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EFFECT OF DIETARY GREEN TEA AND DRIED SEAWEED ON PRODUCTIVE AND PHYSIOLOGICAL PERFORMANCE OF LAYING HENS DURING LATE PHASE OF PRODUCTION

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ABSTRACT: The present study aimed to investigate the effect of dietary green tea and dried seaweeds supplementation for local Sinai hens at late phase of production (52-64 wks of age) on egg production, egg quality, physiological and immunological performance. Two hundred and seventy Sinai hens-52 wks-old were randomly assigned to 9 equal experimental treatments (30 hens each were divided into equal three replicates). Experimental groups were fed as follows: the first group fed a basal diet (control group),the second and third groups were fed a basal diet supplemented with green tea by 0.1% and 0.2%, respectively, the fourth and fifth groups were fed a basal diet supplemented with brown seaweed by 0.1% and 0.2%, respectively, the sixth and seventh groups were fed a basal diet supplemented with green seaweed 0.1% and 0.2% , respectively and the eighth and ninth group were fed a basal diet supplemented with red seaweed by 0.1% and 0.2%,.The obtained results indicated that, live body weight (LBW) of Sinai hens at 64 wks of age and change in body weight (CBW) during the experimental period were significantly improved with green tea as compared with the control diet. Laying rate, and egg mass were significantly improved by green tea and dried seaweed supplementation as compared to the control group. Feed consumption (FC) was increased by supplementing green tea and dried seaweed, however, feed conversation ratio was improved compared to the control without significant differences during the experimental period. Serum total cholesterol, LDL, VLDL, triglycerides and total lipids values were significantly decreased, while, HDL cholesterol was significantly increased for different dietary supplementations as compared to the control group. Supplementing green tea and dried green seaweed had a significant effects on serum total protein, albumin and globulin as compared to the control group. Liver and kidney functions were improved by addition of green tea and seaweed to hen's diet. Therefore, dietary supplementation of green or red seaweeds by 0.1% to laying hens diet at the late phase of production could be used to improve egg production, egg quality, physiological and immunological performance of Sinai laying hens.

Key Words::Sinai hens, laying performance, green tea and dried seaweeds.

INTRODUCTION

Increasing demand of animal protein as a result of increasing human population at last decades, there remains a need for increased animal production efficiency, especially poultry meat and eggs production which had received a great attention in Egypt (Awad et al., 2013). It is well known that egg production, decrease as the age of hen increases, so, laying performance and egg quality parameters including laying rate, egg weight and mass and eggshell quality were negatively affected as a result of increasing hens age (Odabasi et al., 2007; Zita et al., 2009) , this needs special care.

Alternative additives such as herbs, spices essential oils extracted form aromatic plants, enzymes, organic acids and probiotics were used as growth promoters in poultry diets in many countries for organic poultry production (Ghasemi et al., 2010).Green tea (Camellia sinensis) is rich in flavonoids and other polyphenols that have been shown to possess a wide range of biological and pharmaceutical benefits, including anti-carcinogenic,anti-oxidative, and hypolipidemic activities (Buschman, 1998) . Green tea leaves contain antioxidativecatechins (Miura et al., 2001; Varilek et al., 2001). Tea catechins have a variety of health benefits, i.e. antioxidative (Lin et al., 1996), antimutagenic (Jain et al., 1989), anticarcinogenic (Sano et al., 1999), antimicrobial and hypolipidemic effects (Yoshino et al., 1996), and anti-inflammatory effects (Varilek et al., 2001). Moreover, green tea plays a major role in controlling high cholesterol, blood sugar and preventing cancer (Yamamoto, 2002).

Supplementing green tea to layers diet may prevent an excessive accumulation of lipids in the liver and other tissues as a result of green tea content from caffeine and catechin which may have an inhibitor effect on intestinal absorption of lipids (Koo and Sang, 2007).

Seaweeds have been used in poultry to improve animal immune status, to decrease microbial load in digestive tract, and for their beneficial effect on quality of poultry eggs (Wang et al., 2013). Seaweeds such as marine algae, brown seaweed (Sargassum spp.), green seaweed (Enteromorphaprolifera) and red seaweeds are considered as a potential source of nutrients (Table 1), that contain greater amounts of protein, amino acids, carbohydrate, lipid, vitamins A, B, C, (especially B12),colorants, antioxidants and antimicrobial substances (Al-Harthi and El-Deek, 2012; Wang et al., 2013; Mavromichalis,2014). Also, Seaweed supplementation increased the abundance of beneficial bacteria such as Bifido bacteriumlongum and Streptococcus salivarius as well as, it reduced the prevalence of Clostridium perfringens in the gut .The objective of this study was to investigate the effect of dietary green tea and dried seaweed supplementation on laying, physiological and immunological performance of local Sinai hens at late phase of production.

MATERIALS AND METHODS

Experimental design and bird's management:

This experimental was carried out at EL-Serw Poultry Research Station, Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt. Two hundred and seventy of local Sinai hens at 52 weeks old were taken, weighed and randomly divided into nine experimental groups (30 hens each) of equal three replicates (10 hens each). All birds were reared in littered floor under the same managerial, hygienic and environmental conditions. Feed and water were available ad libitium during the experimental period and light regimen was of 16 h of light (16 light: 8 dark). The experimental period lasted for 12 weeks from 52 to 64 wks of age. The experimental treatments were as follow : Birds of control group were fed a basal diet without supplementation ; treatments 2 and 3 were fed the basal diet supplemented with Green Tea (Gr. T) by 0.1% and 0.2% ; respectively, treatments 4 and 5 were fed the basal diet supplemented with brown Seaweed (B. Sw) by 0.1 and 0.2% ; respectively, treatments 6 and 7 were fed the basal diet supplemented with Green Seaweed (G. Sw) by 0.1 and 0.2 % respectively; and treatments 8 and 9 were fed the basal diet supplemented with red Seaweed (R. Sw) by 0.1 and 0.2% , respectively. The composition and calculated analysis of the basal diet are shown in Table 2.

