Effect of Early Feeding (in Ovo) With Nano-Selenium and Vitamin E on Body Weight and Glycogen Level in Broiler Chickens Exposed to Fasting Condition

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Abstract

This study aimed to reduce the severity of stress on incubating chicks as a result of long staying in hatcheries and exposure to food fasting as well as evaluate its subsequent growth performance. In present study, 750 fertilized eggs were used with divided into 5 treatments, each treatment contains 150 eggs, the first treatment (T1) is a negative control treatment without injection and the second treatment (T2) is a positive control treatment injected with distilled water. The treatments (T3, T4, and T5) were injected with a solution containing vitamin E, nano-selenium at concentrations of (15, 30, 45 mg/ml), respectively. The hatching chicks were divided from the injected egg treatments, where each treatment was divided into 3 replicates and the chicks were starved for 48 hours without providing them feed and they provided with water only. According to results, a significant increase occurred for the treatments (T3, T4, and T5) in weight at hatching and weight at age of 48 hours compared to positive and negative control treatments (T1 and T2).

Significant increase occurred for the T5 treatment in the glycogen content of liver with a significant level and for the age at the hatching of (12, 24, 48 hr of bird age), respectively. Significant increase occurred for the treatments (T3 and T5) in the concentration of cardiac glycogen at hatching and at the age of (12 hr). The significant of the T5 treatment continued at the age of (24 and 48 hr) compared to the rest of the treatments. Significant increase occurred for the treatments (T3, T4 and T5) in the concentration of muscle glycogen compared to the treatments (T1 and T2). The results showed that nano-selenium and vitamin E improved the performance of embryonic growth and increased the weight of hatching chicks as well as increasing the level of glycogen in the liver, muscles and heart muscles.

Keywords: Broiler Chickens, Egg injection, Glycogen, Nano-Selenium, Vitamin E.

1. Introduction

The poultry industry has undergone significant development over the recent decades [1], in terms of bird growth and feeds conversion, but the period of embryonic growth and development remains very critical, up to hatching [2,3], where it was found that the good weight during marketing to be based on optimal growth during incubation and chicks’ weight at hatching [4-7]. However, the survival period of the chicks in the hatchery and until the transfer to the breeding houses which is an important problem where the chicks may stay in the hatchery until the end of the counting and sorting process for a day or two without water and feed, which exposes the chicks to lose weight and weakness their immunity and The technique of early feeding through injecting hatching eggs with nutrient solutions is very important for the purpose of improving growth after hatching, living body weight, weight gain and reduced embryo mortality rate [8-11]. The weight of chicks at hatching is influenced by many factors, including egg weight, it's quality and nutrient ratios [12]. Antioxidant components such as nano-selenium and vitamin E are responsible for protecting embryo tissue during embryo growth and development [13]. Fat-soluble antioxidants such as vitamin E and carotenoids are mostly transferred to developing embryonic tissues (such as the yolk sac) for the purpose of utilization by the developing embryo [14,15], where vitamin E is very important through regenerating damaged cells by Glutathione peroxidase, protecting them against lipid peroxidation and damaging cells, that result from oxidative reactions [16], thus improving the performance of Nano-selenium protects tissues against cell damage and prevents generating excessive free radical oxygen through the peroxidase glutathione pathway, thus protecting tissues against oxidation of lipids and proteins [17]. Which improves embryo growth [18]. Injecting hatching eggs with nano-
selenium improved the weight of chicks and the percentage of hatching. [19], indicated that administrated eggs with vitamin E improved the growth rate of hatching chicks, the weight at hatching, as well as the percentage of hatching. Therefore, this study aims to know the effect of injecting the hatching eggs with nano-selenium and vitamin E on the initial weight and the concentration of glycogen for hatchery chicks that exposed to fasting condition.

