Effect of Adding Different Levels of Spirulina Algae (*Spirulina Platensis*) To the Diet of Japanese Quail on the Productive Performance

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Abstract

This experiment was conducted at Poultry Research Station of the Animal Resources Research Department-Office Agricultural Research- Ministry of Agriculture in Iraq, during a period of 16 weeks (four periods and each period of four weeks) from 21th April to 10th August 2019. In this experiment 240 Japanese quail's female 9 weeks old, were used in this experiment. Females were randomly assigned to five treatments with three replicates per treatment (16 females/replicate). The experimental treatments were T_1, T_2, T_3, T_4 and T_5 with an addition of Spirulina in an average of (0, 1, 2, 3, 4%) respectively in the diets of quail to study their effect on productive performance. The results of the experiment showed significant increase ($P \leq 0.05$) regarding egg production with the addition of T_5 and all the other treatments had a significant effect on this trait except T_2. In respect of egg weight, egg mass, and feed conversion ratio, T_5 showed a significant effect ($P \leq 0.05$) during the fourth productive period and the total periods compared to the other treatments. There was a significant improvement ($P \leq 0.05$) in feed consumption ratio regarding T_3 birds during the fourth period of production compared to T_1, T_2 and T_4 treatments, and did not differ significantly from T_5.

Key words: Spirulina algae, Egg production, Egg quality, Quail.

Introduction:

Spirulina is an excellent natural resource with a high biological value for containing active substances that have become a new functional food in the 21st century (Matos *et al*., 2017). It has the ability to create biologically active or active substances such as proteins, carbohydrates, fatty acids, vitamins, minerals and enzymes that positively affect physiological processes (Gutiérrez-Salmeán *et al*., 2015). It is one of the primitive eukaryotic algae, which is characterized by its high content of protein (60-70%), beta-carotene, vitamins and minerals (Ye *et al*., 2018). Among the most important vitamins are (A, B_1, B_2, B_3 B_6, B_{12} and Vitamin C). It also contains a high content of unsaturated fatty acids (Sajilata *et al*., 2008), and on several types of pigments (chlorophyll, carotenoids, xanthophyll) (Rangel-Yagui *et al*., 2004; Madhyastha and Vatsala, 2007). It was also distinguished for its effectiveness against microbes, viruses, cancer, allergies, diabetes, and ageing. (Colla *et al*., 2007). This made it as a natural and ideal food supplement that meets the requirements of the Food and Agriculture Organization, in general, it was considered a safe food for humans by the US Food and Drug Administration (FDA) in 2003.

(FDA, 2003 and da Costa Ores *et al*., 2016). Crude protein content in Spirulina powder ranges from 60-70% dry weight and is much higher than protein for conventional protein sources (such as soybean meal containing about 40% protein) (Soni *et al*., 2017), this high amount of protein makes Spirulina where a protein supplement that can be widely used. In terms of quality, Spirulina contains a complete list of essential amino acids (Sharoba *et al*., 2014). Therefore, it may encourage the use of Spirulina where a protein supplement in poultry feeding (Sugiharto *et al*., 2018). It may be the first option to use as an alternative to the common protein sources in poultry diets (Altmann *et al*., 2018). Spirulina, through its vital effectiveness, plays an important role in improving the productive, physiological and immunological performance in domestic birds by improving the performance and intestinal health and stress resistance (Ibrahim *et al*., 2018). It is the concentration and quality of the fatty acids of egg yolk and its quality improvement by reducing the level of saturated fatty acids and increasing the level of unsaturated fatty acids. (Boiago *et al*., 2019). Lower cholesterol levels (Dogan *et al*., 2016) and Spirulina has the potential to be the natural nutritional source of quail-producing eggs and laying hens due to their nutritional and medicinal values (Hajati and Zaghari, 2019). On this basis, Spirulina algae can be considered a new and promising alternative to some common protein sources used in poultry feed, whether they are vegetables such as soybean meal and other vegetable gains (sunflower, rape, sesame, peanuts, etc.) or animal protein sources (fish meal). hatchery wastes, slaughterhouse wastes, etc.). In the field of poultry feeding. (Becker, 2007). It is used as an effective antioxidant due to the presence of many active substances due to its positive impact on bird health, performance, quality and eggs and preserving them in different storage conditions, this effect is important in the poultry industry (Wu *et al*., 2012). And because they contain many of these compounds and active substances, they can be used to produce functional foods (meat and eggs) of high nutritional value in human nutrition. (Moraes *et al*., 2010; Borowitzka, 2013). Added to the diet as a source rich in protein and unsaturated fatty acids. In addition to being considered a source of vitamins and antioxidants, as well as they contain several types of natural pigment (chlorophyll, carotenoids, xanthophyll) that improve the skin color of broiler chickens and egg yolks of laying hens. (Swiatkiewicz *et al*., 2015). Therefore, this study aimed to use different proportions of Spirulina powder in the diet of quail birds to find out their effect on productive performance of quail during the egg production.

