(effect of early feeding with zinc-methionine on improving growth performance and some biochemical characteristics of broilers)

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Abstract:
This study was conducted to find out the effect of injecting hatching eggs with zinc-methionine on the hatching characteristics, production performance, and some biochemical characteristics of broilers, where 300 eggs from broiler were used, and the eggs were divided into four treatments for each treatment 75 eggs injected with zinc-methionine at concentrations (0, 60, 80 and 100 ppm) and for the treatments T1, T2, T3, and T4 respectively. From the hatched chicks, 45 chicks were taken from each treatment. They were divided into three replicates, each repeating 15 chicks. And these chicks were raised for 35 days. During the two experiments, we reached the following results: Significant superiority (P<0.05) for treatment T3 in the proportion of chicks hatching, live body weight, and total weight increase compared to the rest of the studied treatments, as there was a significant superiority (P<0.05) for the two treatments T2 and T1 in the percentage of embryo mortality compared with the rest of the studied treatments, as the results indicated a significant superiority (P<0.05) for treatment T1 in the feed consumed rate, there was a significant improvement (P<0.01) for the two treatments T4 and T3 in the feed conversion factor compared with the two treatments T2 and T1. Also, there was a significant superiority (P<0.05) for treatment T1 in the glutathione peroxidase and AST enzymes, ALT, and also manlodehydes.

Keywords: broiler, injection, hatching eggs, zinc methionine.

Introduction:
The importance of zinc is due to its role in cell proliferation, increasing growth, improving fertility, immunity, and gene expression, as well as being an essential part of the activity of many enzymes. It is considered very necessary in the process of developing the immune system and its effectiveness (Teeter et al., 1985) and (Mashaly et al., 2004). Sahin et al. (2006) and (Sahin et al., 2009) indicated that zinc is an important factor in enzymatic activity. Some studies indicate that zinc should be added to the diet at 40 ppm according to the recommendations of the Food Research Association (NRC.1994), and Sahin and KUCUK, 2003 noted that there is an improvement in feed consumption rate, body weight, and conversion efficiency. And this was confirmed by (Pierce et al., 2007). Mustafa and Saber (2011) indicated that the injection of hatching eggs with methionine at a concentration of 5 mg / 0.2 ml/egg led to a significant increase (p <0.01) in concentration of Hemoglobin, the total number of red and blood cells The volume of PCV and lymphocytes, total albumin, total globulin, and serum antibodies directed against Newcastle and CBBF, and the results showed that the 19-day-old injection was superior to the rest of the ages compared to the injection at ages 0, 7, 14 Therefore, this study aims to investigate the
effect of injecting the hatching eggs with zinc methionine on improving the hatching characteristics and the subsequent growth performance of the hatched chicks.

Materials and methods.

This experiment was conducted in the cheflawi Poultry Company hatchery in the Mahaweli / Babel Government for the period from 2/5/2020 until 2/25/2020. In the first experiment, eggs were injected, and the second experiment was conducted on a farm for poultry in Babel Government for a period 2/25/2020 to 3/24/2020, in which the hatched chicks were raised from the first experience.

Obtained the eggs from the cheflawi Poultry Company's hatchery (imported from the Turkish company EGE-TAV AS) and the weight of eggs Hatching 300 eggs individually with a digital scale type SF-400 Electronic Kitchen scale (broiler broilers type (ROSS 308) with an average weight of (± 53 g)) 1) The eggs that were dirty or had deformities were excluded. From the hatched chicks, 45 chicks were taken from each treatment and bred for 35 days, where each treatment was divided into three replicates, each of 15 chicks.

Solutions used in egg injection:

Distilled water was used to prepare the egg injection solution and the zinc-methionine powder was obtained from the US company Zinpro.