Obtained data and measured parameters:

1. **Productive performance traits**: Live body weight and feed consumption (g) were recorded for each replicate per treatment throughout the experimental period, then change in body weight (CBW) was easily calculated during the same periods. Egg number and egg weight were daily recorded, then laying rate, egg mass and feed conversion ratio (FCR) as feed consumed (g) / egg mass (g) were calculated during the same periods.
2. **Egg quality parameters**: At 58 weeks of age, a total number of 81 eggs (9 from each treatment) were randomly taken to determine some egg quality parameters, also to determine yolk lipids content including total cholesterol ,HDL, LDL, total lipids and triglycerides.
3. **Slaughter test:** At the end of experimental (64 weeks), 3 hens from each treatment (one from each replicate) were randomly taken, individually weighed and slaughtered. After slaughter and complete bleeding, liver, heart, gizzard, spleen, abdominal fat and small intestine were separated then weighed and their relative weights were calculated as percentages of live body weight. Samples of illume were taken for histological investigation.
4. **Blood biochemical analysis:** At 64 weeks of age, a total number of 27 blood samples (3 per treatment) were collected from slaughtered hens during exsanguinations. About 10 ml blood were collected from each hen and equally divided into heparinized and non-heparinized test tubes. A small amount of fresh blood samples (1 ml) was taken to determine cellular immunity (white blood cells). The rest of the blood samples were centrifuged at 3500 rpm for 15 minutes, blood serum was separated and stored at -20 C^{o} until chemical analysis. Total protein, albumin, globulin, glucose, total cholesterol, total lipids, triglycerides, HDL, LDL, VLDL, urea creatinine, the activities of aspartate amino transferase (AST) and alanine amino transferase (ALT) as well as antioxidant status {total antioxidant capacity(TAC),), glutathione peroxidase (GPx),superoxide dismutase

activity(SOD) and malondialdehyde (MDA)} were determined using diagnostic kits.

5. **Statistical analysis:** Obtained data were statistically analyzed using general linear model procedure of the SPSS (2008), differences between treatments were subjected to Duncan´ s Multiple Range – test (Duncan, 1955).

The following model was used to study the effect of treatments on the parameters investigated as follows:Yij = μ + Ti + eijwhere:

Yij = an observation, μ = overall mean, Ti = effect of treatment (i=1, 2, 3…..9) and eij = experimental random error.

RESULTS AND DISCUSSION

Productive performance:

Final live body weight (FBW) of Sinai hens at 64-wks-old and their change in body weight (CBW) during the whole experimental period (52-64 wks of age) were significantly differ (P≤0.05) among treatment groups (Table 3). Hens received diet supplemented with red seaweed (R.Sw) by 0.2% recorded the lowest FBW than other treatment. However, hens fed diet supplemented with green tea (GT) by 0.2 % had the best FBW and positive CBW as compared with the control and other groups. This improvement may be attributed to that green tea had a high content of pharmacologically active ingredients (Hara, 1993).

Results of Table 4 show laying rate (%) and egg mass per hen of Sinai hens among different treatments during the experimental period. Laying rate (%) and egg mass per hen were significantly affected as a result of supplementing green tea and different seaweeds to the diets during the experimental period. Laying rate was improved by 4.36% and 4.29% for hens fed diet supplemented with red seaweeds by 0.1% and green seaweeds by 0.1%, respectively compared to control group, while it was decreased by 10.91 and 7.85 % for hens fed diet supplemented with green tea by 0.2% and red seaweeds by 0.2**%,** respectively during the experimental period (52-64 wks of age). In the same trend. Supplementing green tea by 0.2% recorded the lowest laying rate per hen as compared with other treatments with or without significant effect. These results may be due to the beneficial components which found in seaweeds such as vitamins (A, B, B_{12}, C), antioxidants, and antimicrobial substances (Al-Harthi and El-Deek, 2012). These results are in agreement with the observations of Kulshreshtha et al. (2014) who reported that supplementing layer diets with red seaweed improved performance, egg quality, and overall gut health of laying hens. Ariana et al. (2011) observed that green tea supplementation to layer diets with 0.50% extract or 1.50% powder had no significant effects on egg production and egg weight than the control. In contrary, Abdel-Azeem (2005) reported that adding green tea to layers diet either as power (1.0-3.0%) or as a water extract (0.50-1.50 L/100 kg) significantly improved egg production values as well as the reproductive performance of both hens and cocks. Al-Harthi (2014) reported that addition of 0.2% green tea to laying hen diets yielded significantly better egg production than the control group.. Egg mass per hen was significantly affected due to supplementing green tea and different seaweeds during experimental period (Table 4). It was greater by 4.41% of hens fed diet supplemented with green seaweeds by 0.1%, while, it was insignificantly greater by 2.1 , 1.24 and

0.9% by feeding diets supplemented with green tea by 0.1%, red seaweed by 0.2% and green seaweed by 0.2%, respectively than those fed the control diet. These results may be due to that these dietary supplementation can be considered as a source of fat and water soluble vitamins, chlorophyll, lutein and zeaxanthin pigments, and an alternative source for n-3 fatty acids (Schiavone et al., 2007 and Becker, 2004**).** These results are in same line with Abdel-Azeem (2005) who reported that adding green tea to layers diet either as power (1.0-3.0%) or as a water extract (0.50-1.50 L/100 kg) significantly improved egg mass of hens. In this respect, Kojima and Yoshida (2008) reported that supplementing layer diets with green tea powder (1%) in the late stage of laying period resulted in the highest egg weight and egg mass. Moreover, Al- Harthi (2014) reported that addition of 0.2% green tea to laying hen diets yielded significantly better egg weight and egg mass than the control group

Results of Table 5 show that feed consumption (FC) per hen was not significantly affected as a result of supplementing green tea and different seaweeds during the experimental period. Feed consumption per hen was insignificantly affected during the experimental period (52-64 wks of age). These results are in agreement with the observations of Kojima and Yoshida (2008) who reported that feed intake not significantly changed by feeding diet supplemented with green tea powder by 1%. In contrast, Unganbayar et al. (2005) stated that feed intake was significantly greater of layers fed diets supplemented with 1.5% green tea than those fed control diet. Ariana et al. (2011) observed that green tea supplementation to layer diets with 0.50% extract or 1.50% powder had no significant effects on feed intake than the control.

Feed conversion ratio was significantly affected due to dietary green tea and different seaweeds supplementation during the experimental period (Table 5). it was insignificantly improved by 0.24,0.53,2.7 and 3.5 % for the groups fed diet supplemented with green seaweed by 0.2% , red seaweed by 0.1% , green tea by 0.1 % and green seaweed by 0.1% , respectively than those fed the control diet during the experimental period (52-64 wks of age). These results may be due to that green tea and seaweeds have been improved animal immune status by decreasing microbial load in digestive tract, which reflect on feed metabolism and improved feed conversion ratio (Wang et al., 2013). These results are in agreement with those obtained by Abdel-Azeem (2005) who reported that adding green tea to layers diet either as powder (1.0-3.0%) or as a water extract (0.50-1.50 L/100 kg) significantly improved feed conversion values as well as the reproductive performance of both hens and cocks.