Materials and methods:

The experiment was conducted at the Poultry Research Station, Animal Resources Research Department of the Agricultural Research Department, Ministry of Agriculture, Baghdad, Iraq, for the period from 21/4/2019 to 10/8/2019 for a period of 16 weeks (each period is four weeks and for four periods\). In the experiment, 240 Japanese quail female, Japanese quail makes, were used at the age of 9 weeks, the females were randomly assigned to five equal treatments (48 female) and three equal replicates (16 female) these treatments included the addition of the proportions of 0, 1, 2, 3 and 4 % of Spirulina powder to the diets. The production diet was used during the experiment and its components and chemical composition were calculated according to the percentage of addition for each treatment. The production feed was used during the experiment and its components and chemical composition according to the percentage of addition for each treatment. The percentage of spirulina algae powder added to the experimental treatments were mixed with the Protein concentrate manually and then placed in the mixer. The percentage of the primary materials used in forming the diets were as in Table (1). In order to calculate the percentage of egg production to each replicate and for each treatment, since the eggs were collected daily at eleven in the morning, the length of the experiment period and the daily production of eggs were recorded, and the percentage of eggs production was calculated based on the number of females present at the end of each week for each treatment Hen day Production (HD)% for a period of 16 weeks, and then it was calculated for four periods of each period of four weeks. The egg production percentage (H.D) was calculated. The cumulative egg production for each female was calculated weekly and four periods, the length of the period is four weeks, and the cumulative egg was calculated for each bird during the full experiment period (16 weeks) and on the basis of H.D and as indicated by (Naji and Hanna, 1989). The egg weights produced are recorded daily and collectively for each of the experiment replicates and by a balance of Sartorius type sensitive to the nearest decimal places, and the average egg weight for each replicate was extracted from the weekly replicates every week during each trial period. The average cumulative egg weight for each replicate was calculated over the course of the experiment (16 weeks).The mass of eggs was calculated for each replicate and for each period of production according to Rose, (1997) indicated, the amount of feed consumption every week for each replicate of treatments was calculated in four periods of each period of four weeks, as well as calculating the cumulative feed for the length of the experiment period of 16 weeks according to (Al-Fayyad and Naji, 1989). The calculation of the feed conversion ratio was performed on the basis of calculating the amount of feed (g) needed to produce one gram of eggs, as well as for each period of production and for the experiment period, and on the basis of H.D according to the formula provided by Ibrahim, (2000).

Statistical analysis:

Statistical analysis of the data was performed using Completely Randomized Design, to study the effect of different treatments on the studied traits and used the ready with statistical program (SAS, 2012) and tested the significant differences between the averages using the Duncan test (1955) according to the following mathematical model:

$$Yij = \mu + Ti + eij$$

μ: general average for the trait.
Yij = It represents the value of viewing (j) of the studied trait (due to treatment i).
Ti = represents the effect of adding treatments (1%, 2%, 3% 4%) of spirulina algae powder.
eij = a randomly distributed random error with a mean of zero and a variance of δ^2e.