Egg injection treatments:

1) The first treatment with NaCl solution injection
2) The second treatment: 0.3 ml injection / egg with zinc-methionine solution (60 ppm)
3) The third treatment, injection of 0.3 ml/egg with a solution of zinc-methionine at a concentration (80 ppm).
4) Fourth treatment, injection of 0.3 ml/egg with a zinc-methionine solution at a concentration (100 ppm)

Feed treatment:

The chicks were fed on the starter diet From the one day age until the third week of the bird's age, containing a protein of 23% and representative energy of 3027 kcal/kg for feed, then they were replaced by final diet until the end of the fifth week, a container containing a protein of 20% and representative energy of 3195.3 kcal/kg. The feed and water were provided free of charge (ad libitum) and the feed used is as shown in the table below.
Table 1: Shows the percentages of diet components in the study and their chemical composition

| Feeding Materials         | % starter diet | % Final diet |
|---------------------------|----------------|--------------|
| yellow corn               | 30             | 40           |
| wheat                     | 28.25          | 24           |
| Soybean meal (48% protein)| 31.75          | 24.8         |
| protein concentrate *     | 5              | 5            |
| Sunflower oil             | 2.9            | 4.4          |
| limestone                 | 0.9            | 0.6          |
| DCP Calcium Diphosphate   | 0.7            | 0.9          |
| salt                      | 0.3            | 0.1          |
| Mix vitamins and minerals | 0.2            | 0.2          |
| Total                     | 100            | 100          |
| General protein (%)       | 23             | 20           |
| Calculated energy represented (kilocalories / kg feed) | 3027 | 3195.3 |
| Lysine (%)                | 1.2            | 1.1          |
| Methionine (%)            | 0.49           | 0.46         |
| Cystine (%)               | 0.36           | 0.32         |
| Methionine + cysteine (%) | 0.85           | 0.76         |
| Available phosphorus (%)  | 0.45           | 0.49         |
| C / P%                    | 131.61         | 159.77       |

*BROCON-5 SPECIAL W protein concentrate *: Chinese origin, each kg contains: 40% crude protein, 3.5% fat, 1% fiber, 6% calcium, 3% phosphorous available, 3.25% lysine, 3.90% methionine + cysteine 2.2% sodium, 2100 kcal / kg energy represented, 20,000 IU vitamin A, 40000 IU vitamin D3, 500 mg vitamin E, 30 mg vitamin K3, 15 mg vitamin B1 + B2, 150 mg B3, 20 mg B6, 300 B12 mg, 10 mg folic acid, 100 mcg biotin, 1 mg iron, 100 mg copper, 1.2 mg manganese, 800 mg zinc, 15 mg iodine, 2 mg selenium, 6 mg cobalt, 900 mg antioxidant (BHT).

**According to the chemical analysis of the diet according to NRC (1994).

studied traits

- Hatching traits.
1- The percentage of hatching %

The percentage of hatching for the treatments was calculated by extracting the percentage of each treatment and according to the following formula (Khattab et al., 1992):

The percentage of hatching from fertilized eggs % = \( \frac{\text{The number of hatching chicks}}{\text{The number of fertilized eggs}} \times 100 \)

2- Weight at hatching (gm).

The hatched chicks are weighed for each treatment with the hatchery, as the box is empty then weighed with the chicks, and then the weight of the empty box is extracted from its weight with the chicks and this represents the weight of the chicks after hatching for the treatment, then divide the total weight (g) of the treatment by the number of chicks for the treatment to obtain the average weight at Hatching (gm) / chick.

3- The percentage of embryonic mortality %

It was calculated as follows (Khattab et al., 1992):

The percentage of embryonic mortality % = \( \frac{\text{The number of mortality chicks}}{\text{The number of fertilized eggs}} \times 100 \)

- Productive traits.

1- live body weight and weight gain

The average live bodyweight of each treatment was calculated at the end of each week and for weeks (1 - 5) by the weight of all birds of one replicate. The average live weight of replicate was calculated as follows (Al-Fayadh and Naji, 1989):

The average of live body weight (g) = \( \frac{\text{Total Live Weight of Birds for the Weekend (g)}}{\text{The number of birds at the end of the week}} \)

As for the weekly weight gain rate (g / m), it is calculated as follows (Al-Fayadh and Naji, 1989):

Average Weekly Live Body Weight (g) - Average Weekly Body Weight (g).

2- Feed consumption
The average feed consumption per week for birds of one replicate and weeks (1-5) was calculated by the weight of the feed provided to it at the beginning of the week, minus the weight of the remaining feed at the end of it, and As for the presence of Mortality in replicate, the feed consumption was calculated as follows (Al-Fayadh and Naji, 1989).

