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Effect of egg injection with different levels of organic selenium and spirulina algae extract in hatching characteristics and productive performance of broiler.

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ABSTRACT

This research was conducted in the plastic house that belongs to the Nursery of Duhok University, located on the Zanko campus between February and June 2022.To study the impact of various Indole Butyric Acid concentrations (IBA) at (0, 1500, 3000 and 4500) mg L^{-1} on the capacity of hardwood stem cuttings to root of four different cultivars of *Bougainvillaea, including: Flame, Ambience, Imperial Delight and Lady Mary* Baring. The results indicate that the growth is affected by cultivars, and the greatly elevated majority of growth characteristics may be the result of Flame cultivars" cuttings compared with other cultivars. Among all IBA concentrations the maximum rooting percentage (62.86%), roots number per cutting (14.81 root $cutting^{-1}$), longest root (12.50 cm), stems number per cutting (2.00 stem $cutting^{-1}$), longest shoot length (18.06 cm) and plant weight (14.04 g) were observed under 3000 mg L^{-1} IBA concentration. In contrast, combining different cultivars and varying IBA concentrations resulted in a significant increase across all parameters. Notably, the highest rooting percentages of 86.60% and 86.13% were shown in the cuttings of Imperial Delight cultivars treated with IBA concentrations of 3000, 4500 mg L^{-1}, respectively.

***Keywords*:** Bougainvillea cultivars, IBA, rooting.

INTRODUCTION

Injecting eggs with nutrients before hatching to enhance the health and growth of broiler chickens is a popular method to obtain healthy, developing chicks. Arginine [1], methionine [2], and many other nutrients have been used in previous studies [3]. Providing embryos with external nutrients in eggs improves the hatching rate and increases the weight of chicks and the final body weight of broiler chickens by modifying the morphology of the fetal intestine [4].

SeMet organic selenium naturally present in feed ingredients is advantageous over conventional selenite. SeMet transferred to eggs provides stronger antioxidant defence to the developing embryo and improves hatchability and vitality of newly hatched nestlings [5]. The antioxidant capacity of nestling embryos was improved and better expressed under conditions of oxidative heat stress when fed as selenomethionine rather than selenite. Sodium is deposited from the mother's diet. Under heat stress conditions, SeMet showed a higher value in reducing oxidative damage than sodium selenite. Glutathione peroxidase activity increased in the liver of chick embryos when organic selenium deposition was observed through maternal diet thus increasing their antioxidant activity under heat stress conditions [6].

Spirulina, known as Arthrospira, is a microscopic, filamentous cyanobacteria (blue-green algae). It thrives in warm tropical and subtropical lakes with a pH of 9.4 to 11.0. There are two different species of Spirulina called Spirulina maxima and Spirulina platensis, and their distribution is variable worldwide [7]. Spirulina platensis is more widely distributed and is found mainly in Africa, Asia and South America [8]. On the other hand, Spirulina maxima is limited to areas in Central America. Blue-green algae Spirulina Platensis has been used for hundreds of years as a food source for humans and animals due to its excellent nutritional value and high content of carotenoids. Spirulina has a relatively high protein content ranging between 55-65% and includes all essential amino acids [9].

The available energy content of Spirulina is estimated at 2.50-3.29 kcal/g and its phosphorus availability is 41% [10]. In addition, it is rich in nutrients such as vitamins (thiamin, riboflavin, pyridoxine, vitamin B), amino acids, gamma linoleic acid, phycocyanin, tocopherol, chlorophyll, beta-carotene, carotenoids and minerals especially iron [9]. Spirulina has been reported to have health benefits in conditions such as diabetes and arthritis. It has also been shown to have immunostimulant effects and have antiviral activity [11]. Therefore, the current study aims to evaluate egg injections with Spirulina algae and organic selenium and study their effect on the productivity characteristics of broiler chickens.