Physiological performance:

Results of Table 6 show the effects of supplementing green tea and different seaweeds on some blood parameters of Sinai hens. Serum total protein, albumin (A) and globulin (G) and A/G ratio constituents were significantly affected due to experimental treatments. Serum total protein, albumin, globulin and glucose were significantly increased by supplementing brown seaweed by 0.02% to hen's diets as compared with other different treatments or control groups, while they were significantly decreased by supplementing red seaweed by 0.1% except of serum glucose. Serum fat profile

of Sinai hens as affected by experimental treatments are present in Table 7. Supplementation of green tea and different dried seaweed to hen's diets had significant effects on total cholesterol, HDL, LDL, VLDL, total lipids and triglycerides. The lowest values of T. cholesterol, LDL, VLDL and triglycerides were recorded by feeding diet supplemented with brown seaweed by 0.2 %, while the highest value of HDL was recorded by supplementing green seaweed with 0.1% as compared to the other treatment groups. However, supplementing red seaweed by 0.2% to laying hens diet caused a decrease in total lipids (323.8) as compared to the control group (428.2). These results may be due to the caffeine and catechin content of green tea may have an inhibitor effect on intestinal absorption of lipids (Koo and Sang, 2007). These results are in agreement with Yang et al. (2003) who reported that the addition of green tea by-product to diets tended to decrease blood low-density lipoprotein (LDL) cholesterol content compared to the control group.

Serum antioxidant status of Siani hens are shown in Table 8. All studied antioxidant status such as MDA, TAC, CAT, GPX and SOD enzymes revealed significant difference among treatments. Hens fed diet supplemented with both green tea or brown seaweed with 0.2% had a significant higher concentration of TAC and GPX enzymes in serum, respectively, but supplementing red seaweed by 0.2% recorded a significant higher of serum CAT and SOD enzymes. On the other hand, all experimental treatments show significantly lowest concentration of MDA than the control group. These results may be due to that seaweeds have been used in poultry to improve animal immune status, to decrease microbial load in digestive tract, and for their beneficial effect on quality of poultry eggs (Wang et al., 2013)

Results of Table 9 demonstrated that supplementing hen diet with green tea and dried seaweed levels significantly improved the liver function. Since the activity of AST and ALT significantly decreased compared with that in the control group. Serum urea and creatinine concentration significantly differ among experimental groups. The kidney function was improved by supplementing green tea and dried seaweed in the diet of Sinai hens. Addition of green tea and dried Seaweed in the diet resulted in a significant decrease of serum urea compared to control. On the other hand, all experimental treatments show the significantly increase in serum creatinine compared to the control, The heights value of plasma creatinine was recorded by supplementing red seaweed by 0.2% (0.915 mg/dl) compared to the control group (0.775 mg/dl).

Hematological parameters of hens fed diet supplemented with green tea and dried Seaweed are represented in Table 10. Supplementing green tea by 0.1 or 0.2% and red seaweed by 0.1% to hens diet resulted in a significant high level of blood heterophils (H) cells (%) and lower lymphocytes (L) cells (%) which reflect higher H/L ratio than other treatments . However, supplementing green seaweed by 0.1 or 0.2% to hens diet resulted in the best values of heterophil (H) cells (%) which significantly decreased and lymphocytes (L) cells (%) which significantly increased , so H/L ratio was decreased than other treatments. Data in Table 11 shows the effect of supplemental green tea and dried Seaweed on some carcass and immune organs weight

(spleen) and length (intestine) of Sinai hens. Relative spleen weight was significantly increased in hens fed diet supplemented with green tea and dried Seaweed. The highest value of relative spleen weight was recorded by supplementing green seaweed by 0.2% (0.180%) as compared to the control group (0.108%). Moreover, relative heart, liver and gizzard weights were significantly influenced by green tea and dried Seaweed .The highest heart weights were recorded when supplementing red seaweed by 0.1 or 0.2 % and brown seaweed by 0.1%, while, the highest gizzard was recorded by feeding green seaweed by 0.1 % diet. Differences in intestinal weights and length were significantly affected by green tea and other treatments. It could be noticed that there was a significant increase in intestinal length by 10.66, 11.79 and 14.68% above the control value for groups fed diet supplemented with green tea by 0.2% and brown seaweed by 0.1 and 0.2 %, respectively compared to the control. These results may be due to seaweeds have been used in poultry to improve animal immune status, and to decrease microbial load in digestive tract (Wang et al., 2013).

Egg quality parameters:

The results of external and internal egg quality measurements among experimental treatments are presented in Table 12. There were a significant effects among treatments in all studied external parameters except of shape index, and all internal parameters except of yolk color and albumen weight %. These results are in agreement with the observations of Sadao and Yuko (2008) who reported that there were no significant differences in the yolk color by feeding diet supplemented with green tea powder by 1.0, 5.0 and 10.0% of laying hen compared to the control. On the other hand, the highest values for shell thickness and shell weight % were recorded in control group compared to other treatments, these results are in agreement with Uuganbayar et al., (2005) who found that eggshell thickness was significantly ($P<0.05$) reduced for layer eggs which fed diets containing green tea powder regardless of dietary levels (0.5%, 1.0%, 1.5% and 2.0%). In contrary, Zeinab et al., (2010) found that supplementing green tea powder by 0.5 or 1.0% as extract to hens diet improved egg shell thickness as compared to the control group.