Table (1): components and chemical analysis (%) of the production diet used for a period of (9-25) weeks.

Types of diets	Treatments				
	T_1 (control)	T_2	T_3	T_4	T_5
Yellow corn	52.9	52.9	52.8	52.8	52.8
Wheat	9	9	9	9	9
Soybean meal[1]	26	25	24	23	22
Protein meal[2]	5	5	5	5	5
Spirulina[3]	0	1	2	3	4
Sunflower oil	1.2	1.2	1.2	1.2	1.2
DCP	0.3	0.3	0.4	0.4	0.4
Limestone	5.5	5.5	5.5	5.5	5.5
Salt	0.1	0.1	0.1	0.1	0.1
Total	**100**	**100**	**100**	**100**	**100**
Chemical Calculated Values[4]					

ME (kcal/kg)	2902	2907	2908	2913	2919
C.P %	20	20.2	20.3	20.4	20.4
C.F %	2.6	2.5	2.5	2.5	2.5
E.E %	3.9	4	4	4.1	4.1
Lysine	1.13	1.15	1.17	1.19	1.22
Meth+cys	0.76	0.78	0.80	0.81	0.83
Ca	2.5	2.5	2.52	2.51	2.51
AV.P	0.72	0.72	0.73	0.73	0.73

[1]Soybean cake used an Argentine source of crude protein content by 48% and 2440 Kcal/ Kg M.E.

[2]The protein meal (Laycon-s special W) produced by the Dutch company Wafi, which contains 40% Crude protein, 2125 Kg of energy represented / kg of feed, 5% calcium, 3.80% methionine, 3.29% methionine, cysteine, 3.80% lysine and 2% phosphorous available, 5% calcium.

[3]Spirulina platensis green-blue algae The amount of energy represented (M.E) has 1234 kcal/ kg, Crude protein 62%, 6 % E.E , 2 %C.F .

[4] (NRC, 1994).

Results and discussion:

Table (2) shows the effect of the use of Spirulina algae on the average of egg production on the basis of HD%, where the results of the statistical analysis for the first period indicated a significant increased ($P \leq 0.05$) for the T_5 treatment in which Spirulina algae was used at 4% compared to the control treatment (T_1) With treatment T_3 and T_4, in which it used Spirulina algae at 2, 3%, respectively, it did not differ significantly ($P \leq 0.05$) treatment T_3, T_4 compared to treatment T_2 in which It uses Spirulina algae by 1% and the T_2, T_3 and T_4 treatments excelled on T_1 control treatment birds. As for the second period from production periods, a significant excelled ($P \leq 0.05$) was observed in favor of the T_5 treatment compared to the rest of the experiment treatments (T_1, T_2, T_3 and T_4) and these treatments did not differ significantly between them. As for the total period for egg production, the T_5 treatment was significantly increasing ($P \leq 0.05$) to all experiment treatments except for the T_2 treatment birds which did not differ significantly with it and no significant differences ($P \leq 0.05$) between T_1, T_2, T_3 and T_4 treatments were shown in the trait of the average of Egg production.

Table (2): Effect of using different levels of spirulina algae on egg production ratio H.D% (averages ± standard error)

Treatments[1]	**period per weeks**				
	The first period (9-13)	**The second period (14-17)**	**The third period (18-21)**	**The Fourth period (22-25)**	**Total period (9-25)**
T_1	78.57 ± 1.61^{c}	87.94 ± 0.12^{b}	79.88 ± 2.92	83.56 ± 5.00	82.49 ± 2.15^{b}
T_2	87.80 ± 1.31^{ab}	87.80 ± 1.31^{b}	82.93 ± 2.39	82.49 ± 4.48	85.26 ± 1.42^{ab}
T_3	83.96 ± 0.80^{b}	83.96 ± 0.80^{b}	86.05 ± 2.17	80.55 ± 7.47	83.63 ± 2.25^{b}
T_4	86.68 ± 0.74^{b}	86.68 ± 0.74^{b}	82.12 ± 1.99	82.15 ± 2.98	84.41 ± 1.49^{b}
T_5	92.42 ± 2.33^{a}	92.42 ± 2.33^{a}	85.94 ± 1.40	91.95 ± 1.29	90.68 ± 1.48^{a}
Sg	*	*	Ns	Ns	*

