adrenal cortex, pituitary, ovary and liver as target organs (Tillman, 1993 and Abdelhamid *et al.* 1995).

Blood Parameters and Mineral Content of Egg Shell

Serum cholesterol and total lipids decreased with the supplementation of AA, particularly in drinking water (Table 7). In this manner, serum cholesterol and total lipids (mg/100 ml) showed the lowest values of 143.7 and 1340 for hens which received AA at a level of 400 ppm

in drinking water, while the control group showed the highest values for these traits. El-Gendi *et al.* (1999) came also to the same conclusion. It is probably that AA may be involved in fat metabolism. However, the reduction in cholesterol level due to AA supplementation may be due to a negative correlation between adrenal vit C concentration and the metabolic rate of the steroid system (Kitabchi and West, 1975). Also, Takahashi and Jensen (1985) stated that the AA supplementation may be effective in alleviating some disorders of steroid metabolism under certain conditions.

TABLE (7). Blood constituents and mineral content in egg shell as affected by AA supplementation (Means ± SE)

Traits	Ascorbic acid levels (ppm)					Sig.
	0	200 (D)	400 (D)	200 (W)	400 (W)	
Serum cholesterol (mg/100 ml)	158.9^{a} ±2.0	153.2^{ab} ±1.9	146.2^{bc} ±2.3	$150.^{bc}$ ±2.0	143.7^{c}±2.1	*
Serum total lipids (mg/100 ml)	1375^{a} ±4.8	1355^{b} ±5.2	1341^{b} ±4.7	1350^{b} ±4.00	1341^{b} ±3.90	*
Glucose, mg/100 ml	152.1^{b} ±2.1	156.7^{ab} ±2.3	164.9^{ab} ±3.1	158.7^{ab} ±2.9	167.8^{a} ±3.0	*
Total protein, g/100 ml	5.25 ±0.45	5.63 ±0.40	5.49 ±0.43	5.20 ±0.31	5.11 ±0.49	N.S.
Albumin, g/100 ml	3.21 ±0.35	3.17 ±0.30	2.95 ±0.37	3.05 ±0.28	3.00 ±0.20	N.S.
Globulin, g/100 ml	2.04 ±0.17	2.46 ±0.20	2.54 ±0.18	2.15 ±0.16	2.11 ±0.13	N.S.
Albumin/globulin ratio	1.57 ±0.14	1.29 ±0.13	1.16 ±0.11	1.42 ±0.10	1.42 ±0.11	N.S.
Ca, mg/100 ml	15.45^{b} ±0.53	16.55^{a}±0.41	16.58^{a}±0.43	16.65^{a}±0.40	16.62^{a}±0.38	*
Inorganic P mg/100 ml	5.60 ±0.24	5.80 ±0.29	5.82±0.25	5.73±0.30	5.70±0.31	N.S.
Ca: P ratio	2.75 ±0.21	2.85 ±0.19	2.85±0.20	2.90±0.18	2.91±0.19	N.S.
Mineral content in egg shell						
Ca, mg/ 1 gm	364^{b} ±7.2	378^{a} ±8.9	375^{a} ±8.0	382^{a} ±7.3	380^{a} ±6.9	*
Total P, mg/1 gm	1.33 ±0.07	1.37 ±0.08	1.40 ±0.07	1.38±0.09	1.35 ±0.06	N.S.

^{a,b,c} Means with different superscripts in the same row are significantly different (P< 0.05).
Sig. = Significance N.S. = not significant * = (P< 0.05) D=diet W=water

A significant increase (P<0.05) in glucose occurred with the increase of AA level either in diet or drinking water. These results agreed with those of Hedaya and Korshom (1993) and Abou-Zeid *et al.* (2000). However, elevated serum glucose in the current work could be attributed to the fact that AA can be synthesized by birds through converting D-glucose to L-gulonolactone and 2-keto L- gulonolactone, which is spontaneously converted to L- AA acid. When exogenous AA is available for birds, the converting rate of D-glucose to AA may be diminished, thus leading to increase glucose in serum (Chaudhuri and Chatterjee, 1969 and Abou-Zeid

et al., 2000). Serum total protein, albumin, globulin and albumin/globulin ratio showed no significant differences in their values due to AA supplementation either in diet or drinking water.