Data presented in Table 13 showed that, feeding diet supplemented with green tea and dried seaweed significantly decreased egg yolk content of total lipids, LDL, total cholesterol and triglycerides, while HDL cholesterol was significantly increased as compared to control. These results are in agreement with the observations of Uuganbayer et al. (2005); Koo and Sang (2007) who reported that feeding green tea powder to laying hens in a long-term study had favorable effects on lowered cholesterol and triglycerides content of eggs .Comparison with the control diet, Triglycerides, Cholesterol, T. Lipids, LDL and HDL were significantly affected by the dietary supplements applied. It is remarkable that the best values of Triglycerides, Cholesterol, LDL and T. lipids in egg yolk were occurred by supplementing red seaweed by 0.2% (124,197.9,68.7 and 813.9 mg/dl , respectively), being significantly lower than the others treatments. Indeed, the most remarkable results is that all treatments results in an increase in the HDL in egg yolk, as the highest value was recorded for the diet supplemented with red seaweed by 0.2% (68.3 mg/dl) as compared to the control. This refer to the

importance of dried seaweed and green tea as natural antioxidant in the hen diets were eggs are one the most widely consumed animal food products. Therefore, it was suggested that the decrease in the egg yolk cholesterol is dependent on the decrease in cholesterol synthesized in the liver. Hence, the decrease in total lipids and cholesterol may be attributed to the diminishing effect of herbal extracts on hepatic 3- hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) reductase that is needed for cholesterol synthesis in liver. The pure components of essential oils could inhibit the activity of HMG-CoA reductase (Crowell, 1999**)** and increase the activity of LDL receptor. Therefore, it could strengthen direct absorption of very low density lipoproteins (VLDL) in the liver and reduce the amount of VLDL transformed to LDL to achieve cholesterol reduction **(**Pitman et al., 1998**).** Also, Al- Harthi (2014) reported that addition of 0.2% green tea to laying hen diets yielded significantly decreased egg yolk cholesterol, total lipids and triglycerides compared to the control group .

The histological traits:-

The histological traits illustrated the length and high of villus of intestinal as affected by dried Seaweed and Green tea in the hen diets during 48 -60 weeks of age, (H&E X 200). All treatments appeared slight increase in length and moderately longer than control.

Fig (1) the control group normal intestine.

Fig (2) showed intestine of hens in group fed 1% green tea as the height of villi are nearly normal.

Fig (3) showed intestine of hens in group fed 2 % green tea

Fig (4) Intestine of hens in group fed 1% brown seaweed which showed normal appearance of villi.

Fig (5) Intestine of hen in group fed 2% brown seaweeds showing slight increase in the height of villi.

Fig (6) intestine of hen in group fed 1% green seaweed revealing slight increase in the length of the villi

Fig (7) intestine of hen in group fed 2% green seaweed demonstrating slight increase in the length of the villi

Fig (8) intestine of hen in group fed 1% red seaweed revealing moderate increase in the length of the villi

Fig (9) intestine of hen in group fed 2% red seaweed revealing the length of the villi which appeared moderately longer than the normal.

Green tea consumption did not affect jejunum villus width, height / crypt depth ratio or epithelial cell area. In this connection, Mosleh et al. (2011**)** concluded that 1% green tea in diet appears to lower body weight and improve FRC in broiler chickens and is not apparent detrimental to jejunal mucosa. Kulshreshtha et al.(2014) stated that red marine algee increased the average villus height in laying hens fed 2% S. gaudichaudii (SG) and red seaweeds C. crispus (CC) seaweed. Moreover, 1.8% red seaweed had longer villus height and width due to the increase in growth performance (Karimi, 2015**).**

CONCLUSION

From the obtained results, dietary supplementation of green or red seaweeds by 0.1% to laying hens diet at the late phase of production (52-64 wk.) could be used to improve egg production, egg quality, physiological and immunological performance of Sinai laying hens.

Table (1) : Chemical composition of brown, red and green algae.

	Ascophyllum nodosum	**Laminaria digitata**	**Alaria fsculenta**	**Palmaria palmate**	**Porphyra yezoensis**	**Ulva species**
Type	Brown	Brown	Brown	Red	Red	Green
Water (%)	70 – 85	73-90	73-86	79-88	Nd	78
Ash	15 – 25	21-35	14-23	15-30	7.8	13-22
Total Carbohydrates	-	-	-	-	44.4	42-46
Alginic acid	15 -30	20-45	21-42	0	0	0
Xylans	0	0	0	29-45	0	0
Laminaran	0-10	0-18	0-34	0	0	0
Mannitol	5-10	4-16	4-13	0	0	0
Fucoidan	4-10	2-4	nd	0	0	0
Floridoside	0	0	0	2-20	Nd	0
Other Carbohydrates	c.10	1-2	1-2	Nd	Nd	Nd
Protein	5-10	8-15	9-18	8-25	43.6	15-25
Fat	2-7	1-2	1-2	0.3-0.8	2.1	0.6-0.7
Tannins	2-10	c.1	0.5-6.0	Nd	Nd	Nd
Potasssium	2-3	1.3-3.8	Nd	7-9	2.4	0.7
Sodium	3-4	0.9-2.2	Nd	2.0-2.5	0.6	3.3
Magnesium	0.5-0.9	0.5-0. 8	Nd	0.4-0.5	Nd	Nd
Iodine	0.01-0.1	0.3-1.1	0.05	0.01-0.1	nd	nd
References	Baardseth (1970)	Haug andJensen(1954) Gayral and Cosson(1973)	Haug and Jensen (1954)	Morgan et al.,(1980)	Nisizawa et al.,(1987)	Arasaki and Arasaki (1983)

Table (2) : Composition and calculated analysis of the basal diet.

Ingredients %	Layer
Yellow corn	61.57
Soy bean meal (44%)	17.00
Wheat brain	6.70
Corn gluten meal (60%)	4.50
Di- calcium phosphate	1.39
Limestone	8.16
* Vit& Min. permix	0.30
NaCl	0.37
DL-Methionine	0.01
Total	100.00
Calculated Analysis	
Crude protein (%)	16.5
ME(Kcal/Kg)	2700
Ether extract (%)	3.0
Crude fiber (%)	3.5
Calcium (%)	3.4
Av.phosphorus (%)	0.40
Lysine (%)	0.70
Methionine (%)	0.34
Methio+ Cys (%)	0.62
Sodium	0.16

*Premix added to the 1 kg of diet including Vit.A 10000 I.U; vit. D3 2000 I.U;vit. E 15mg; vit. K3 1 µg; vit B1 1mg; vit. B2 5mg; vit. B12 10 µg; vit B6 1.5mg; Niacin 30mg;Pantothenic acid 10mg; folic acid 1mg; Biotin 50 mg; choline chloride 300 mg; zinc 50mg; copper4mg; iodine 0.3 mg; iron 30mg; selenium 0.1mg; manganese 60mg; cobalt 0.1mg and carrier $CaCO_3$ up to 1 kg

Table (3): Effect of supplementing green tea and different seaweed on live body weight and their change (g) of Sinai laying hens during the experimental period**.**