2. Materials and Methods

2.1. Ethical Approval

This study was conducted in the hatchery belonging to Al-Anwar Poultry Company in Babylon province for the period from 15/1/2019 to 6/2/2019, where 750 fertilized eggs were used divided into 5 treatments, each treatment contains 150 eggs, the first treatment (T1) is a negative control treatment without injection and the second treatment (T2) is a positive control treatment injected with distilled water. The treatments (T3, T4, T5) were injected with a nutrient solution containing vitamin E, nano-selenium at concentrations of (15, 30, 45 mg/ml), respectively. After that, the hatching chicks were divided from the injected egg treatments, where each treatment was divided into 3 replicates and bred randomly for 48 hours without providing them with feed and they provided with water only.

2.2. Experiment design & bird management

This study was conducted in the hatchery belonging to Al-Anwar Poultry Company in Babylon province for the period from 15/1/2019 to 6/2/2019, where 900 eggs were weighed and incubated, at the age of 17.5 days from embryo age and after conducting the scanning candling process for eggs in order to exclude the unfertilized eggs, 750 fertilized eggs were used (for each treatment 150 eggs), where the treatments were as follows:

- First treatment T1: negative control (without injection).
- Second treatment T2: positive control: injecting with 0.3 ml distilled water/egg.
- Third treatment T3: injecting with (0.3 ml/egg) nutrient solution containing nano-selenium and vitamin E at a concentration (15 mg/ml).
- Fourth treatment T4: injecting with (0.3 ml/egg) nutrient solution containing nano-selenium and vitamin E at a concentration (30 mg/ml).
- Fifth treatment T5: injecting with (0.3 ml/egg) nutrient solution containing nano-selenium and vitamin E at a concentration (45 mg/ml).

After hatching, the chicks were raised for 48 hours, where each treatment was randomly divided into three replicates and supplying it with water only without feed.

2.3. Source of experiment eggs

The eggs were obtained from the hatchery of Al-Anwar Poultry Company (EGE-TAV AS), 750 hatching eggs were weighed individually with a digital balance (SF-400 Electronic Kitchen scale type) (Mothers of broiler chickens (Ross 308), with an average weight (58-60 g)

2.4. Solutions used in the injection of eggs

The distilled water was used in the preparation of the egg injection solution and to get the concentrations that were used to injecting the eggs, Organic nano-selenium (liquid) was obtained from Nanosany Corporation of Iran, with the size of (30 nm) and purity (99.95%). Vitamin E (liquid dissolve in water) (α-Tocopherol) was obtained from the office of medical and veterinary equipment in Bab al-Muadham, Baghdad province which produced by Indian HIMEDIA company.

2.5. weight at hatching (g)

The hatching chicks were weighed for each treatment in the hatchery, where the box has weighed without chicks and then weighed with the chicks. This represents the weight of the chicks after hatching for the treatment, the total weight (g) of the treatment was then divided by the number of chicks for the treatment to obtain the average weight at hatching (g/chick) [20].

2.6. level of glycogen (mg / g tissue).

The content of glycogen in the liver, heart, and muscles was determined using the Anthrone method [21].
2.7. Mortality percentage %.

No mortality was recorded in chicks until 48 hours of the chicks’ age.

2.8. Statistical analysis

The data were analyzed using a completely random design (CRD) to study the effect of the studied factors on the different traits. Significant differences between the averages were compared using Duncan's Multiple-Range Test [9]. SAS [22], was used in the statistical analysis according to the following mathematical model:

\[ Y_{ij} = \mu + T_i + e_{ij} \]

Were:

- \( Y_{ij} \): the value of viewing j to treatment i.
- \( \mu \): general average for the trait.
- \( T_i \): effect of treatment i (the study included the effect of five treatments).
- \( e_{ij} \): a random error that is normally distributed with an average of zero and a variation of \( \sigma_e^2 \).