Average daily feed consumption (g / bird) = \( \frac{A}{H \times 7 \times 5} \)

Where \( A \) = represents the amount of Feed consumption within a week

\( H \) = represents the number of live chicks at the end of the week

3- feeding conversion ratio

The feeding conversion ratio was calculated according to the formula indicated by Al-Fayadh and Naji (1989)

Weekly feeding conversion ratio = \( \frac{The \ average \ amount \ of \ Feed \ consumption \ (g) \ within \ a \ week}{average \ weight \ gain \ (g) \ within \ a \ week} \)

4-Total mortality rate%

The mortality was recorded from the start of the experiment until the end of the experiment at the end of the fifth week and was calculated as follows.

Total mortality rate\% = \( \frac{The \ number \ of \ mortality \ birds \ during \ the \ experiment \ period}{total \ number \ of \ birds} \times 100 \)

- Biochemical traits.

The concentration of glucose and cholesterol in the bird's blood serum was estimated 21 days old of beards. Blood samples were taken from birds immediately after their slaughter and were collected in tubes that do not contain anticoagulant, and then The serum was separated from the blood by using a centrifuge at a speed of 3000 cycles/minute for 15 minutes, and then the traits mentioned in the life sciences laboratory at the College of Science / University of Babylon were measured, the enzyme glutathione peroxidase, its concentration was measured using a kit measuring (Kit) from Roche company based on Rotruck and others 1973) and malonaldehyde has been measured using a kit measuring kit (Roc) based on Buege and Aust 1978).
The concentration of ALT and AST enzymes was estimated using a kit (Kit) from the German company Roche and according to the method (Ritman and Frankel 1957).

- **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 (Duncan, 1955). SAS (2012) was used in the statistical analysis according to the following mathematical model:

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

  where

  \( Y_{ij} \): 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 \( \sigma^2_e \)

  **Results and discussion**

  **1- Productive characteristics**

  **1-1 hatching characteristics**

  It is evident from Table (2) that there were no significant differences between the treatments studied in the weight of chicks at hatching. As for the percentage of hatching, it was significantly superior (P<0.05) treatment T3 compared to treatments T1, T2, T4, and treatment T4 was superior compared to the two treatments T1 and T2. There was a significant improvement between the two treatments T1 and T2 and in the percentage of embryo damages, the two treatments T3 and T4 improved significantly (P<0.05) compared to the two treatments T1 and T2. There were no significant differences between the two treatments T1 and T2 as well as the two treatments T3 and T4.

  The improvement in hatchability and the decrease in fetal mortality in T3 and T4 treatments may be due to the role of zinc-methionine injection in eggs as zinc deficiency in maternal diets causes decreased hatching, abnormal embryonic development, and impaired growth and development of embryos (Zhu, 2016; Zhu et al. Zinc increases the synthesis of metallothionein within the body, which is a protein-
rich in cysteine that works to suppress free radicals. Zinc also acts as a cofactor for antioxidants, especially superoxide dismutase, as well as its association with enzymes that maintain cell integrity (Huang et al., 2013; Liao et al., 2013). (2013: Shen et al., 2013: Liu et al., 2015: Li et al., 2015: Suo et al., 2015) Zinc is also important in the process of bone formation and mineralization (Yair and Uni, 2011) as zinc participates in the regulatory pathways of bone and cartilage formation such as collagen formation (Starcher et al., 1980) and that the low concentration of zinc inside the egg hinders these processes in the last days of embryonic growth and development as indicated by Zhu et al. (2017) that dietary zinc increases the ability of embryos to resist heat and oxidative stress during pregnancy. The fetal growth period, as well as the sulfur-containing amino acid methionine, has an important role in the growth and development of the fetus, as it improves the growth and development of the intestine by injecting it into the amniotic sac and swallowing it by the fetus at the age of 19 days of the age of the fetuses into the abdominal cavity and thus directly affect the intestine (Vaezi et al., 2011) also plays an important role in developing fetal immunity (Huygehebaert et al., 2010). Mohammadrezaei et al. (2015) also mentioned that methionine injection improves embryo growth, hatching rate, and the weight of hatched chicks, and between Kidd, (2004) that methionine aids in growth. And the development of the body through its entry into the processes of protein synthesis and the manufacture of glutathione peroxidase, which plays a role in scavenging free radicals. Also, methionine is included in the methylation reaction of DNA. Nazem et al. (2017) found that methionine injection caused an increase in the percentage of hatching and the weight of the hatched chicks and attributed the reason for its role. In fetal antioxidant status, Brosnan and Brosnan (2006) show that methionine forms the amino acid cysteine inside the body, which improves fetal development.