Averages with different letters within a single column differ significantly between them. * Mean significant differences between treatments at probability level (0.05 P ≤) and N.S were significant. [1] Experiment treatmentsT_1: control, T_2: use of 1% spirulina, T_3: use of 2% spirulina, T_4: use of 3% spirulina, T_5: use of 4% spirulina.

Table (3) shows the effect of the use of spirulina algae on cumulative egg production. There were not significant differences from treatment during first period (9-13week). Significant increased ($P \leq 0.05$) in the cumulative egg production trait to the second period (14-17 weeks) of production in favor of the

T_5 treatment on the rest of the experimental treatments (T_1, T_2, T_3, and T_4) and these treatments did not differ significantly between them. As for the other third production periods (18-21 weeks) and the fourth (22-25 weeks), the results did not show any significant differences ($P \leq 0.05$) between all experiment treatment in the cumulative egg production. The results in Table (3) showed the presence of significant differences ($P \leq 0.05$) for the total period of cumulative egg production, The T_5 treatment was significantly excelled ($P \leq 0.05$) to all experiment treatments except for the T_2 treatment birds, which did not differ significantly with it and no significant differences ($P \leq 0.05$) between T_1, T_2, T_3 and T_4 factors were found in the cumulative egg production trait.

Table (3): Effect of using different levels of spirulina algae on the cumulative egg production ratio (mean ± standard error) for quail females.

Treatments	Period per weeks				
	The first period (9-13)	The second period (14-17)	The third period (18-21)	The Fourth period (22-25)	Total period (9-25)
T_1	21.77± 0.45	24.62± 0.03 ^{b}	22.37±0.82	23.40±1.40	23.04 ±0.60^{b}
T_2	21.94±0.37	24.59±0.37 ^{b}	23.22±0.67	23.10±1.25	23.87± 0.40^{ab}
T_3	22.13±0.23	23.51 ±0.23^{b}	24.09±0.16	22.55±2.09	23.07±0.63 ^{b}
T_4	22.00±0.21	24.27± 0.21 ^{b}	22.99±0.56	23.00±0.84	23.06±0.42 ^{b}
T_5	22.90±0.65	25. 88±0.65 ^{a}	24.06±0.26	25.74±0.36	24.65± 0.42 ^{a}
Sg	**N.S**	*****	**N.S**	**N.S**	*****

Averages with different letters within a single column differ significantly between them. * Mean significant differences between treatments at probability level (0.05 P ≤) and N.S were significant. [1] Experiment treatmentsT_1: control, T_2: use of 1% spirulina, T_3: use of 2% spirulina, T_4: use of 3% spirulina, T_5: use of 4% spirulina.

It is clear from the results of the statistical analysis shown in Table (4) that there were no significant differences ($P \leq 0.05$) in the traits of egg weights produced among all experiment treatments during the first period (9-13) weeks of production. The results show a significant difference ($P \leq 0.05$) during the second, third and fourth production periods, as well as the total period of egg production. In the second period (14-17 weeks) for egg production, a significant improvement ($P \leq 0.05$) was observed in the average egg weight of the T_5 treatment that recorded higher Value compared to the rest of the experimental treatments and did not differ significantly with the T_2 treatment birds for the egg weight trait nor did it differ with the rest of the experiment treatments T_1, T_3 and T_4, As for the third period (18-21 weeks), it was noticed a significant excelled ($P \leq 0.05$) for the average egg weight for the T_5 and T_4 treatments compared to the T_1 and T_3 treatments, and they did not significantly differ ($P \leq 0.05$) from the T_2 treatment and no significant differences occurred ($P \leq 0.05$) between T_1, T_2 and T_3 treatments, As for the fourth period (22-25 weeks), the significantly excelled continued ($P \leq 0.05$) for the T_5 treatment in which Spirulina algae was used at 4% compared to the rest of the experiment treatments, which showed no significant differences between them ($P \leq 0.05$), where the case in the total period (9-25 weeks), where it was noted that the treatment T_5 was significantly excelled($P \leq 0.05$) in the egg weight trait of all treatments and that no significant differences were seen between the rest of the experimental treatments.