Materials and methods:

The experiment was conducted for the period from (9/16/2023 to 11/18/2023), to study the effect of injecting eggs with different levels of organic selenium and spirulina algae extract on the hatchability characteristics, productive performance of broiler chickens. The injection and hatching of chicks were conducted in the Lailani hatchery located in the Lailan area, which contains BROODTECH type hatcheries. The duration of the experiment was 21 days. (600) hybrid eggs (Ross 308) from a flock of 33-week-old mothers imported from Turkey were used. The average egg weight was 58 g according to the certificate of origin. They were randomly distributed among (6) treatments with (100) eggs for each treatment and placed in BROODTECH incubator drawers until the age of (18 days), after which the eggs were injected and the drawers were transferred to the hatchery until the chicks emerged at the age of (21 days). The parameters used were as follows:

T1 = no negative control injection

T2 = injection of 0.5 ml of deionized distilled water per egg (positive control)

T3 = injection of 0.5 ml/egg containing a concentration of 10 micrograms of organic selenium

T4 = 0.5 ml/egg injection containing a concentration of 20 micrograms of organic selenium

T5 = 0.5 ml/egg injection containing 1.5 mg of spirulina algae extract

T6= 0.5 ml/egg injection containing 3 mg of spirulina algae extract

The spirulina algae injected into the egg were prepared by dissolving 0.15 g of spirulina algae in 50 ml of distilled water. The second concentration was dissolving 0.3 g of spirulina algae in 50 ml of distilled water. The selenium substance injected into the egg was prepared by dissolving 1000 micrograms of selenium in 50 ml of distilled water. The second concentration was achieved by dissolving 2000 micrograms of selenium in 50 ml of distilled water. When 18 days of incubation had passed, and after disinfecting the shell with an alcohol swab, a small hole was made in the larger end of the egg, above the air chamber. Using a diabetic needle (0.5 gauge and 30G needle size), 0.5 ml of spirulina solution was injected into the air chamber, the injection site on the shell was closed with nail polish, and the eggs were returned to the hatchery. When 18 days of incubation had passed, and after disinfecting the shell with an alcohol swab, a small hole was made in the wide end of the egg, above the air chamber. Using a diabetic needle (0.5 gauge and 30G needle), 0.5 ml of selenium solution was injected into the air chamber, the injection site on the shell was closed with nail polish, and the eggs were returned to the hatchery. The hatched chicks were raised during the period from (10/8 to 11/18) 2023 in the poultry field of the Department of Animal Production, College of Agriculture - University of Kirkuk. The average temperature was (35) degrees Celsius and the relative humidity was (20) % in the poultry field. The chicks were distributed randomly, with twenty chicks per replicate. The incubation temperature was adjusted to 35°C using electric heaters. Electric lighting was used to stimulate the chicks to eat and drink. The chick's weight and feed intake were recorded at free periods (10, 24, and 42) days by using an electronic balance [12, 13]. After that, the chicks' increasing weight and FCR were measured [14]. The data were subjected to statistical analysis by applying one-way ANOVA using SAS software [15]. Differences between treatments were tested using Duncan's multiple comparison test [16], at a significance level of $P \leq 0.05$.

Result and discussion:

Table (1) shows the effect of injecting hatching eggs with different concentrations of organic selenium and spirulina algae extract on the hatching rate, and embryo mortality. Significant differences were observed in both hatched rate, and embryonic mortality (%). The highest value of hatching rate was in treatment 4, and the lowest was in treatment 6 (90, and 85) respectively. The highest value of the embryo mortality was in treatment 6, and the lowest in treatment 4 (15, and 10) respectively. The Improvement of hatchability rate was due to the contain of selenium [5].

Table 1: The effect of injecting hatching eggs with different concentrations of organic selenium and spirulina algae extract on the hatching rate, and embryo mortality.

Treatment	Egg number	Fertilized eggs%	Hatching rate%	Embryo mortality%
T1	100	100	87±2.0 ab	13±2.0 ab
T2	100	100	88±2.5 ab	12±2.5 ab
T3	100	100	86±2.0 ab	14±2.0 ab
T4	100	100	90±1.0 a	10±1.0 b
T5	100	100	86±2.0 ab	14±2.0 ab
T6	100	100	85±1.0 b	15±1.0 a

T1=negative control treatment (no injection), T2=positive control treatment (injection of 0.5 ml of deionized pure water), T3=injection of 0.5 ml/egg (containing a concentration of 10 µg organic selenium), T4=injection of 0.5 ml/egg (contains a concentration of 20 micrograms of organic selenium), T5 = injection 0.5 ml/egg (contains 1.5 mg of spirulina algae extract), T6 = injection 0.5 ml/egg (contains 3 mg of spirulina algae extract). Different letters in the same column indicate a significant difference. NS= non-significant, *= significant at $P \leq 0.05$, **= significant at $P \leq 0.01$, ***= significant at $P \leq 0.001$.