Table 2. Effect of early zinc-methionine feeding on weight at hatching (g), hatchability rate (%), and fetal lethality percentage (%).

| Treatment | Average ± standard error | Hatching percentage | Embryonic mortality |
|-----------|--------------------------|---------------------|---------------------|
|           | Weight in hatching       |                     |                     |
| T1        | 1.05 ± 40.30             | c 2.55 ±80.00       | a 1.17 ±20.00       |
| T2        | 1.20 ± 41.10             | c 2.28 ±80.50       | a 1.25 ±19.50       |
| T3        | 2.37 ± 41.62             | a 1.88 ±84.00       | b 1.33 ±16.00       |
| T4        | 0.25 ± 40.25             | b 1.21 ±83.00       | b 1.87 ±17.00       |
| Significant| N. S                    | *                   | *                   |

The averages carrying different letters within the same column differ significantly with each other at the level of * (P <0.05), NS: not significant. The treatments T1, T2, T3, and T4 are control treatments without injection, injection of 60,80,100 ppm of zinc-methionine into the hatching eggs, respectively.

**1-2 live body weight and weekly weight gain (g / bird)**

Table (3) shows that there is significant superiority (P<0.05) for treatment T4 in live body weight during the first and fourth week compared to the rest of the treatments, and for the two treatments T2 and T3 compared to treatment T1, and there were no significant differences
between the two treatments T2 and T3. Significant superiority (P<0.05) for the two treatments T4 and T3 compared to the two treatments T2 and T1 and the treatment T2 outperformed the treatment T1. No significant difference was obtained between the two treatments T3 and T4. In the fifth week, a highly significant (P<0.01) was found for treatment T3 compared to the two treatments T1, T2, and treatment T2 surpassed treatment T1. There were no significant differences between the two treatments T3 and T4 on the one hand and the two treatments T2 and T3 on the other hand.

In the weekly weight gain increase table (4), it was found during the first week that there was a significant superiority (P<0.01) for treatment T4 compared to the rest of the treatments, and for the two treatments T3 and T2 compared to treatment T1, and no significant difference appeared between the two treatments T2 and T3. In the second week, it was found that there is a significant superiority (P<0.01) for treatment T3 compared to the rest of the treatments and treatment T1 outperformed the two treatments T2 and T4, and there was no significant difference between the two treatments T2 and T4. In the third week, there was a significant superiority (P<0.01) for treatments T2, T3, and T4 over treatment T1, and no difference was obtained Significant among the treatments T2, T3, and T4, and in the fourth week, a significant superiority was found (P<0.05) for treatment T4 compared to the rest of the treatments, as treatment T2 outperformed the two treatments T1 and T3 and treatment T3 outperformed treatment T2 and at the fifth week a significant superiority was found (P<0.01) For treatment T3 compared to the rest of the trial treatments, treatment T4 outperformed the two treatments T2 and T1. There were no significant differences between the two treatments T1 and T2. The significance (P<0.05) of treatment T3 continued in the cumulative weight increase compared to the two treatments T2, T1, and the two treatments T2 and T4 outperformed the treatment T1, and there was no significant difference between the two factors T3 and T4 and also the two treatments T2 and T4.

**Table 3: Effect of Zinc-Methionine Hatching Eggs Injection on Live body Weight (g / Bird) of broilers**

| Treatments | One week   | Two week  | Three week | Four week  | Five week |
|------------|------------|-----------|------------|------------|-----------|
| T1         | 144.18 ± 0.40 c | 465.19 ± 3.50 c | 738.40 ±0.30 c | 1212.00 ± 1.00 c | 1997.17 ±1.25 c |
| T2         | 153.55 ± 0.60 b | 471.20 ± 2.50 b | 761.73 ±0.40 b | 1252.90 ± 2.10 b | 2030.90 ±1.50 b |
| T3         | 152.14 ± 0.50 b | 479.75 ± 1.15 a | 769.60 ±1.50 a | 1250.17 ± 1.55 b | 2110.18 ±1.40 a |
| T4         | 159.80 ± 0.25 a | 479.10 ± 2.15 a | 768.13 ±2.00 a | 1290.50 ±1.76 a | 2098.15 ±2.25 ab |

The averages carrying different letters within the same column differ significantly between them at the level of * (P<0.05), ** (P<0.01). The treatments T1, T2, T3, and T4 are control treatments without injection, injection of 60,80,100 ppm of zinc-methionine into the hatching eggs, respectively.