Table (4): Effect of using different levels of spirulina algae on the egg weight (g) (mean ± standard error) for quail females

Treatments	period per weeks				
	The first period (9-13)	The second period (14-17)	The third period (18-21)	The Fourth period (22-25)	Total period (9-25)
T_1	8.86±0.17	10.29±0.08 b	9.64±0.14 b	9.41±0.48 b	9.55±0.17 b
T_2	8.33±0.17	10.79±0.29 ab	10.15±0.07 ab	9.68±0.13 b	9.73±0.09 b
T_3	8.57±0.56	10.24±0.13 b	9.51±0.36 b	9.59±0.65 b	9.48±0.35 b
T_4	8.99±0.50	10.48±0.33 b	10.37±0.25 a	9.70±0.32 b	9.88±0.21 b
T_5	9.56±0.78	11.47±0.27 a	10.78±0.12 a	11.02±0.21 a	10.71±0.23 a
Sg	N.S	*	*	*	*

Averages with different letters within a single column differ significantly between them. * Mean significant differences between treatments at probability level (0.05 P ≤) and N.S were significant. [1] Experiment treatmentsT_1: control, T_2: use of 1% spirulina, T_3: use of 2% spirulina, T_4: use of 3% spirulina, T_5: use of 4% spirulina.

The results obtained and shown in Table (5) that there were significant differences ($P \leq 0.05$) in egg mass averages between experiment treatments during the first, second, third and fourth productive periods of the experiment period, as well as in the total period, it is clear in the first period (9-13 weeks) and the third period (19-21 weeks) that a significant increase ($P \leq 0.05$) was found for the T_5 treatment in which spirulina algae was used by 4% in the egg mass compared to the control treatment (T_1), but it did not differ significantly from Both T_2, T_3 and T_4 treatments did not differ significantly from T_1 control treatment. As for the second period (14-17 weeks) and the fourth (22-25 weeks) of production, it was noticed that persistent significant excelled ($P \leq 0.05$) for the T_5 treatment was compared to the rest of the experiment traits, which showed no significant differences ($P \leq 0.05$) between them (T_1, T_2, T_3, T_4) in which spirulina algae were used at (0, 1, 2 and 3%) respectively, and when calculating the overall average of eggs mass produced throughout the experiment period (9-25 weeks) we note the significant increasing of the fifth treatment on all the treatments of the experiment, while the rest of the treatments did not differ significantly between them.

Table (5): Effect of using different levels of spirulina algae on the mass egg weight (g/ bird / day) (mean ± standard error) for quail females.

Treatments	period per weeks				
	The first period (9-13)	The second period (14-17)	The third period (18-21)	The Fourth period (22-25)	Total period (9-25)
T_1	6.97±0.27 b	9.05±0.07 b	7.69±0.17 b	7.91±0.87 b	7.91±0.33 b
T_2	7.32±0.25 ab	9.48±0.40 b	8.42±0.23 ab	7.99±0.50 b	8.30±0.17 b
T_3	7.19±0.41 ab	8.60±0.18 b	8.20±0.49 ab	7.81±1.20 b	7.95±0.47 b
T_4	7.79±0.40 ab	9.09±0.37 b	8.53±0.40 ab	7.99±0.54 b	8.35±0.32 b
T_5	8.87±0.94 a	10.61±0.52 a	9.26±0.11 a	10.13±0.06 a	9.72±0.37 a
Sg.	*	*	*	*	*

Averages with different letters within a single column differ significantly between them. * Mean significant differences between treatments at probability level (0.05 P ≤) and N.S were significant. [1] Experiment treatmentsT_1: control, T_2: use of 1% spirulina, T_3: use of 2% spirulina, T_4: use of 3% spirulina, T_5: use of 4% spirulina.

