ARTICLE / INVESTIGACIÓN

# Effect of adding and in ovo injecting hatching eggs produced with omega-3 on some hatching traits and body weight of Japanese quail

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**Abstract:** This study was conducted at a private hatchery in Thi-Qar Governorate to determine the effect of adding omega-3 fatty acid to quail's diet with the outcome of ovo injecting the resulting hatching eggs with omega-3 on some hatching traits and body weight of Japanese quail. A total of 540 eggs were used. The experiment treatments were as follows: T1: Negative control (without adding oil); T2: Positive control (adding 0.01% sunflower oil); T3: Feed the parent with 0.01% omega-3 oil; T4: Feed the parent with 0.01% omega-3 oil, and the resulting eggs were in ovo injected with 0.01 ml omega-3; T5: Feed the parent by 0.01% omega-3 oil, and the resultant eggs were in ovo injected with 0.01 ml sunflower; T6: Feed the parent by 0.01% sunflower oil, and the resulting eggs were in ovo injected with 0.01 ml sunflower; T7: Feed the parent by 0.01% sunflower oil, and the resultant eggs were in ovo injected with 0.01 ml omega-3; T8: Feed the parent by free diet, and the resulting eggs were in ovo injected with 0.01 ml omega-3; T9: Feed the parent by free diet, and the resultant eggs were in ovo injected with 0.01 ml sunflower. The results showed a significant improvement in T4 (the treatment whose parents were fed omega-3 and in ovo injected with omega-3 oil) compared to the control treatment on hatching rate and fertility rate of whole eggs, with a significant decrease in the percentage of embryonic mortality and pipped eggs for the hatched chicks. Feeding Japanese quail mothers with omega-3 hatching egg injections led to a substantial increase in the average weekly body weight.

**Key words:** In ovo injecting, hatching eggs, with omega-3, hatching traits, body weight, Japanese quail.



## Introduction

The quail bird occupies a prominent position as one of the smallest types of domestic birds[1], for its contribution to meeting the needs of animal protein has unique characteristics that distinguish it from other domestic birds[2,3]; among these characteristics that determine the quail bird from other domestic birds, which made him popular for scientific research, including the short range of the generation, where the period of hatching ranges between 16-18 days, it takes up little space per unit area, small size, ease of handling, consumes less feed compared to chicken, considered an economic bird, it is a dual-purpose bird raised to produce eggs and meat, characterized by being a highly efficient biological machine in food conversion, its abundant production of eggs[4].

The fertilized egg is an isolated environment; it has characteristics that aim to produce new chicks when providing this environment with some nutrients by using the early feeding technique, which can improve the growth and development of fetuses, positively reflecting on the performance of chicks after hatching[5].

Recently, attention has focused on the process of injecting eggs with nutrients to provide the fetus with additional amounts of nutrients because the reserve of nutrients for the fetus decreases as it grows to reduce the stress that the chick is exposed to when hatching, supporting the development of the immune system of hatched chicks[6,7].

Including the use of one of the types of unsaturated fatty acids, especially omega-3, in ovo injection by air cell. Omega-3 acts as an energy source that supports the growth of fetuses and enhances the ability to digest and metabolize[8]. Omega-3 enhances the absorption of fat-soluble vitamins, increases the palatability of the feed materials and improves the utilization of the consumed energy; it also reduces the rate at which food passes through the gastrointestinal tract, leading to better absorption of nutrients[9].

The study aimed to determine the effect of adding omega-3 oil to quail's diet and injecting the resulting eggs with omega-3 on hatching traits and body weight.

## Materials and methods

This study was conducted from 20/11/2021 to 11/12/2021 in a private hatchery affiliated with Thi-Qar Governorate. A total of 540 360 fertile eggs from Japanese quail parents was reared at the poultry field of the Department of Animal Production, College of Agriculture and Marshlands, Thi Qar University. The experiment treatments were as follows:

T1: Negative control (without adding oil).

T2: Positive control (adding 0.01% sunflower oil).

T3: Feed the parent by 0.01% omega-3 oil.

T4: Feed the parent by 0.01% omega-3 oil, and the resulting eggs were in ovo injected with 0.01 ml omega-3.

T5: Feed the parent by 0.01% omega-3 oil, and the resulting eggs were in ovo injected with 0.01 ml sunflower.

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T6: Feed the parent by 0.01% sunflower oil, and the resulting eggs were in ovo injected with 0.01 ml sunflower.

T7: Feed the parent by 0.01% sunflower oil, and the resulting eggs were in ovo injected with 0.01 ml omega-3.

T8: Feed the parent by free diet, and the resulting eggs were in ovo injected with 0.01 ml omega-3.