Treatments		**Live body weight (LBW) g /hen**		
		Initial LBW 52 wks	**Final LBW 64 wks**	**Change in body weight (CBW)**
Control		1653.3	1720.0 ^{ab}	66. 7^{b}
Green Tea	0.1%	1696.7	1746.6 ^{ab}	49.9^{bc}
	0.2%	1676.2	1816.6^{a}	140.4^{a}
Brown Seaweeds	0.1%	1680.1	1723.4 ^{ab}	43.3^{cbd}
	0.2%	1683.2	1723.2 ^{ab}	40.0^{cd}
Green Seaweeds	0.1%	1720.0	1756.7 ^{ab}	36.7^{cd}
	0.2%	1680.0	1720.0 ^{ab}	40.0^{cd}
Red Seaweeds	0.1%	1676.6	1700.0 ^{ab}	23.4^{d}
	0.2%	1659.8	1683.1^{b}	23.3^{d}
Pooled SEM		10.3	12.8	6.9
Sig.		NS	0.05	0.05

a,b,c…. means in the same column bearing different superscripts are significantly different (p ≤ 0.05) ; NS= non-significant ; SEM = standard error mean.

Table (4) : Effect of supplementing green tea and different seaweed on laying rate and egg mass per hen of Sinai hens.

Treatments		**Laying rate, %**	**Egg mass per hen (g)**
		Period (wks) 52-64	
Control		64.67^{ab}	2924.4^{ab}
Green Tea	0.1%	66.74^{a}	2986.1^{a}
	0.2%	57.61^{c}	2635.2^{c}
Brown Seaweeds	0.1%	64.23^{ab}	2803.6^{abc}
	0.2%	62.81^{abc}	2806.2^{abc}
Green Seaweeds	0.1%	67.45^{a}	3053.4^{a}
	0.2%	66.3^{a}	2951.4^{ab}
Red Seaweeds	0.1%	67.49^{a}	2960.7^{ab}
	0.2%	59.59$_{bc}$	2698.1^{bc}
Pooled SEM		0.84	34.97
Sig.		0.05	0.05

a,b,c,..: means in the same column bearing different superscripts are significantly different (p ≤ 0.05); NS= non-significant ; SEM = standard error mean.

Table (5): Effect of supplementing green tea and different seaweed on feed consumption (g) and feed conversion (g feed/g egg) of Sinai laying hens**.**

Treatments		**Feed consumption per hen / g**	**Feed conversion ratio**
		52-64 wks	
Control		8192.9	2.8^{b}
Green Tea	0.1%	8124.1	2.72^{b}
	0.2%	8075.3	3.06^{a}
Brown Seaweeds	0.1%	8226.0	2.93^{ab}
	0.2%	8199.3	2.92^{ab}
Green Seaweeds	0.1%	8260.0	2.70^{b}
	0.2%	8251.3	2.79^{b}
Red Seaweeds	0.1%	8233.4	2.78^{b}
	0.2%	8262.7	3.07^{a}
Pooled SEM		0.28	0.033
Sig.		NS	0.05

a,b,c,..: means in the same column bearing different superscripts are significantly different ($p \leq 0.05$) ; NS= non-significant; ; SEM = standard error mean.

Table (6): Effect of supplementing green tea and different seaweed on some blood serum constituents of Sinai laying hens at 64 weeks of age.

Treatments		**Serum constituents**				
		T. protein (g/dl)	**Albumin (g/dl)**	**Globulin (g/dl)**	**Al/Gl (g/dl)**	**Glucose (mg/dl)**
Control		3.22^{d}	1.834^{e}	1.394^{cde}	1.315^{abc}	117.39^{d}
Green Tea	0.1%	3.57^{c}	2.134^{abc}	1.443^{bcd}	1.482^{ab}	134.82^{bc}
	0.2%	3.81^{ab}	2.183^{ab}	1.633^{ab}	1.353^{abc}	141.38^{ab}
Brown Seaweeds	0.1%	3.62^{c}	2.053^{cd}	1.567^{abc}	1.348^{abc}	137.47^{ab}
	0.2%	3.94^{a}	2.213^{a}	1.731^{a}	1.290^{bc}	143.92^{a}
Green Seaweeds	0.1%	3.28^{d}	1.982^{d}	1.302^{de}	1.573^{ab}	127.66^{c}
	0.2%	3.69^{bc}	2.07^{bcd}	1.620^{ab}	1.281^{bc}	137.38^{ab}
Red Seaweeds	0.1%	2.89^{e}	1.559^{f}	1.339^{de}	1.172^{c}	108.15^{e}
	0.2%	3.03^{e}	1.847^{e}	1.186^{e}	1.592^{a}	96.38^{e}
Pooled SEM		0.05	0.033	0.032	0.029	2.27
Sig.		0.05	0.05	0.05	0.05	0.05

a,b,c,..: means in the same column bearing different superscripts are significantly different ($p \leq 0.05$) ; SEM = standard error mean.

Table (7): Effect of supplementing green tea and different seaweed on serum profile fats of Sinai laying hens at 64 weeks of age.

Treatments		Serum constituents					
		T. Chol. (mg/dl)	**H.D.L. (mg/dl)**	**L.D.L. (mg/dl)**	**T. Libids (mg/dl)**	**Trigly. (mg/dl)**	**VLDL (mg/dl)**
Control		179.24^{a}	70.28^{a}	88.77^{a}	428.24^{a}	100.90^{a}	19.78^{a}
Green Tea	0.1%	141.67^{bc}	66.50^{b}	55.95^{b}	394.30^{bc}	96.06^{a}	19.21^{a}
	0.2%	110.91^{e}	59.53^{cd}	35.46^{de}	367.39^{d}	79.54^{cd}	15.90^{cd}
Brown	0.1%	123.48^{d}	62.55^{c}	44.44^{cd}	385.37^{c}	82.42^{c}	16.48^{c}
Seaweeds	0.2%	108.18^{e}	58.71^{d}	34.19^{e}	361.05^{de}	76.36^{e}	15.27^{d}
Green	0.1%	146.06^{b}	68.03^{ab}	58.26^{b}	399.03^{b}	98.78^{a}	19.75^{a}
Seaweeds	0.2%	138.33^{bc}	62.71^{c}	57.79^{b}	394.58^{bc}	89.09^{b}	17.81^{b}
Red	0.1%	134.39^{c}	60.03^{cd}	56.72^{b}	352.96^{e}	88.18^{b}	17.63^{b}
Seaweeds	0.2%	123.64^{d}	58.77^{d}	49.35^{bc}	323.87^{f}	77.57^{cd}	15.51^{cd}
Pooled SEM		2.943	0.642	2.314	4.11	1.31	0.25
Sig.		0.05	0.05	0.05	0.05	0.05	0.05

a,b,c,..: means in the same column bearing different superscripts are significantly different (p ≤ 0.05) ; SEM = standard error mean.