Data presented in table (7) showed that Ca level in blood was significantly ($P<0.05$) increased with AA supplementation either in diet or drinking water. The same trend was found for inorganic P, but without significant differences. These results agreed with the findings of El-Gendi *et al.* (1999) and Al-Shoquiry (1999). Mineral content of egg shell as indicated by Ca and total P (Table 7) followed also the same trend, where Ca level was significantly ($P<0.05$) increased with the increase of AA in diet or drinking water. Total P in egg shell showed slightly higher values with increasing the level of AA in diet or drinking water.

The significant increase of Ca in blood and egg shell may explain the importance of AA in Ca metabolism. Dorr and Balloun (1976) reported that AA promotes mineral mobilization resulting in increased plasma calcium. In this connection, Orban *et al.* (1993) indicated that AA involved in Ca mobilization by enhancing its absorption from the intestine. Moreover, Mebta and Sbingari (1999) found that AA supplementation helps in promoting mineral mobilization from bones, increases the plasma Ca level and reduces bone ash. These AA mediated influences on Ca metabolism could also explain the improvement that occurred in egg shell quality.

Economical Evaluation

Economical evaluation as affected by AA level either in diet or drinking water are summarized in table (8). It could be concluded that diets supplemented with AA either at a level of 200 or 400 ppm gave economical efficiency lower than the other treatments. However, El-Gendi *et al.* (1999) reported lower economical efficiency up to 400 ppm AA/kg diet in laying hens. On the other hand, 200 ppm AA in drinking water showed the highest economical efficiency compared to the other groups. It should be mentioned that hens in the same previous group showed also a higher egg production and higher egg mass throughout the experimental periods.

TABLE (8). Economical evaluation of treatments

Traits	Ascorbic acid levels (ppm)				
	0	200 (D)	400 (D)	200(W)	400(W)
Average feed intake, Kg/hen	10.06	9.99	10.03	9.99	10.02
Total feed cost (A), L.E.	9.63	9.56	9.60	9.56	9.59
Egg mass, Kg/hen	4.217	3.992	3.993	4.320	4.155
Total revenue (B), L.E.	18.98	17.96	17.97	19.44	18.70
Net revenue (B-A), L.E.	9.35	8.40	8.37	9.88	9.11
Economical efficiency (B-A)/A	0.971	0.879	0.872	1.033	0.949
Relative economical efficiency	100	90.53	89.80	106.39	97.73

D=diet W=water

In general, it is obvious that the effects of AA supplementation on the performance and the metabolism of birds are variable and relate to several factors such as husbandry practices, environmental conditions, age of birds, preparation and the type of AA administration, level of dosage and length of supplemental feeding. The vitamin inherent instability and the experimental methodology must be taken into consideration (McKee *et al.*, 1997). Although most work was carried out using AA in the diet, there were wide variations concerning the recommended levels of AA in laying hen diets. However, these variations may be due to appreciable loss of vitamin activity in feed during storage. Temperature, moisture and oxidation by polyunsaturated fatty acids, peroxides and trace minerals are the most critical factors that affect vitamin stability in poultry feeds (Daghir, 1995).

It was found that few experiments were carried out on using of AA in drinking water. However, the present work revealed the importance of adding AA to drinking water with a lower level of 200 ppm AA. Al-Homidan (2000) also reported that the effective dose of AA in drinking water was 250 ppm, while the other levels (500, 750, 1000 and 1500 ppm/liter) showed no significant effects on productive performance. In the same way, El-Fiky (1998) found that the higher level of AA in drinking water (1g/liter) could have negative effects relating to palatability. Furthermore, the lower dose of AA might be more suitable in stimulating metabolic processes in body than the higher ones.

Finally, it could be recommended to use AA at a level of 200 ppm/liter in drinking water for laying hens during summer months. This may be more effective than dietary supplementation, as hens under higher environmental temperature tend to drink more water for evaporative cooling. In this study AA at a level of 200 ppm in the drinking water showed a positive effect on productive performance, egg quality measurements and some blood constituents.

REFERENCES

A. O. A. C., Association of Official Analytical Chemists (1990). *In"Official methods of analysis*". 15th Ed., Washington, USA.