T9: Feed the parent by free diet, and the resulting eggs were in ovo injected with 0.01 ml sunflower.

The eggs were in ovo injected on day zero after sterilization with cotton and ethyl alcohol at a concentration of 70%. The injection hole was closed with nail polish, placed the eggs in the incubator; after setting the temperature at 37.7°C and humidity at 65%, the eggs hatched after 18 days of hatching and incubation. The following hatching traits were studied:

### Fertility

The fertility was calculated after breaking the unhatched eggs and identifying dead embryos in each hatch, where the fertility and hatchability ratios were measured for each replicate, as indicated by Yoo and Wientjes[10] by the following equation:

Fertility=(Fertile eggs)/(Total eggs)×100

### Hatchability of fertile eggs

The hatchability of fertilized eggs is calculated according to the following equation:

Hatchability of fertile eggs=(Hatched chick)/(Fertile egg)×100

### Hatchability of whole eggs

The hatchability of total eggs was calculated, was calculated from the whole eggs after breaking the non-hatched eggs due to the difficulty of optically examining fertilized quail eggs because of the spotted eggshell color and according to the following equation[11].

Hatchability of fertile eggs=(Hatched chick)/(Total egg)×100

### Pipped Eggs

All unhatched eggs were individually broken after the hatching period, and the number of pipped eggs was recorded, according to what was mentioned by Al-Zujaji and Ibrahim[12]. As in the following equation:

Pipped eggs perecetnt=(Pipped eggs)/(Fertile egg)×100

### Embryonic mortality

Embryonic mortality was calculated for each of the experimental treatments according to the equation mentioned[13]:

Embryonic mortality=(Embryo dead)/(Fertile egg)×100

Average weekly live body weight

The birds were weighed weekly for each replicate of the experiment using a scale with a capacity of 50 kg.

## Results

Table (1) indicates the effect of feeding Japanese quail parents. In ovo, injecting the resulting eggs with omega-3 fatty acid and sunflower oil on the fertility and hatchability of fertilized and total eggs, embryonic mortality, and pipped eggs of hatched chicks, the results indicate that there was a significant effect of (P≤0.01) of omega oil on the fertility, as the superiority of treatment T2, T3, T4, T5 and T6 compared to the rest of the treatments, its values were recorded as 93.36, 96.32, 96.26, 96.33 and 93.41%, followed by the treatments that significantly outperform T1 and T9, its values were recorded at 90.33 and 90.33%, respectively.

The results showed a highly significant (P≤0.01) for the hatching of whole eggs in the T3 treatment, it did not differ

| Treatments | Fertility (%) | Total eggs hatchability (%) | Fertile eggs hatchability (%) | Embryonic mortality (%) | Pipped eggs (%) |
|---|---|---|---|---|---|
| T1 | 90.33±0.38 $^{b}$ | 86.48±0.43 $^{c}$ | 96.37±0.43 $^{a}$ | 3.71±0.11 $^{c}$ | 0.00±0.00 $^{e}$ |
| T2 | 93.36±0.55 $^{a}$ | 82.97±1.38 $^{d}$ | 89.17±0.44 $^{c}$ | 3.53±0.12 $^{c}$ | 7.24±0.55 $^{c}$ |
| T3 | 96.32±0.62 $^{a}$ | 92.68±1.33 $^{a}$ | 96.44±0.72 $^{a}$ | 0.00±0.00 $^{d}$ | 4.08±1.12 $^{d}$ |
| T4 | 96.26±0.57 $^{a}$ | 90.40±0.42 $^{ab}$ | 96.37±0.43 $^{a}$ | 0.00±0.00 $^{d}$ | 7.23±0.10 $^{c}$ |
| T5 | 96.33±0.61 $^{a}$ | 89.66±1.45 $^{b}$ | 96.37±0.66 $^{a}$ | 0.00 ±0.00 $^{d}$ | 6.79±0.15 $^{c}$ |
| T6 | 93.41±0.38 $^{a}$ | 86.36±0.55 $^{c}$ | 92.78±0.54 $^{b}$ | 7.32±7.32 $^{b}$ | 0.00±0.00 $^{e}$ |
| T7 | 86.48±0.72 $^{c}$ | 76.54±0.79 $^{e}$ | 88.27±0.54 $^{c}$ | 0.00±0.00 $^{d}$ | 7.66±0.20 $^{c}$ |
| T8 | 84.82±2.35 $^{c}$ | 70.38±0.84 $^{f}$ | 80.31±0.58 $^{d}$ | 7.48±0.10 $^{b}$ | 11.47±0.49 $^{b}$ |
| T9 | 90.33±0.38 $^{b}$ | 66.52±0.77 $^{g}$ | 74.35±0.50 $^{e}$ | 11.28±0.51 $^{a}$ | 14.80±0.11 $^{a}$ |
| Sig. | ** | ** | ** | ** | ** |

**Table 1.** Effect of Japanese quail parents feeding and the resulting eggs being in ovo injected with omega-3 fatty acid and sunflower oil on some hatching traits (mean ± standard error).

with treatment T4 followed by treatment T5 in comparison with the rest of the experimental treatments, the values of the therapy were 92.68, 90.40 and 89.66%, respectively.