Table (8) : Effect of supplementing green tea and different seaweed on serum antioxidant status of Sinai laying hens**.**

Treatments		**Serum** antioxidant enzymes				
		MDA (mg/dl)	**TAC (U/ml)**	**CAT (U/L)**	**GPx (U/L)**	**SOD (U/L)**
Control		37.12^{a}	215.22^{g}	8.25^{d}	3.96^{f}	10.70^{e}
Green Tea	0.1%	27.52^{c}	251.60^{de}	9.05^{c}	5.03^{e}	12.24^{d}
	0.2%	25.27^{e}	276.28^{a}	10.22^{b}	6.14^{c}	14.11^{b}
Brown	0.1%	30.36^{b}	236.53^{f}	8.80^{c}	5.17^{de}	13.00^{c}
Seaweeds	0.2%	26.18^{cd}	245.99^{e}	10.13^{b}	6.62^{a}	14.04^{b}
Green	0.1%	27.76^{c}	254.80^{cd}	9.05^{c}	5.37^{d}	12.57^{d}
Seaweeds	0.2%	26.55^{cd}	259.13^{bc}	10.16^{b}	6.45^{ab}	14.14^{b}
Red Seaweeds	0.1%	24.64^{e}	259.93^{bc}	10.19^{b}	6.19^{bc}	13.30^{c}
	0.2%	22.45^{f}	265.22^{b}	11.02^{a}	6.56^{a}	14.79^{a}
Pooled SEM		0.578	2.395	0.123	0.119	0.168
Sig.		0.05	0.05	0.05	0.05	0.05

a,b,c,..: means in the same column bearing different superscripts are significantly different (p ≤ 0.05) ; SEM = standard error mean.

Table (9) : Effect of supplementing green tea and different seaweed on liver and kidney functions of Sinai laying hens.

Treatments		Liver and kidney functions			
		AST (IU/L)	ALT (IU/L)	Urea (mg/dl)	Creatinine (mg/dl)
Control		34.21^{a}	10.73^{a}	40.27^{a}	0.775^{d}
Green Tea	0.1%	32.85^{b}	10.30^{ab}	37.50^{ab}	0.782^{d}
	0.2%	28.93^{d}	9.42^{c}	35.06^{bc}	0.790^{cd}
Brown	0.1%	31.12^{c}	9.97^{bc}	39.23^{a}	0.806^{bcd}
Seaweeds	0.2%	27.48^{e}	8.57^{d}	33.33^{cd}	0.834^{abcd}
Green	0.1%	28.75^{d}	10.06^{b}	36.80^{abc}	0.830^{bcd}
Seaweeds	0.2%	27.39^{e}	8.50^{d}	34.72^{bc}	0.872^{abc}
Red Seaweeds	0.1%	28.07^{de}	9.54^{c}	35.41^{bc}	0.882^{ab}
	0.2%	26.89^{e}	8.23^{d}	30.20^{d}	0.915^{a}
Pooled SEM		0.358	0.131	0.54	0.01
Sig.		0.05	0.05	0.05	0.05

a,b,c,..: means in the same column bearing different superscripts are significantly different (p ≤ 0.05) ; SEM = standard error mean.

Table (10) : Effect of supplementing green tea and different seaweed on blood hematology parameters of Sinai laying hens at 64 weeks of age.

Treatm.		Blood constituents				
		Heterophil (%)	Lymphocyt (%)	Monocyte (%)	Eosinophi (%)	H/L ratio
control		18.00^{cd}	78.00^{b}	4.00^{de}	1	23.0^{d}
Green Tea	0.1%	23.00^{b}	70.67^{d}	5.67^{c}	1	32.5^{b}
	0.2%	26.00^{a}	72.00^{cd}	7.00^{b}	1	36.1^{a}
Brown	0.1%	17.00^{d}	72.33^{cd}	9.00^{a}	1	23.5^{d}
Seaweeds	0.2%	19.67^{c}	75.00^{bc}	5.00^{cd}	1	26.2^{c}
Green	0.1%	10.00^{e}	86.00^{a}	3.33^{e}	1	11.6^{e}
Seaweeds	0.2%	11.00^{e}	88.00^{a}	3.33^{e}	1	12.4^{e}
Red	0.1%	24.00^{ab}	71.33^{cd}	3.00^{e}	1.33	33.6^{ab}
Seaweeds	0.2%	19.67^{c}	72.33^{cd}	7.67^{b}	1.33	27.2^{c}
Pooled SEM		1.037	1.254	0.417	0.051	0.08
Sig.		0.05	0.05	0.05	NS	0.05

a,b,c,..: means in the same column bearing different superscripts are significantly different (p ≤ 0.05) ; SEM = standard error mean.

Table (11) : Effect of supplementing green tea and different seaweed on relative weight of some carcass parts and organs of Sinai hens at 64 weeks of age

Treatment		Parameters						
		Abd. Fat wt. %	**Heart wt.%**	**Liver wt. %**	**Gizzard wt.%**	**Spleen wt.%**	**Intestine wt.%**	**Intestine length.%**
Control		3.38^{a}	0.452^{b}	2.98^{b}	1.37^{e}	0.108^{d}	5.97^{b}	7.97^{c}
Green Tea	0.1%	2.96^{c}	0.455^{b}	2.56^{d}	1.67^{b}	0.147^{c}	5.79^{c}	7.88^{c}
	0.2%	3.56^{b}	0.451^{b}	1.98^{f}	1.23^{f}	0.116^{d}	4.82^{f}	8.82^{b}
Brown Seaweeds	0.1%	3.36^{b}	0.507^{a}	3.21^{a}	1.65^{bc}	0.165^{b}	6.63^{a}	8.91^{ab}
	0.2%	2.45^{d}	0.489^{a}	2.41^{e}	1.61^{bc}	0.115^{d}	6.1^{b}	9.14^{a}
Green Seaweeds	0.1%	4.28^{a}	0.454^{b}	2.04^{f}	1.87^{a}	0.140^{c}	5.34^{e}	6.82^{d}
	0.2%	4.27^{a}	0.397^{c}	2.56^{d}	1.62^{bc}	0.180^{a}	5.45^{de}	8.07^{c}
Red Seaweeds	0.1%	3.05^{c}	0.508^{a}	2.05^{f}	1.58^{cd}	0.144^{c}	5.40^{de}	8.02^{c}
	0.2%	2.56^{d}	0.508^{a}	2.83^{c}	1.52^{d}	0.164^{b}	5.54^{d}	7.83^{c}
Pooled SEM		0.122	0.007	0.082	0.034	0.004	0.097	0.137
Sig.		0.05	0.05	0.05	0.05	0.05	0.05	0.05