Abdelhamid, A.M.; Mervat A. Ali; El-Samra Abou-Egla; T.M. Dorra; M.M. Khalifa and P. Merat (1995). Effect of feed restriction and Vitamin C supplementation on reproductive performance of mature female and chickens. *J. Agric. Sci., Mansoura Univ., 20:* 181-199.

Abou-Raya, A. K. and Gh. Galal (1971). Evaluation of poultry feeds in digestion trials with references to some factors involved. *U. A. R.. Anim. Prod.*, 11: 207-221.

Abou-Zeid, A.E.; N.S. Isshak; Neamat. A. Badawy and Naglaa Abou-Ouf (2000). The potential effect of Vitamin C supplementation in Quail. *Egypt. J. Poult. Sci.*, 20: 817-838.

Ahmed, M.M.; I.E. Moreng and H.D. Miller (1967). Breed responses in body temperature to elevated environmental temperature and ascorbic acid. *Poult. Sci.*, 46: 6-15.

Ait-Tahar, N. and M. Picard (1987). Influence of ambient temperature on protein requirements of broilers. *Research Note, INRA Laboratoire de Recherches Avicoles, Nouzilly, France.* (Cited by Daghir, N. J., 1995).

Al-Homidan, A. A. (2000). Effect of vitamin C addition in water for broilers raised under two different ambient temperatures on growth performance and water consumption. *Egypt. J . Poult. Sci.*, 20: 327-346.

Al-Shoquiry, N.E.A. (1999). Influence of some dietary factors on the performance of chicks. *M.Sc. thesis,* Fac. Agric., Menoufyia Univ., Shebin El-Kom, Egypt.

Attia, M. El. S. (1976). Effect of different levels of vitamin C on body temperature of White Russian birds during heat stress. *Egypt. Vet. Med. J.*, 24: 111.

Bains, B.S. (1996). The role of vitamin C in stress management. *Misset-World Poultry*, 12: 38-41.

Balnave, D. and S.K. Muheereza (1997). Improving egg shell quality at high temperatures with dietary sodium bicarbonate, *Poult. Sci.*, 76: 588-593.

Bell, D.E. and J.E. Marion (1990). Vitamin C in laying hen diets. *Poult. Sci.*, 69: 1900-1904.

Bogin, E. and P. Keller (1987). Application of clinical biochemistry to medically relevant animal models and standardization and quality control in animal biochemistry. *J. Clin. Chem. Clin. Biochem.*, 25: 873-878.

Chaudhuri, C.R. and I.B. Chatterjee (1969). L. Ascorbic acid synthesis in birds: phylogenetic trend. *Science*, 164: 435-436.

Daghir, N. J. (1995). In "*Poultry production in hot climates*: *Nutrient requirements of poultry at high temperature*". (Daghir, N. J. ed.). CAB International Walingford, U.K.

Daghir, N.J. (1987). Nutrient requirements of laying hens under high temperature conditions. *Zootecnica International*, 5: 36-39.

Dorr, P. and S.L. Balloun (1976). Effect of dietary vitamin A, ascorbic acid and their interaction on turkey bone mineralization. *Brit. Poult. Sci.*, 17: 581-599.

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

Eisen, E. J.; B. B. Bohren and H. E. Mckean (1962). The Haugh unit as a measure of egg albumen quality. *Poult. Sci.*, 41: 1461-1468.

El- Deek, A.A.; M.A. Asar; M.A. Kosba and H.M. Fawzy (1988). The effect of vitamin C supplementation on hen performance. *Egypt. J Poult. Sci.*, 8: 1-17.

El-Fiky, A.A. (1998). Addition of ascorbic acid to relieve the adverse effects of using underground and saline water on egg quality and some physiological parameters. *Egypt. J. Poult. Sci.*, 18: 81-101.

El-Gendi, G.M.; M.M. Iraqi and A.A. Abd Elrahman (1999). Effect of vitamin C supplementation on some productive and physiological parameters in laying hens. *Egypt. J. Nutr. and Feeds (Special issue)*: 649-664.

Esmail, S. (2001). Thermal influences on poultry. *Misset-World Poultry*, 17: 26-27.

Faria, D.E.; P.A. Souza; M.R. Mazalli and D. Salvador (1999). Influence of different levels of Vitamin D and C and age of laying hens on performance and egg quality. I- Summer. *Revista-Brasileira de-Ciencia-Avicola*, 3: 193-201.