Table (6) shows the effect of the use of spirulina algae on the average of feed consumption by birds, where it was observed that no significant differences occurred at the probability level ($P \leq 0.05$) in the trait the average of feed consumption in the first productive period (9-13 weeks) ,the second (14- 17 weeks) and the third (18-21 weeks), while the results of the statistical analysis of the data of the average of feed consumption showed that significant differences occurred during the fourth period (21-25 weeks) of production. There was a significantly excelled ($P \leq 0.05$) in the average of feed consumption for treatment T_3 in which spirulina was used by 2%, which recorded 35.54 g / bird compared to treatment T_1, T_2 and T_3 and did not differ significantly with treatment T_5, while The total period experiment (9-25 weeks) showed a significantly excelled ($P \leq 0.05$) in the feed consumption average for spirulina use treatments at their different levels compared to the control treatment.

Table (6): Effect of using different levels of spirulina algae on the feed consumption (g/ bird / day) (mean ± standard error) for quail females.

Treatments	period per weeks				
	The first period (9-13)	The second period (14-17)	The third period (18-21)	The Fourth period (22-25)	Total period (9-25)
T_1	24.71±0.72	28.75±1.08	28.03±1.09	29.22±1.22 ^{c}	27.68±0.50 ^{c}
T_2	25.77±0.24	30.51±0.50	28.17±0.71	32.24±0.44 ^{b}	29.17±0.16 ^{ab}
T_3	24.58±0.72	30.68±1.55	28.76±0.84	35.54±1.07 ^{a}	29.89±0.59 ^{a}
T_4	24.63±0.54	30.74±0.24	26.48±0.49	31.27±0.29 ^{bc}	28.28±0.10 ^{b}
T_5	24.63±0.54	30.74±0.24	27.74±1.39	33.11±0.57 ^{ab}	29.06±0.33 ^{ab}
Sg	N.S	N.S	N.S	*	*

Averages with different letters within a single column differ significantly between them. * Mean significant differences between treatments at probability level (0.05 P ≤) and N.S were significant. [1] Experiment treatmentsT_1: control, T_2: use of 1% spirulina, T_3: use of 2% spirulina, T_4: use of 3% spirulina, T_5: use of 4% spirulina.

The results in Table (7) showed that there were significant differences ($P \leq 0.05$) in the food conversion ratio for the first, second and fourth periods of production, in the first production period (9-13 weeks) the T_5 treatment in which spirulina algae was used improved At an average of 4% a significant ($P \leq 0.05$) on the rest of the experiment's treatments in the trait of the feed conversion ratio, the best value was recorded at 2.84 g for feed/ g of egg mass with the exception of the T_4 treatment, which did not significantly differ with it. The results show that no significant differences occurred between the experimental treatments T_1, T_2, T_3 and T_4, in which I used spirulina algae by 0, 1, 2, and 3%, respectively, and no significant differences ($P \leq 0.05$) were shown between all experimental treatments during the third period (18-21 weeks) of experiment , As for the second period (14-17 weeks) and the fourth (22-25 weeks), the T_5 treatment achieved a significant improvement ($P \leq 0.05$) compared to the T_3 treatment and It did not significantly differ from the T_1, T_2 and T_4 treatments. The same applies to the T_3 treatment, which was not significantly ($P \leq 0.05$) from the T_1, T_2 and T_4 treatments. When calculating the total period (9-25 weeks), a significant improvement ($P \leq 0.05$) was observed in favor of the T_5 treatment that achieved 3.01 g feed / g egg mass compared to the control treatment (T_1), T_2 and T_3 and did not significantly differ with the T_4 treatment which gave 3.41 g Feed / cloud an egg mass and treatment T_4 did not differ significantly from treatment T_1, T_2 and T_3.