The results of the hatchability percentage of fertilized eggs indicated a significant increase was observed in favor of treatment T1, T3, T4 and T5 compared to the rest of the experimental treatments; its values were recorded as 96.37, 96.44, 96.37, and 96.37%, respectively.

The results showed a significant superiority of the T6 treatment compared to the rest; its value was 92.78%.

The results of the table indicated the percentage of embryonic mortality, and there was a decrease in the rate of embryonic mortality for the treatments in which omega-3 oil has been added, while the results recorded a highly significant increase in treatment T9, its value was 11.28 compared to the rest of the experimental treatments.

Table (2) shows the effect of feeding Japanese quail mothers and the resulting eggs injected with omega-3 fatty acid and sunflower oil on the weekly body weight of the resulting chicks. There was a significant increase (P≤0.01) for treatments T4 and T5 compared to the positive and negative control treatments T1, T2 and the rest of the treatments, whose value reached 28.09 and 24.62 gm, respectively, for the first week of rearing. While there were no significant differences between the two control treatments and the rest of the treatments (T3, T6, T7, T8 and T9). While it was noted that there was a significant increase (P≤0.01 for treatment T4 compared with the negative and positive control treatments and the rest of the treatments, as its value reached 53.82 g and a significant increase for treatment T6 compared to treatments T2, T3 and T9 for the second week of life of the birds. In the third week of life, it was found that there was a significant increase For treatment T4 compared to the control treatment and the rest of the treatments the value was 91.02 g and a significant increase for treatments T5, T6 and T7 compared with the rest of the treatments and their value was 80.68, 82.05 and 1.418 g. While no significant difference was observed between the two control treatments and T3, T8 and T9, and their value was 78.28 and 76.26 and 76.70 g, respectively. It was found that there was a significant increase in treatment T6 compared with the control treatment, and the rest of the treatments were valued at 124.31 and did not differ with treatments T7, T8 and T9, and the values were 121.05, 121.44 and 118.70 gm, respectively, at the fourth week of bird life. It indicated a significant increase in T4 compared to the control treatment, and its value was 152.80 gm; it did not differ from T2, T3, and T7 values, which were 147.93, 148.75 and 148.78 gm, respectively, at the fifth week of life. While it was observed that there was a significant increase for treatments T4, T5, T6 and 8T compared with the control treatments and the rest of the treatments and a significant rise in the treatments, as the values of treatments were recorded as 231.71, 232.12, 229.67 and 231.25 gm, respectively. So, no significant difference was observed between the control and the rest of the treatments, T3, T4, T7, T8 and T9, in the sixth week of the age.

## Discussion

The reason is that omega-3 oil contains unsaturated fatty acids, which have a role in increasing the rate of fertility[14].

As for the hatchability of the total eggs, it was observed that there is a significant superiority of the omega-3 treatment, a decrease in fetal mortality was also observed in favor of omega-3 treatment, because it is a fatty acid, and this agrees with Botsoglu *et al.*[15]. Omega contains a wide range of nutrients, minerals, chemical compounds, and vitamins, which has a positive role in improving production performance[16]. Thus, the egg's internal components were the main source of growth and embryonic development. Omega is an antioxidant because it contains many phenolic compounds, vitamins C and E.

The results showed a significant decrease in the percentage of pipped eggs for all treatments, a highly significant increase was recorded for the treatment T9, as its value was 14.80%; as for the characteristic of pipped eggs, a decrease in the percentage of captive eggs was observed with omega-3 treatment, the increased activity and vitality of chicks is due to the presence of unsaturated fatty acids, supportive of Growth[17,] which was the result of increased