Fathi, M.M.; Y.M. El-Hommosany; A.A. Hemid and U. M. Ali (1999). Responses of laying hens to water supplementation with sodium bicarbonate and Vitamin E- Se. during hot weather. *Egypt. J. Poult. Sci.*, 19: 197-219.

Freeman, B.M.; A.C.C. Manning and I.H. Flack (1983). Dietary ascorbic acid or procaine penicillin and the response of the immature fowl to stressors. *Comparative Biochemistry and Physiology*, 74: 51-56.

Funk, E. M.; G. Froning; G. Grottes; R. Forward and J. Kinder (1958). Quality of eggs laid by caged layers. *World Poult. Sci. J.*, 15: 207.

Hedaya, I. and M. Korshom (1993). Effect of ascorbic acid supplementation on some biochemical and hematological parameters in broiler chickens. *Beni Suef Vet. Med. Res.*, 111: 24-32.

Jacobsen, P. E.; S. G. Kirsten and S. H. Nielson (1960). Digestibility trials with poultry. *Bertning fraforogs laboratoriet, Udgivet of Stants. Kobenhavn*, 56: 1.

Kassim, H. and I. Norziha (1995). Effects of ascorbic acid supplementation in layers and broiler diets in the tropics. *Asian-Aust. J. Anim.* Sci., 8: 607-610.

Keshavarz, K. (1996). The effect of different levels of Vitamin C and cholicalciferol with adequate or marginal levels of dietary calcium on performance and egg shell quality of laying hens. *Poult. Sci.*, 75: 1227-1235.

Kitabchi, A.E. and W.H. West (1975). Effects of steroidogenesis on ascorbic acid content and uptake in isolated adrenal cells. *Ann. N.Y. Acad. Sci.*, 258: 422-431.

Krautmann, B.A. (1988). In "*The role of vitamin C in poultry stress management*": Practical application of ascorbic acid in combating stress, (Hoffmann La Roche, and N.J. Nutly, eds.) p 48-67 .

Mann, A. (1991). Stress management in poultry, particularly under hot climate conditions. *Roche South Africa. Rovigypt Poult. Seminar*, 5: 96.

McKee, J.S.; P.C. Harrison and G.L. Riskowski (1997). Effect of supplemental ascorbic acid on energy conversion of broilers during heat stress and feed withdrawal. *Poult. Sci.*, 76: 1278-1286.

Mebta, R.K. and B.K. Sbingari (1999). Feeding under heat stress. *Poult. Inter.*, 38: 68-77.

Merat, P.; A. Bordas and G. Coquerelle (1994). Response of naked-neck or normal plumage hens to additional vitamin C in the feed at high ambient temperature. *Archiv fur Geflugelkunde*, 58: 289- 292.

N.R.C., National Research Council (1994). In "*Nutrient Requirements of Poultry*". 9th Rev. Ed. National Academy Press, Washington, D.C.

Njoku, P.C. and A.O.U. Nwazota (1989). Effect of dietary inclusion of ascorbic acid and palm oil on the performance of laying hens in a hot tropical environment. *Brit. Poult. Sci.*, 30: 831-840.

Orban, J.I.; D. A. Roland, S.R.K. Cummins and T.R. Lovell (1993). Influences of large doses of ascorbic acid on performance, plasma calcium, bone characteristics and egg shell quality in broilers and Leghorn hens. *Poult. Sci.*, 72: 691-700.

Paganelli, C.V.; A. Olszowka and A. Ar (1974). The avian egg: surface area, volume and density. *The Condor*, 76: 319-325. (Cited by El-Fiky, A.A., 1998).

Rahn, H. (1981). Gas exchange of avian eggs with special reference to turkey eggs. *Poult. Sci.*, 60: 1971-1980.

Romanoff, A. L. and A. J. Romanoff (1949). In "*Avian egg*", John Wiley & Sons, Inc., New York.

Salem, F.A.; M.R. El-Mahdy and N.M. El-Medany (2003). Influence of ascorbic acid supplementation on productive performance, digestion coefficients, some blood constituents and carcass traits of growing New Zealand White rabbits. *Egypt. J. Rabbit Sci.*, 13: 37-48.