3. Results

3.1. Effect of early feeding with nano-selenium and vitamin E on the average weight of chicks

Table 1 indicates the effect of early feeding with nano-selenium and vitamin E on the average weight of chicks (g) at hatching and after 48 h from the age of the chicks. It was noted that the weight at the hatching was significantly increase (P≤0.01) for the treatments of the nano-selenium and vitamin E (T3, T4, and T5) compared to the treatments (T1 and T2). The positive control treatment (T2) has excelled on the negative control treatment (T1). There were no significant differences between the treatments (T3, T4, and T5). At 48 hours of birds age, the excelling of the treatments (T3 and T4) continued compared to the treatments (T1 and T2), the excelling of the T2 treatment on the T1 treatment. There were no significant differences between the treatments (T3, T4, and T5) as well as the treatments (T2 and T5).

| Treatments | Weight at hatching | Weight after 48 hours |
|------------|-------------------|-----------------------|
| T1         | 0.20 ± 35.68c     | 0.55 ± 34.71c         |
| T2         | 0.19 ± 37.43b     | 0.09 ± 37.37b         |
| T3         | 0.69 ± 40.60a     | 0.94 ± 40.04a         |
| T4         | 0.53 ± 39.78a     | 0.23 ± 39.43a         |
| T5         | 0.32 ± 39.18a     | 0.19 ± 38.76ab        |

The averages with different letters within one column are significantly different among them at the level ***(P≤0.01).**

The treatments (T1, T2, T3, T4, T5) are a negative control treatment without injection, positive control treatment injected with distilled water, injecting with a nutrient solution containing vitamin E, nano-selenium at a concentration of (15, 30, 45 ppm), respectively.

3.2. Effect of early feeding with nano-selenium and vitamin E on the level of glycogen in the liver (mg / g tissue)

Table 2 shows the effect of early feeding with nano-selenium and vitamin E on the level of glycogen in liver (mg/g tissue) and with different ages of bird age, where it was noted at the hatching was significantly increase (P≤0.01) for the treatments of the nano-selenium and vitamin E (T4 and T5) compared to the T1 treatment. It was no significant differences between the treatments (T4 and T5) and the treatments (T2, T3 and T4) As well as the treatments (T1, T2 and T3). At the age of (12 and 24 hours), the treatments (T4 and T5) were significantly excelled (P≤0.01) compared to the treatments (T1 and T2). The T5 treatment also excelled on the T3 treatment. There was no significant difference between the treatments (T4 and T5), between the treatments (T3 and T4) and between the treatments (T1, T2 and T3). At 48 hours of birds age, the treatments (T3 and T4)
were significantly excelled on the treatments (T1, T2, and T3). The statistical analysis showed no significant differences between the treatments (T4 and T5), as well as between the treatments (T1, T2 and T3).

Table 2. Effect of early feeding with nano-selenium and vitamin E on the level of glycogen in the liver (mg / g tissue)

| Treatments | Average ± standard error |
|------------|--------------------------|
|            | At hatching  | 12 hours | 24 hours | 48 hours |
| T1         | 0.52 ± 10.87c | 0.37 ± 10.23c | 0.48 ± 9.44c | 0.45 ± 10.19b |
| T2         | 0.19 ± 15.05bc | 2.02 ± 11.50c | 0.61 ± 11.91c | 0.80 ± 10.98b |
| T3         | 0.60 ± 15.51bc | 0.94 ± 13.77bc | 0.85 ± 13.65bc | 1.12 ± 13.19b |
| T4         | 3.46 ± 20.68ab | 3.03 ± 19.098ab | 2.87 ± 19.79ab | 2.73 ± 19.42a |
| T5         | 2.44± 24.30a | 2.32 ± 23.54a | 2.17 ± 23.15a | 1.95 ± 22.41a |

The averages with different letters within one column are significantly different among them at the level *(P≤0.05) and **(P≤0.01) respectively. The treatments (T1, T2, T3, T4, and T5) are a negative control treatment without injection, positive control treatment injected with distilled water, injecting with a nutrient solution containing vitamin E, nano-selenium at a concentration of (15, 30, and 45 ppm), respectively.

3.3. Effect of early feeding with nano-selenium and vitamin E on the level of glycogen in the Heart muscle (mg / g tissue).