| Treatments | Bird age (week) | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| T1 | 23.53±$^{c}$ 0.21 | 41.97±0.54 $^{cd}$ | 76.87± $^{c}$ 0.20 | 115.78± $^{bc}$3.12 | 144.12±0.29 $^{bc}$ | 225.11±3.09 $^{b}$ |
| T2 | 23.51± $^{c}$ 0.25 | 41.11±0.06 $^{d}$ | 76.17± 0.53 $^{c}$ | 111.10±2.41 $^{cd}$ | 147.93± $^{ab}$ 1.13 | 208.93±0.32 $^{c}$ |
| T3 | 23.94±$^{bc}$0.19 | 40.10± 0.51 $^{d}$ | 78.28±0.08 $^{c}$ | 109.18±0.44 $^{cd}$ | 148.75±$^{ab}$2.73 | 209.08±0.54 $^{c}$ |
| T4 | 28.09± $^{a}$ 0.29 | 53.82±2.56 $^{a}$ | 91.02±0.12 $^{a}$ | 122.45±0.90 $^{bc}$ | 152.80±0.95 $^{a}$ | 231.71±3.39 $^{a}$ |
| T5 | 24.62±$^{b}$ 0.09 | 49.18±0.19 $^{b}$ | 80.68±0.86 $^{b}$ | 105.64± $^{d}$0.76 | 141.60±2.12 $^{c}$ | 232.12± $^{a}$ 0.60 |
| T6 | 23.47±0.17 $^{c}$ | 45.34±1.39 $^{c}$ | 82.05± $^{b}$ 0.65 | 124.31±3.59 $^{a}$ | 143.43± $^{bc}$ 2.54 | 229.67±0.78 $^{ab}$ |
| T7 | 23.17±0.52 $^{c}$ | 44.09±1.10 $^{cd}$ | 81.41±0.88 $^{b}$ | 121.05±2.17 $^{ab}$ | 148.78±2.36 $^{ab}$ | 224.89±3.20 $^{b}$ |
| T8 | 23.82±0.40 $^{bc}$ | 42.63±1.55 $^{cd}$ | 76.26±0.88 $^{c}$ | 121.44±3.62 $^{ab}$ | 146.51±1.70 $^{bc}$ | 231.25±0.52 $^{ab}$ |
| T9 | 23.56±0.37 $^{c}$ | 40.31±1.16 $^{d}$ | 76.70±0.85 $^{c}$ | 118.70±1.88 $^{ab}$ | 142.72±1.44 $^{bc}$ | 225.07±1.05 $^{b}$ |
| Sig. | ** | ** | ** | ** | ** | ** |

**Table 2.** Effect of Japanese quail parents feeding and the resulting eggs being in ovo injected with omega-3 fatty acid and sunflower oil on body weight (mean ± standard error).

accumulation of glycogen stores in the liver in the last period of hatching, it gives the chick energy that enables it to make the hatching process faster[18]. Its effect may be attributed to the analysis of red blood cells or affect membrane permeability and gas exchange; thus, it disrupts the general biological system, which appeared with a high percentage of sucker eggs and dead pecking chicks[19].

The reason for the weight gain of the treatment to which omega-3 was added is due to the presence of unsaturated fatty acids, especially omega-3, which is present in cod liver oil and its addition to the diets of plant sources converts the carbohydrates and glycogen present in abundance in the diets of plant sources into glucose and transmitted by insulin, which binds With unsaturated fatty acids and converting them to triglycerides in the adipose tissue, thus achieving superiority in weight gain, as well as working to supply the chicks with fat-soluble vitamins that enter the composition of cells or due to a decrease in the speed of food passage through the alimentary canal and thus allowing food to be absorbed well as confirmed[20], agreed with Abdullah and Bahaa El Din[21] when adding olive oil and argan oil to the diet did not agree with Nobakht *et al.*(2011), as no significant differences were observed between the treatments to which the source of fat was added in the weight gain for broiler meat.

## Conclusions

We conclude that omega-3 has an essential role in improving the hatching characteristics of Japanese quail; injecting hatching eggs with omega-3 improves the attributes of hatching, which is represented by an increase in the rate of hatching and a decrease in the percentage of embryonic deaths, which is reflected in a financial return on the hatchery owners, and thus they can be encouraged to use omega-3 injections for hatching eggs on a commercial scale. Injection of early hatching eggs for broilers with different percentages of omega-3 improved the final weight rate during the period of rearing, which is one of the indicators of improved health of birds.

### Supplementary Materials

The following are available in this PDF, Table S1: Composition culture medium, Sheet 1 S2: Total cost, Sheet 2 S2: Stages of production, Sheet 3 S2: Direct and indirect labor, Sheet 4 S2: Culture medium, Sheet 5 S2: IMC, Sheet 6 S2: 6. Assumptions.

### Author Contributions

Conceptualization, Ana María Henao Ramírez and Aura Inés Urrea Trujillo; methodology and software, Hernando David Palacio Hajduck and Ana María Henao Ramírez; validation anf formal analysis, Ana María Henao Ramírez; investigation, resources, data curation, writing—original draft prepara-tion, Ana María Henao Ramírez; writing—review and editing and supervision, Aura Inés Urrea Trujillo. All authors have read and agreed to the published version of the manuscript.

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### Conflicts of Interest

The authors declare no conflict of interest.

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