SAS Institute (1994). In "*SAS User's Guide: Statistics*", Ver. 6.04, Fourth Edition, SAS Institute, Inc., Carry, NC.

Seemann, M. (1991). Is vitamin C essential in poultry nutrition?. *Misset-World Poultry*, 8: 17-19.

Stein, E.A. (1986). In "*Textbook of Clinical Chemistry*", (Tietz, N.W. and W. B. Saunders, eds.) Philadelphia.

Sturkie, P.D. (1976). In "*Avian Physiology*." 3rd ed., Springer Verlag. N.Y., Heidelberg, Berlin.

Takahashi, K.Y. and L.S. Jensen (1985). Reduction in hepatic lipid and plasma estradiol in estrogenized chicks injected with ascorbic acid. *Proc. Soc. Exp. Biol. Med.*, 178: 200-203.

Teeter, R. G. (1995). Optimizing production of heat stressed broilers. *Proceeding of the International conference on animal production in hot climates*. Muscat, Sultanate of Oman, 8-10 January, 129-137.

Teeter, R.G.; M.O. Smith; S. Sangiah and F. B. Mather (1987). Effects of feed intake and fasting duration upon body temperature and survival of thermo- stressed broiler. *Nutrition Reports International*, 35: 531-537.

Thim, K.; C. Cheng; N. Coon and H.L. Melvin (1990). Effect of environmental stress on the ascorbic acid requirement of laying hens. *Poult. Sci.*, 69: 774-780.

Thornton, P.A. (1962). The effect of environmental temperature on body temperature and oxygen uptake by the chickens. *Poult. Sci.*, 41: 1053-1060.

Tillman, P.B. (1993). Vitamin C for laying hens: A review. *Multi-State Poultry Feeding and Nutrition Conference, Indianapolis,* IN. p. 1-31

Ubosi, C.O. and E.D. Gandu (1995). Effect of dietary treatments of ascorbic acid on productive performance and egg quality of caged laying chickens in semi-arid zone of Nigeria. *Discovery and Innovation,* 7: 77-82.

Volker, H.L. and H.Weiser (1993). The relevance of Vitamins D3 and C for bone metabolism in poultry, *Proceedings of Maryland Nutrition Conference, Baltimore, MD.* p. 42-54

Zapata, L.F. and A.G. Gernat (1995). The effect of four levels of ascorbic acid and two levels of calcium on egg shell quality of forced molted W.L. hens. *Poult. Sci.*, 74: 1049-1052.

Zollner, N. and K. Kirsch (1962). Total lipid reagent colorimetric method. (Kit of total lipid). *Z. Fur die Geesampte Exp. Med.*, 135: 545.

Received: 20/01/2004
Accepted: 14/05/2004

تأثير إضافة حامض الأسكوربك اما إلى العليقة أو مياه الشرب للدجاج البياض خلال أشهر الصيف

رأفت السيد خضر
قسم تغذية الحيوان والدواجن – مركز بحوث الصحراء – المطرية – القاهرة – مصر

أجريت هذه التجربة بمحطة بحوث رأس سدر بجنوب سيناء بغرض إلقاء الضوء على تأثير مستويين من حامض الأسكوربك إما في العليقة أو مياه الشرب وعلاقة ذلك بالتغير في وزن الجسم، معدل إنتاج البيض، الاستفادة من الغذاء، معاملات الهضم، مقاييس جودة البيض وبعض صفات الدم في الدجاج البياض تحت الظروف الصحراوية خلال أشهر الصيف.

استخدم في هذه التجربة عدد ٦٠دجاجة عمر ٢٤ أسبوع (أحمر خليط-هاى لاين)حيث قسمت بصورة عشوائية إلى ٥ مجموعات تجريبية، اشتملت كل مجموعة على ١٢ طائر في ٣ مكررات بكل مكررة ٤ دجاجات أضيف حامض الأسكوربك عند مستويان هما ٢٠٠، ٤٠٠ ملجم/كجم من العليقة أو ١لتر من مياه الشرب. امتدت التجربة خلال أشهر الصيف (يونيه-يوليه-أغسطس).