Table 3 shows the effect of early feeding (in Ovo) with nano-selenium and vitamin E on the level of glycogen in the heart muscle (mg / g tissue), where it was noted at hatching age and the age of 12 hours from the birds age a significant (P≤0.05) increasing for the treatments (T3 and T5) compared to the treatments (T1 and T2). There was no significant difference between the treatment (T3, T4, and T5) and between the treatment (T1 and T2). At the age of 24 h, significant superiority (P≤0.05) was observed for the T5 treatment compared to other treatments and the treatments (T3 and T4) have excelled on the treatments (T1 and T2). It did not record a significant difference between the treatments (T3 and T4) and between the treatments (T1, T2). At the age of 48 hours from the birds age, the T5 Treatment (P≤0.05) was significantly increased compared to other treatments and the treatments (T3 and T4) have excelled on the treatments (T1 and T2). There was no significant difference between the treatments (T3, T5) and between the treatments (T3 and T4) and between the treatments (T1 and T2).

Table 3. Effect of early feeding with nano-selenium and vitamin E on the level of glycogen in the heart muscle (mg / g tissue).

| Treatments | Average ± standard error |
|------------|--------------------------|
|            | At hatching  | 12 hours | 24 hours | 48 hours |
| T1         | 1.28 ± 9.94b | 1.70 ± 8.47b | 1.49 ± 8.52c | 1.01 ± 10.18c |
| T2         | 1.16 ± 12.04b | 0.88 ± 9.46b | 0.39 ± 8.84c | 1.17 ± 10.58c |
| T3         | 0.54 ± 19.30a | 0.50± 18.52a | 0.44 ± 15.79b | 1.05 ± 16.30ab |
| T4         | 4.49 ± 16.01ab | 4.51 ± 15.60ab | 4.45 ± 15.20b | 1.44 ± 14.90b |
| T5         | 2.31 ± 19.74a | 2.01 ± 19.12a | 2.66 ± 18.02a | 2.25 ± 18.77a |

The averages with different letters within one column are significantly different among them at the level *(P≤0.05). The treatments (T1, T2, T3, T4, and T5) are a negative control treatment without injection, positive control treatment injected with distilled water, injecting with a nutrient solution containing vitamin E, nano-selenium at a concentration of (15, 30, and 45 ppm), respectively.

3.4. The level of glycogen in the breast muscle (mg / g tissue).

Table 4 shows the effect of early feeding (in Ovo) with nano-selenium and vitamin E on the level of glycogen in the chest muscle (mg / g tissue). The table 4 indicates a significant superiority (P≤0.05) for the treatments (T3, T5) at hatching age and the age of 48 hours from bird age compared to the treatments (T1 and T2). The T4 treatment has significant increase compared to the T2 treatment. There were no significant differences between the treatments (T3, T4 and T5) and between the treatment (T1 and T4). At the age of 12 and 24 hours, all treatments of nano-selenium and vitamin E have increased on the control treatments with significant (P≤0.05) and (P≤0.01) respectively. There was no significant difference between the T1, T2 and between the T3, T4 and T5.
Table 4. Effect of early feeding with nano-selenium and vitamin E on the level of glycogen in the breast muscle (mg / g tissue).

| Treatments | Average ± standard error |
|------------|--------------------------|
|            | At hatching   | 12 hours | 24 hours | 48 hours |
| T1         | 0.55 ± 18.91bc | 1.53 ± 15.02b | 2.84 ± 14.41b | 3.05 ± 15.41bc |
| T2         | 0.22 ± 15.03c  | 2.16 ± 16.38b | 2.01 ± 10.23b | 1.94 ± 12.51c  |
| T3         | 1.98 ± 30.45a  | 1.53 ± 26.71a | 2.48 ± 27.63a | 2.55 ± 29.07a  |
| T4         | 2.04 ± 29.22ab | 1.52 ± 28.62a | 1.50 ± 28.15a | 2.49 ± 27.66ab |
| T5         | 2.51 ± 31.74a  | 2.56 ± 31.29a | 2.49 ± 30.60a | 1.17 ± 30.98a  |

Significant level

* *(P≤0.01) and *(P≤0.05) respectively. The treatments (T1, T2, T3, T4, and T5) are a negative control treatment without injection, positive control treatment injected with distilled water, injecting with a nutrient solution containing vitamin E, nano-selenium at a concentration of (15, 30, and 45 ppm), respectively.