Table (7): Effect of using different levels of spirulina algae on the feed conversion ratio (g feed /g egg mass) (mean ± standard error) for quail females

Treatments	period per weeks				
	The first period (9-13)	The second period (14-17)	The third period (18-21)	The Fourth period (22-25)	Total period (9-25)
T_1	3.55±0.05 [a]	3.18±0.13 [ab]	3.65±0.18	3.75±0.25 [ab]	3.53±0.09 [a]
T_2	3.53±0.12 [a]	3.22±0.08 [ab]	3.35±0.10	4.07±0.29 [ab]	3.54±0.06 [a]
T_3	3.43±0.14 [a]	3.58±0.24 [a]	3.54±0.30	4.76±0.71 [a]	3.83±0.26 [a]
T_4	3.17±0.11[ab]	3.39±0.11 [ab]	3.12±0.18	3.95±0.29 [ab]	3.41±0.13 [ab]
T_5	2.84±0.32 [b]	2.91±0.15 [b]	3.00±0.17	3.27±0.08 [b]	3.01±0.13 [b]
Sig	*	*	N.S	*	*

Averages with different letters within a single column differ significantly between them. * Mean significant differences between treatments at probability level (0.05 P ≤) and N.S were significant. [1] Experiment treatmentsT_1: control, T_2: use of 1% spirulina, T_3: use of 2% spirulina, T_4: use of 3% spirulina, T_5: use of 4% spirulina.

This improvement in the studied productive traits and for some experiment periods within the productive performance of Japanese quail birds, which significantly increased HD egg production, cumulative egg number, egg mass and egg weight by increasing levels of Spirulina platensis in the standard diet and is associated with significant improvement in the amount of feed consumed and feed conversion efficiency where feed consumed is positively associated with increased production, this is an indication of the utilization of feed inside the bird's body and its transformation into building and production units. Perhaps the reason is due to the palatability of the feed consumed at levels (3, 4%) of spirulina (Shokri *et al*., 2014) or it may be spirulina contains active substances that have a great role in eliminating or reducing the activity of positive and negative bacteria because spirulina is the most effective of all types of microalgae against all pathogens studied and is considered an anti-bacterial (Parwani and Singh, 2018), It works to improve the health of the intestinal environment, increase the numbers of lactic acid bacteria and reduce the numbers of pathological colon bacteria. or it may be due to the content of *Spirulina platensis* for Gamma Linolenic acid (GLA) (Gershwin and Belay, 2007) and this was confirmed by Liu et al. (2017) when adding GLA in different percentage (0.4, 0.8%) in diets. Laying hens Estrogen levels were higher than the control treatment level, which improved the egg production of the GLA chicken. The egg weight due to and egg specific traits are influenced by the different fat sources involved in the composition of the diet and this is determined by the composition of the added fatty acids (Guclu *et al*., 2008). Since the eggs mass depends entirely on the percentage of egg production that was significantly high in the fifth treatment in which spirulina algae was used by 4% compared to the rest of the experiment treatments (Table 6), this was reflected in the egg mass. Or, the significantly excelled of this treatment may be due to its content rich in active biological substances such as long-chain polyunsaturated fats n-3 DHE (docohexaenoic), EPE (eicosapentaenoic), protein, and antioxidants pigments and vitamins (E and B) The results of improvement of the feed conversion ratio at the level of 4% of spirulina in the current study did not agree with the results of Kanagaraju and Omprakash, (2016), which indicated that the quail feeding on spirulina and 1, 2 and 3% in the diet had a better feed conversion ratio compared to treatment the control, Whereas, the results of the feed conversion ratio were consistent with the researcher Danny, (2014), who stated that 4% of spirulina in the quail diet had an effect on the feed conversion ratio compared to the control treatment.

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