Table (2) shows the effect of injecting hatching eggs with different concentrations of organic selenium and spirulina algae extract on the weight of birds of different ages. It was found that the weight at hatching was superior to the second and third treatments over the rest of the treatments by 39.41 and 38.75 g, respectively. As for the weight at 10 days of age, there were no significant differences between the treatments. As for the weight at 24 days of age, the third, fifth, and sixth treatments exceeded 1301.74, 1303.34, and 1287.01 g, respectively. As for the weight at 42 days of age, the fifth treatment exceeded the rest by 2992.18 g. The current study agreed with a study

conducted by [17] by injecting chicken eggs prepared for hatching with different concentrations of spirulina algae, where they found significant differences in the weight of chicks upon hatching. [18], in their study in which they used different ratios of selenium, vitamin E, and their mixture to inject chicken eggs prepared for hatching, concluded that there was no significant difference in the weight of the hatched chicks. [19], in their study in which they injected the eggs of brown chickens with different concentrations of selenium, concluded that there was no significant difference in the weight of hatched chicks between the treatments.

Table 2: the effect of injecting hatching eggs with different concentrations of organic selenium and spirulina algae extract on the weight of birds of different ages

Treatment	0 day	10 days	24 days	42 days
T1	36.54±0.06 b	307.37±2.95 a	1237.19±15.97 bc	2850.29±38.44 c
T2	39.41±0.20 a	307.69±3.62 a	1214.24±15.41 c	2927.57±24.01 abc
T3	38.75±0.82 a	315.23±3.51 a	1301.74±10.17 a	2961.87±17.81 ab
T4	36.02±0.29 b	310.36±3.97 a	1268.38±10.45 ab	2854.92±16.27 c
T5	36.91±0.33 b	317.16±2.58 a	1303.34±7.19 a	2992.18±30.76 a
T6	35.84±0.41 b	314.77±4.63 a	1287.01±14.76 a	2896.03±29.07 bc
Sig.	**	N.S.	***	**

T1=negative control treatment (no injection), T2=positive control treatment (injection of 0.5 ml of deionized pure water), T3=injection of 0.5 ml/egg (containing a concentration of 10 µg organic selenium), T4=injection of 0.5 ml/egg (contains a concentration of 20 micrograms of organic selenium), T5 = injection 0.5 ml/egg (contains 1.5 mg of spirulina algae extract), T6 = injection 0.5 ml/egg (contains 3 mg of spirulina algae extract). Different letters in the same column indicate a significant difference. NS= non-significant, *= significant at $P\leq0.05$, **= significant at $P\leq0.01$, ***= significant at $P\leq0.001$.

Table (3) shows the effect of injecting hatching eggs with different concentrations of organic selenium and spirulina algae extract on weight gain for three age stages. It was found that the weight gain at the age of 10 days was not significant, but in the weight gain at the age of 24 days, the third, fifth, and sixth treatments outperformed the rest of the treatments, 986.51, 986.18, and 972.23 g, respectively. As for the weight gain at 42 days, the second and fifth on the rest of the transactions are 1713.34 and 1688.54 g, respectively. The current study agreed with the study conducted by [17], by injecting chicken eggs prepared for hatching with different concentrations of spirulina algae, where he found significant differences in the weight gain of the birds between the treatments used, and this is also [20] found in His experiment in which he used different concentrations of spirulina algae to inject chicken and quail eggs. As for [21], he found that in his study in which he injected chicken eggs with spirulina algae, there was no significant difference in the weight gain of birds between the treatments. The current study also agreed with the findings of [22] in his study in

He injected local chicken eggs with selenium and found significant differences in weight gain between the different treatments. [18], In their study, they used different ratios of selenium, vitamin E, and their mixture to inject chicken eggs prepared for hatching and concluded that there was no significant difference in the weight gain of birds.

Table 3: The effect of injecting hatching eggs with different concentrations of organic selenium and spirulina algae extract on weight gain for three age stages.

Treatment	10 days	24 days	42 days
T1	270.82±3.29 a	929.82±13.50 bc	1613.10±33.90 bc
T2	268.28±3.79 a	906.54±13.55 c	1713.34±25.30 a
T3	276.48±3.46 a	986.51±7.23 a	1660.14±9.77 ab
T4	274.34±3.83 a	958.02±7.31 ab	1586.54±11.51 c
T5	280.25±2.91 a	986.18±9.07 a	1688.84±25.32 a
T6	278.93±4.61 a	972.23±10.41 a	1609.02±23.77 bc
Sig.	N.S.	***	**

T1=negative control treatment (no injection), T2=positive control treatment (injection of 0.5 ml of deionized pure water), T3=injection of 0.5 ml/egg (containing a concentration of 10 µg organic selenium), T4=injection of 0.5 ml/egg (contains a concentration of 20 micrograms of organic selenium), T5 = injection 0.5 ml/egg (contains 1.5 mg of spirulina algae extract), T6 = injection 0.5 ml/egg (contains 3 mg of spirulina algae extract). Different letters in the same column indicate a significant difference. NS= non-significant, *= significant at $P\leq0.05$, **= significant at $P\leq0.01$, ***= significant at $P\leq0.001$.