a,b,c,..: means in the same column bearing different superscripts are significantly different ($p \leq 0.05$) ;
SEM = standard error mean.

Table (12): Effect of supplementing green tea and different seaweed on egg quality of Sinai laying hens at 58 weeks of age.

Treatments		External egg quality			Internal egg quality				
		Egg Shell (%)	Shell thickens (mm)	Shape index (%)	Haugh unit	Yolk color	Yolk Index	Yolk (%)	Albumen (%)
Control		11.86^{a}	0.333^{a}	0.766	98.67^{a}	6.67	4.533^{a}	32.47^{ab}	55.65
Green	0.1%	11.34^{ab}	0.297^{bc}	0.763	97.33^{ab}	6.33	4.400^{ab}	31.14^{ab}	57.51
Tea	0.2%	10.69^{bc}	0.307^{b}	0.753	97.33^{ab}	6.67	4.267^{ab}	32.69^{ab}	56.61
Brown	0.1%	11.19^{ab}	0.280^{c}	0.766	97.33^{ab}	6.33	3.967^{b}	30.97^{ab}	57.83
Seaweeds	0.2%	11.20^{ab}	0.307^{b}	0.753	93.33^{bc}	6.67	4.300^{ab}	32.54^{ab}	56.24
Green	0.1%	10.58^{bc}	0.300^{bc}	0.780	96.00^{abc}	6.33	4.667^{a}	31.93^{ab}	57.71
Seaweeds	0.2%	9.99^{c}	0.280^{c}	0.773	93.33^{bc}	6.67	4.333^{ab}	31.88^{ab}	58.11
Red	0.1%	11.13^{ab}	0.303^{bc}	0.770	92.33^{c}	6.33	4.400^{ab}	32.90^{a}	56.02
Seaweeds	0.2%	11.62^{ab}	0.307^{b}	0.770	98.67^{a}	6.33	4.467^{ab}	30.54b	57.84
Pooled SEM		0.14	0.003	0.004	0.59	0.11	0.05	0.24	0.26
Sig.		0.05	0.005	NS	0.05	NS	0.05	0.05	NS

a,b,c,..: means in the same column bearing different superscripts are significantly different ($p \leq 0.05$).
NS= non-significant ; SEM = standard error mean.

Table (13) : Effect of supplementing green tea and different seaweed on profile fat of egg yolk of Sinai hens at 58 weeks of age.

Treatment		Items				
		T.Chol. (mg/dl)	**H.D.L. (mg/dl)**	**L.D.L. (mg/dl)**	**T. Lipids (mg/dl)**	**Triglycerides (mg/dl)**
Control		253.1[a]	45.6[f]	124.4[a]	985.1[a]	168.8[a]
Green Tea	0.1%	227.3[b]	51.6[e]	122.1[a]	972.6[b]	155.4[b]
	0.2%	230.9[b]	57.5[d]	85.1[c]	955.2[c]	147.4[c]
Brown Seaweeds	0.1%	220.3[c]	57.3[d]	94.9[b]	933.3[d]	143.9[c]
	0.2%	218.9[c]	60.6[c]	94.2[b]	914.4[e]	136.0[d]
Green Seaweeds	0.1%	212.3[d]	64.2[b]	78.1[d]	876.1[f]	130.7[e]
	0.2%	206.5[e]	66.9[ab]	87.4[c]	854.2[g]	127.7[f]
Red Seaweeds	0.1%	200.6[f]	67.8[a]	75.2[d]	839.3[h]	127.8[f]
	0.2%	197.9[f]	68.3[a]	68.7[e]	813.9[i]	124.0[f]
Pooled SEM		3.19	1.46	3.63	11.41	2.79
Sig.		0.05	0.05	0.05	0.05	0.05

a,b,c,..: means in the same column bearing different superscripts are significantly different ($p \leq .05$) ; SEM = standard error mean.

Figure (1): Effect of experimental treatments on small intestinal histology of Sinai laying hens at 60 weeks of age.