أوضحت الدراسة بأن إضافة حامض الأسكوربك إما إلى العليقة أو مياه الشرب لم يكن له تأثيرا معنويا على الزيادة في وزن الجسم وكذلك وزن الجسم النهائي على الرغم من أن المعاملات التي حصلت على حامض الأسكوربك إما في العليقة أو مياه الشرب أظهرت قيما أعلى لتلك الصفتين السابقتين بالمقارنة بمجموعة الكنترول.

أدت إضافة حامض الأسكوربك إلى مياه الشرب عند مستوى ٢٠٠ ملجم الى ارتفاع نسبة إنتاج البيض(٨٦،٩٦%) مجموعة الكنترول. (٨٦،٨٠%) أظهرت الطيور التي حصلت على ٢٠٠ ملجم من حامض الأسكوربك يليها تلك التي حصلت على ٤٠٠ ملجم في مياه الشرب أعلى قيمة معنوية(عند مستوى ٥%) لوزن البيضة .أظهرت كتلة البيض كجم/دجاجةأعلى قيمة لها في المجموعة التي حصلت على حامض الأسكوربك بمعدل ٢٠٠ ملجم/لتر من مياه الشرب متبوعة بمجموعة المقارنة حيث كانت القيم في هذا الصدد هى ٤،٣٢٠ و٤،٢٧٧ كجم بيض/ دجاجة على التوالي.

لم تكن لإضافة حامض الأسكوربك بمستوييه سواء في العليقة أو في مياه الشرب تأثيرا معنويا على كل من معدل استهلاك العليقة وكذلك معدل الكفاءة التحويلية للغذاء .لم تتأثر معاملات هضم المكونات الغذائية بمستويات إضافة حامض الأسكوربك سواء إلى العليقة أو مياه الشرب على الرغم من أن معاملات هضم كل من المادة العضوية، البروتين، مستخلص الدهن وكذلك المستخلص الخالي من النتروجين قد أظهرت ارتفاعا غير معنويا في تلك المجموعة التي حصلت على حامض الاسكوربك بمعدل ٢٠٠ ملجم/لتر مياه شرب.

كان لإضافة حامض الأسكوربك بمستوييه سواء إلى العليقة أو مياه الشرب تأثيرا معنويا (عند مستوى ٥%)على صفات جودة القشرة مثل نسبة القشرة، وزن القشرة، سمك القشرة، وزن القشرة بالنسبة للمساحة الكلية وكذلك حجم القشرة الكلي وقد سجلت تلك الصفات السابقة أعلى قيما لها في تلك المجموعة التي حصلت على ٢٠٠ ملجم/لتر من حامض الأسكوربك بالمقارنة بالمجاميع التجريبية الأخرى.

لوحظ أن إضافة حامض الأسكوربك إما إلى العليقة أو مياه الشرب أدت الى زيادة معنوية في قيم الكالسيوم في سيرم الدم بالمقارنة بمجموعة الكنترول، كما لوحظ أيضا انخفاضا معنويا (عند مستوى معنوية ٥%) في كل من الكوليسترول والليبدات الكلية بإضافة حامض الأسكوربك إلى العليقة أو مياه الشرب. على النقيض من ذلك ارتفع مستوى الجلوكوز بزيادة

مستوى حامض الأسكوربك إما إلى العليقة أو مياه الشرب .أظهرت المجموعة التي حصلت على حامض الأسكوربك بمعدل ٢٠٠ ملجم في مياه الشرب أعلى قيمة في معدل احتواء قشرة البيضة على الكالسيوم عن تلك المجاميع الأخرى بينما لم تتأثر قيمة الفوسفور معنويا بالمعاملات التجريبية.

حققت المجموعة التي حصلت على حامض الأسكوربك بمعدل ٢٠٠ ملجم/لتر في مياه الشرب أعلى كفاءة اقتصادية بالمقارنة بالمجاميع التجريبية الأخرى.

مما سبق يمكن التوصية بإضافة حامض الأسكوربك إلى مياه الشرب بمعدل ٢٠٠ ملجم/لتر للدجاج البياض خلال اشهر الصيف الحارة الأمر الذي يؤدى إلى تحسين في معدل إنتاج البيض، تحسن في صفات قشرة البيض النوعية، تحسين الكفاءة الاقتصادية وأيضا تحسن في بعض الظواهر الفسيولوجية في الدم.