4. Discussion

The increase in the weight of incubating chicks and concentration of glycogen in the treatments of nano-selenium and vitamin E may be due to their antioxidant role, which was positively reflected on the growth and development of chicks. It may also cause energy depletion within the body for the purpose of resistance to the stressful factors, which explains the high concentration of glycogen in birds that injected with nano-selenium and vitamin E treatments, while Antioxidants have been shown to be beneficial in mitigating the harmful effects of stress on the bird [23-26]. Or may be the effect of nano-selenium on the activity of antioxidant enzymes was efficient in this process, where [10], indicated that nano-selenium improves the state of antioxidants by activating the activity of glutathione peroxidase enzyme, [17] mentioned that spherical nano-particles of selenium which range in size from 100 to 500 nm have increased antioxidant activity [20], where it has a high ability to decipher free radicals [22]. These results are in agreement with [8,27]. [2], reported that nano-selenium at a concentration of (0.1, 0.2 mg/kg) caused an increase in the activity of glutathione peroxidase and malondialdehyde compared to the control treatment, which improved resistance to oxidation and beta-oxidation and eliminating free radicals and then increased the weight of body, and the growth performance for birds, Nano-selenium plays important roles in regulating thyroid hormone, and antioxidant defense systems [28]. In combination with alpha-tocopherol and inhibits cells against oxidation and oxidative stress damage, because thyroid hormones play an important role in protein-synthesis and its metabolism [26]. Selenium deficiency affects overall growth performance and feather development in birds through weakening the T₃ production [29]. Vitamin E prevents free radical formation reactions from normal metabolic processes, thus protects tissues from damage leading to improved growth [16,30]. It may also be due to the role of the antioxidant vitamin E which maintains red blood cells, thus improves the level of bio-processes within the body as well as its active role in supporting the immune system [31,33]. These results agree with [32], that injecting nano-selenium at age of 7 days increased body weight and immunity of hatching chicks. [2] mentioned that selenium stimulated embryonic growth and increased immunity of the hatching chicks but it did not promote post-hatching growth but it increased expression of growth genes. Hassan so the injection of nano-selenium with concentration of 15 mg/ml improves the growth performance of broiler chickens. vitamin E partially protects against or delays the appearance of several forms of selenium deficiency, where tissue breakdown occurs in most species that are deficient in both vitamin E and nano-selenium, mainly through the oxidation process by hydroperoxides, which are extremely destructive to tissue integrity and lead to infection with disease. where vitamin E in cellular and sub-membranes is the first agent of defense against bio-phospholipid peroxide, but even with adequate amounts of vitamin E some peroxides are formed, but selenium as part of the glutathione peroxidase enzyme is the second line of defense that destroys these peroxides before it has the opportunity to cause damage to the membranes, therefore, Nano-selenium and vitamin E and through some different biochemical processes are mechanisms capable of preventing some of the same nutritional diseases [30]. It can be the feed deprivation exposed by the chicks and stress during the incubation of embryos resulting from the operation of the floating egg and transfer to the hatchery, as well as waiting for the completion of the hatching process of all eggs and the hatching chicks in the early hours of the start of the hatching process exposed to stress inside the hatchery and feed deprivation until the release of chicks. As well as the counting, sorting, inoculation, and transport for hatching chicks is a major factor in reducing growth performance and reducing body weights. This may be due to the fact that the control treatment was lower in its production performance compared to the injecting treatments. Where nano-selenium and vitamin E exclude oxidative processes as well as their role in metabolism [6], vitamin E breaks the chain of peroxides resulting from lipid oxidation processes that generate harmful free radicals to the embryo [33,34], reported that 80% of vitamin E in embryonic tissue is represented in embryonic tissue and the most active form is tocopherol. The results of this study agree with [5] who found a significant increase in the weight of hatching quail chicks that injected with alpha-tocopherol.
Conclusion

Early feeding of nano-selenium and vitamin E was effective in supporting the growth of chicks and increasing their susceptibility to fasting food, as it improved the weight of the incubated chicks, as well as the concentration of glycogen in the muscles of the breast, heart and liver within two days after hatching, this increases the tolerance of chicks to stay after hatching without food, which is also reflected in their subsequent growth to marketing.

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