**Table 4: The effect of injecting the hatching eggs with zinc-methionine on the weekly weight gain (g / bird) of broilers**

The averages carrying different letters within the same column differ significantly between them at the level of * (P<0.05), ** (P<0.01). The treatments T1, T2, T3, and T4 are control treatments without injection, injection of 60,80,100 ppm of zinc-methionine into the hatching eggs, respectively.
The averages carrying different letters within the same column differ significantly between them at the level of * (P < 0.05), ** (P < 0.01). The treatments T1, T2, T3, and T4 are control treatments without injection, injection of 60, 80, 100 ppm of zinc-methionine into the hatching eggs, respectively.

**1-3 feed rate consumption (gm / bird)**

Table (5) shows the effect of the studied treatments on the feed consumed rate and during the first week a significant superiority (P <0.01) was observed for treatment T4 compared to the rest of the treatments and for treatment T3 compared to treatment T1. There was no significant difference between the two treatments T2 and T3 on the one hand and the two treatments T2 and T4 compared to the two treatments T1 and T3 on the other hand. In the second week, it was significantly superior (P <0.05), treatment T1, compared to the two treatments T3, T4 and there was no significant difference between the two treatments T1, T2 and also the two treatments T3, T4. T1, T3 compared to the two treatments T2 and T4, and there was no significant difference between the two treatments T1 and T3 on the one hand and the two treatments T2, T4 on the other hand. Treatment T3 and in the last week of the experiment significantly outperformed (P <0.05) treatment T3 over the two treatments T2 and T4 and treatment T4 outperformed treatment T2. There was no significant difference between the two treatments T1, T3, and also the two treatments T1, T4. As for the rate of feed consumed, it exceeded significantly (P<0.05) treatment T1 compared to the rest of the treatments, and treatment T2 was superior to treatment T4 No significant difference occurred between the two treatments T2 and T3 on the one hand and the two treatments T3 and T4 on the other hand.

**Table 5: The effect of zinc-methionine injection of hatching eggs on feed consumed rate (g / bird) for broilers**
Table 6: The effect of zinc-methionine injection of hatching eggs on feed conversion efficiency (gm feed / gm meat / bird) for broilers

| Treatments | One week | Tow week | Three week | Four week | Five week | Total |
|------------|----------|----------|-----------|-----------|----------|-------|
| T1         | 0.061±1.165 | 0.130±1.245 | 0.512±2.237 | 0.350±1.808 | 0.633±1.543 | a 0.121±1.584 |
| T2         | 0.210±1.126 | 0.180±1.228 | 0.180±2.021 | 0.520±1.732 | 0.339±1.523 | b 0.133±1.527 |
| T3         | 0.100±1.175 | 0.113±1.154 | 0.113±2.105 | 0.340±1.646 | 0.432±1.416 | c 0.149±1.463 |
| T4         | 0.200±1.115 | 0.171±1.156 | 0.171±2.015 | 0.381±1.561 | 0.391±1.497 | c 0.125±1.461 |
| Significant | **       | **       | **       | **       | **       | **   |
The averages carrying different letters within the same column differ significantly between them at the level of * (P<0.05), ** (P<0.01). The treatments T1, T2, T3, and T4 are control treatments without injection, injection of 60, 80, 100 ppm of zinc-methionine into the hatching eggs, respectively.

### 1-5 Total mortality percentage

It is noticed from Table (7) that there are no significant differences between the studied treatments in the total percentage of perdition.

**Table 7: Effect of zinc-methionine injection of hatching eggs on the% total mortality of chicks for broilers**

| Treatments | Average ± standard error |
|------------|-------------------------|
|            | Total mortality         |
| T1         | 0.02 ± 0.25             |
| T2         | 0.05 ± 0.20             |
| T3         | 0.00 ± 0.00             |
| T4         | 0.00 ± 0.00             |
| Significant| NS                      |

The averages carrying different letters within the same column differ significantly with each other at the level of NS: not significant. The treatments T1, T2, T3, and T4 are control treatments without injection, injection of 60, 80, 100 ppm of zinc-methionine into the hatching eggs, respectively.