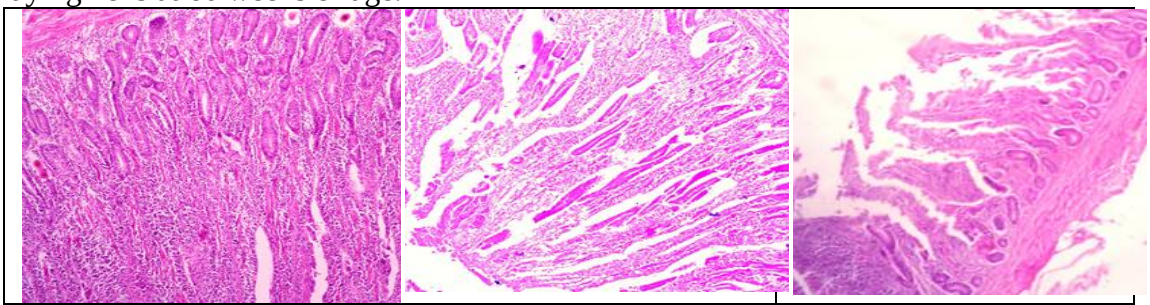

Fig (1) Control | Fig (2) GT 1% | Fig (3) GT 2%

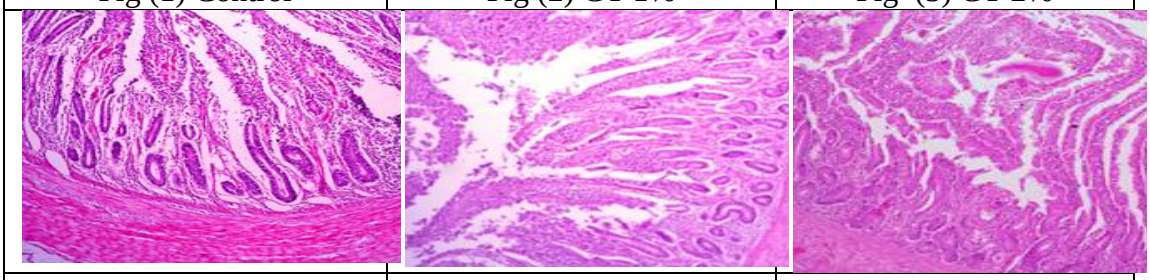

Fig (4) B se1% | Fig (5) B se2% | Fig (6) G se 1%

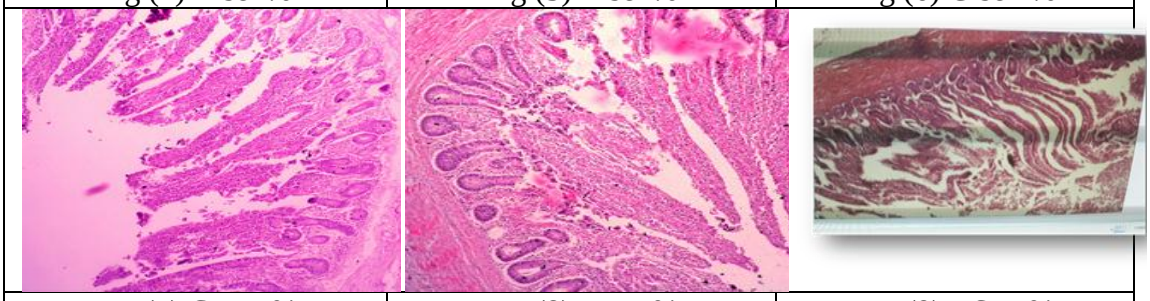

Fig (7) G se 2% | Fig (8) Rse 1% | Fig (9) RSe 2%

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الملخص العربى

تأثير إضافة الشاى الأخضر والطحالب البحرية المجففة لعلائق الدجاج البياض على إنتاج وجودة البيض والأداء الفسيولوجى والمناعى فى نهاية فترة الإنتاج .

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أجريت هذه التجربة لدراسة تأثير إضافة الشاى الاخضر والطحالب البحرية المجففه لعلائق دجاج سينا فى الفترة الأخيرة من مرحلة إنتاج البيض عند عمر 52-64 اسبوع على الأداء الإنتاجى والفسيولوجى والمناعى وبعض صفات جودة البيض. حيث تم توزيع عدد 270 دجاجة سينا عمر 52 اسبوع عشوائيا الى 9 مجاميع متساوية فى كل مجموعة ثلاث مكررات متساوية بكل منها 10 دجاجات . وتم تغذية هذه المجاميع على النحو التالى : المجموعه الأولى تم تغذيتها على العليقة الأساسية (كنترول) ، المجموعتين الثانية والثالثة تم تغذيتها على العليقة الأساسية مضافا اليها 1. و 2. % من الشاى الاخضر على التوالى ، والمجموعتين الرابعة والخامسة تم تغذيتها على العليقة الأساسية مضافا اليها 1. و 2. % طحالب بحرية مجففه بنية على التوالى ، والمجموعتين السادسة والسابعة تم تغذيتها على العليقة الأساسية مضافا اليها 1. و 2. % طحالب بحرية مجففه خضراء على التوالى ، والمجموعتين الثامنة والتاسعة تم تغذيتها على العليقة الأساسية مضافا اليها 1. و 2. % طحالب بحرية مجففه حمراء على التوالى وذلك لمدة 12 أسبوع. تم تسجيل الوزن الحى فى بداية ونهاية التجربة ، وتسجيل عدد البيض الناتج ووزنه لكل مكررة وكذلك كمية العليقة المستهلكة وتم أخذ عينات دم وإجراء تقدير مكوناته وتقدير مكونات سيرم الدم وإنزيمات الكبد والكلية فضلا عن إجراء اختبار ذبح لتقدير الوزن النسبى لبعض الأعضاء وكذلك اختبار جودة بيض وتقدير محتوى الصفار من الدهون المختلفة.

وكانت النتائج كالاتى :

لوحظ تحسن معنوى فى وزن الجسم بإضافة كل من الشاى الاخضربمستوى 2. % مقارنة بمجموعة الكنترول .كما ان معدل الانتاج قد تحسن باضافة الشاى الاخضروالطحالب الخضراء والحمراء بمستوى1. % مقارنة بمجموعة الكنترول خلال فترة التجربة الكلية (52-60 أسبوع).

كما لوحظ تحسن معنوى فى كتلة البيض باضافة الشاى الاخضر1. % والطحالب الخضراء 1. % و2. % والطحالب الحمراء 1. % . كما لوحظ تحسن غير معنوى فى كمية الغذاء المأكول ، معامل التحويل الغذائي خلال فترة التجربة الكلية (52-64 أسبوع) بإضافة الشاى الاخضر والطحالب المجففه مقارنة بالكنترول.

لوحظ انخفاضا معنويا فى مستوى كل من الكوليسترول الكلى والدهون المنخفضة الكثافه والدهون المنخفضة جدا والدهون الثلاثية والدهون الكلية بينما ازداد تركيز الدهون المرتفعة الكثافه فى السيرم لكل المعاملات الغذائية مقارنة بالكنترول.

كان لاضافة الشاى الاخضر والطحالب تاثير ايجابى على نسبة خلايا الدم الليمفاوية. كما لوحظ ارتفاع معنوى فى تركيز كل من البروتينات الكلية والالبيومين والجلوبيولين فى الدم مقارنة بالكنترول. لوحظ أيضا تحسن لوظائف الكبد والكلية كما ارتفعت تركيزات الانزيمات المضادة للأكسدة بإضافة الشاى الاخضر والطحالب البحرية المجففه مقارنة بالكنترول.

من هذه الدراسة يمكن استنتاج أن اضافة مسحوق الطحالب البحرية الخضراء أو الحمراء بمعدل 0,1 % لعلائق الدجاج البياض ادى الى تحسن الأداء الانتاجى والفسيولوجى والمناعى فضلا عن جودة البيض لدجاج السينا المحلى فى خلال الفترة الاخيرة من انتاج البيض.