Table (4) shows the effect of injecting hatching eggs with different concentrations of organic selenium and spirulina algae extract on feed consumption for three age stages. It was found that feed consumption at the age of 10 days was exceeded by the first and second treatments over the rest of the treatments by 309 and 310 g/bird, respectively. As for feed consumption at the age of 24 days, the fifth and sixth treatments exceeded the rest of the treatments by 1250 and 1250 g/bird, respectively, and when at 42 days old, the first, third, fifth, and sixth treatments exceeded 2830, 2622, 2861, and 2833 g/bird, respectively. The current study was consistent with a study conducted by [17], by injecting chicken eggs prepared for hatching with different concentrations of spirulina algae, where he observed significant differences in the amount of feed consumed by birds in the different treatments. Likewise, [21], in his study in which he injected chicken eggs with spirulina algae, found a significant difference between the treatments used in the amount of feed consumed by the birds in the different treatments. This is also what [20] found in his experiment in which he used different concentrations of spirulina algae to inject chicken and quail eggs, where he noticed significant differences in the amount of feed consumed between the treatments. The current study also agreed with the findings of [22] in his study, in which he injected local chicken eggs with selenium, where he found that there were significant differences in the rate of feed consumption between the different treatments. [18] In their study, in which they used different ratios of selenium, vitamin E, and their mixture to inject chicken eggs prepared for hatching, they concluded that there was no significant difference in the amount of feed consumed. [23] found in his study, in which he used different percentages of selenium to inject hatching eggs, that there were significant differences in the rate of feed consumption between the treatments used, which results are consistent with the findings of the current study.

Table 4: the effect of injecting hatching eggs with different concentrations of organic selenium and spirulina algae extract on feed consumption for three age stages

Treatment	10 days	24 days	42 days
T1	309±0.01 a	1180±0.02 c	2830±0.04 a
T2	310±0.02 a	1120±0.01 d	2516±0.03 ab
T3	295±0.01 b	1230±0.01 ab	2805±0.03 b
T4	294±0.03 b	1200±0.01 bc	2622±0.03 a
T5	282±0.03 c	1250±0.01 a	2861±0.06 a
T6	276±0.02 c	1250±0.02 a	2833±0.06 a
Sig.	***	***	***

T1=negative control treatment (no injection), T2=positive control treatment (injection of 0.5 ml of deionized pure water), T3=injection of 0.5 ml/egg (containing a concentration of 10 µg organic selenium), T4=injection of 0.5 ml/egg (contains a concentration of 20 micrograms of organic selenium), T5 = injection 0.5 ml/egg (contains 1.5 mg of spirulina algae extract), T6 = injection 0.5 ml/egg (contains 3 mg of spirulina algae extract). Different letters in the same column indicate a significant difference. NS= non-significant, *= significant at $P \leq 0.05$, **= significant at $P \leq 0.01$, ***= significant at $P \leq 0.001$.

Table (5) shows the effect of injecting hatching eggs with different concentrations of organic selenium and spirulina algae extract on the feed conversion factor for three age stages. It was found that in the food conversion factor at the age of 10 days, the fifth and sixth treatments improved over the rest of the treatments by 1.1 and 0.99, respectively. As for the food conversion factor at the age of 24 days, there was no significance between the treatments, and at the age of 42 days, the second treatment improved over The rest of the coefficients are 1.47. The current study agreed with the findings of [20] in his experiment in which he used different concentrations of spirulina algae to inject chicken and quail eggs. While the current study did not agree with the study, [17] injected chicken eggs prepared for hatching with different concentrations of spirulina algae, noting that there was no significant difference between the treatments used in the experiment. As for [21], in his study in which he injected chicken eggs with spirulina algae, he found no significant difference between the treatments used in food conversion plants. The current study also agreed with the findings of [22] in his study in which he injected local chicken eggs with selenium, where he found that there were significant differences in the feed conversion factor between the different treatments. As for [18], in their study in which they used different ratios of selenium, vitamin E, and their mixture to inject chicken eggs prepared for hatching, they concluded that there was no significant difference in the feed conversion factor. [23] found in his study, in which different percentages of selenium were injected into hatching eggs, that there were significant differences in the feed conversion factor, which is consistent with the results of the current study.

These outcomes might be the consequence of in-ovo injections, which improve the health and development of broiler chicks by giving the embryos external nutrients, which could raise hatching chick weight or alter the final body weight of the broiler by changing the shape of the embryo's gut [21, 23]. Additionally, these nutrients may be distributed throughout various organs and tissues of the developing embryos and transferred to them. This could protect the developing embryos from oxidative damage, especially during the vulnerable stages of hatching and the early post-hatch life [23].

Table 5: the effect of injecting hatching eggs with different concentrations of organic selenium and spirulina algae extract on the feed conversion factor for three age stages

Treatment	10 days	24 days	42 days
T1	1.14±0.01 c	1.26±0.02 a	1.76±0.06 b
T2	1.16±0.02 c	1.24±0.03 a	1.47±0.04 a
T3	1.07±0.01 b	1.25±0.01 a	1.69±0.01 b
T4	1.07±0.01 b	1.25±0.01 a	1.65±0.01 b
T5	1.01±0.02 a	1.26±0.01 a	1.70±0.06 b
T6	0.99±0.01 a	1.28±0.02 a	1.76±0.05 b
Sig	***	N.S.	**

T1=negative control treatment (no injection), T2=positive control treatment (injection of 0.5 ml of deionized pure water), T3=injection of 0.5 ml/egg (containing a concentration of 10 µg organic selenium), T4=injection of 0.5 ml/egg (contains a concentration of 20 micrograms of organic selenium), T5 = injection 0.5 ml/egg (contains 1.5 mg of spirulina algae extract), T6 = injection 0.5 ml/egg (contains 3 mg of spirulina algae extract). Different letters in the same column indicate a significant difference. NS= non-significant, *= significant at P≤0.05, **= significant at P≤0.01, ***= significant at P≤0.001.

Conclusion:

The study conducted found that injecting the egg with organic selenium enhanced the bird's weight and weight gain. Moreover, both organic selenium and the spirulina extract significantly affected feed intake and FCR. The spirulina extract also significantly affected the hatching rate.

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تأثير حقن البيض بمستويات مختلفة من السيلينيوم العضوي ومستخلص طحالب السبيرولينا في صفات الفقس والأداء الإنتاجي لفروج اللحم.

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[1] قسم الانتاج الحيواني، كلية الزراعة، جامعة كركوك، كركوك، العراق.

الخلاصة

أجريت الدراسة الحالية للفترة من (2023/9/16 إلى 2023/11/18) بهدف دراسة تأثير حقن البيض بمستويات مختلفة من السيلينيوم العضوي ومستخلص طحالب السبيرولينا في صفات الفقس والأداء الإنتاجي الدجاج الفروج. أجريت تجربة حقن وتفريخ الافراخ في مفقس ليلاني الواقع في منطقة ليلان. تم استخدام (600) بيضة هجين (روس 308) من قطيع أمهات بعمر 33 أسبوع مستوردة من تركيا. تم توزيعها عشوائياً على (6) معاملات بواقع (100) بيضة لكل معاملة وهي: المعاملة الاولى بدون حقن السيطرة السلبية، المعاملة الثانية حقن 0.5 مل من الماء المقطر منزوع الأيونات لكل بيضة (سيطرة إيجابية)،المعاملة الثالثة حقن 0.5 مل / بيضة تحتوي على تركيز 10 ميكروغرام من السيلينيوم العضوي، المعاملة الرابعة حقن 0.5 مل / بيضة تحتوي على تركيز 20 ميكروغرام من السيلينيوم العضوي، المعاملة الخامسة حقن 0.5 مل / بيضة تحتوي على 1.5 ملغم من مستخلص طحالب سبيرولينا، معاملة السادسة حقن 0.5 مل / بيض تحتوي على 3 ملغم من خلاصة طحالب السبيرولينا. توصلت الدراسة إلى أن حقن البيض بالسيلينيوم العضوي أدى إلى زيادة وزن الطائر النهائي ومعدل الزيادة الوزنية، كما أثر كل من السيلينيوم العضوي ومستخلص السبيرولينا بشكل معنوي على كمية العلف المتناولة ومعدل تحويل العلف. وكان لمستخلص السيلينيوم العضوي تأثير معنوي على معدل الفقس.

الكلمات المفتاحية : الحقن، البيض، السيلينيوم، سبيرولينا، الفروج.