The significant improvement in the productive performance of broilers may be due to the role of zinc in improving the productive performance of broilers to reach better growth through its work in reducing the damage of oxidative stress, as antioxidants are necessary to prevent economic losses in poultry (Salami et al., 2015). Zinc increases the synthesis of metallothionein, a protein rich in cysteine that suppresses free radicals (Oteiza, 1996). Zinc also acts as a cofactor for antioxidants, especially superoxide dismutase, as well as its association with enzymes that maintain the integrity of cells that participate in the immune response and thus Improving the production performance of broilers (Valko et al., 2016). Also, zinc is absorbed in the intestine, where it binds to the intestinal protein metallothionein or can be transported by albumin to the liver (Prasad, 1993; Oteiza, 1996). And zinc can replace some mineral elements.
such as iron Fe and copper Cu in their places of union and bind with cell membranes and reduce the production of free radicals and thus it acts as an anti-oxidant directly in body tissues (Powell, 2000; Prasad and Kucuk, 2002). The improvement in growth of zinc-methionine injection treatments may be due to the role of methionine in the metabolism processes within the body as it works to balance other amino acids such as cysteine and participates in the synthesis of betaine, choline, vitamin B12 and folate metabolism (Chen et al., 1993). Important for sulfur in the body and a strong donor of the methylation group, which contributes to the formation of many important compounds within the body such as creatine and choline (Bender, 2012). Free radicals lead to damage to somatic cells (Surai, 2000), and zinc works to prevent this condition in the body by preventing lipid peroxidation by inhibiting glutathione depletion (Prasad, 1997). Also, the significant improvement in the treatments that were injected with zinc-methionine may be due to the role that zinc plays in enhancing the birds’ resistance to oxidative stress, which was directly reflected in the improvement in the productive performance of the birds in these treatments compared to the control treatment that achieved the lowest growth rate and the lowest food conversion factor. Zinc is necessary for the activity of many enzymes, and it is involved in many enzymatic activities that are involved in the metabolic processes in the body (Prasad and Kucuk, 2002). Zinc also works to increase the growth rate of birds by increasing the utilization of the food intake through its participation in the metabolism of carbohydrates, fats and proteins (MacDonald, 2000), and this is consistent with what we found in the results of our experiment in which we observed an increase in live body weight and feed consumption and an improvement in the coefficient Dietary conversion compared to a control treatment. The increase in live body weight, the rate of weight gain, and the improvement in the efficiency of the nutritional conversion in injection treatments compared to control may be due to the role of zinc in maintaining the synthesis of metalloproteins such as GH, IGF-1 and insulin, and this role contributes to Maintaining the normal growth and development of the body, as these hormones regulate glucose uptake and regulate cellular processes (Midilli et al. 2014; Khan et al. 2014; Rouhalmini et al. 2014). The reason may also be due to the role that zinc plays in improving the health status of birds by increasing the effectiveness of the metabolism rate in the body as a result of an increase in the level of the thyroxine hormone (T4 when adding zinc). Levels of Thyroid-stimulating hormone (TSH), which is secreted by the pituitary gland, and then a decrease in the thyroid hormones Thyroxine and Triiodothyronine, indicating that zinc plays a role in building body tissues by increasing the level of thyroid hormones. It plays an important role in regulating protein metabolism in the body and protecting it from breakdown by preventing the oxidation process in cellular membranes (Park et al., 2011; Xiao et al., 2011; Midilli et al., 2014). Zinc also acts as an adjunct to several enzymes related to the manufacture of proteins and carbohydrates. Energy metabolism and other biochemical reactions, it also plays a role in RNA and DNA synthesis, tissue restoration and growth, bone mineralization, and blood clotting (Salim et al., 2008). Methionine also plays An important role in improving growth through its effectiveness as an antioxidant (Kidd, 2004) and also important in the synthesis of protein inside the body and the development of the body through its entry into the processes of protein synthesis and synthesis of glutathione peroxidase, which plays a role in scavenging free radicals, as well as methionine in the methylation reaction of DNA Nazem et al. (2017), also found that methionine injection caused an increase in the percentage of hatching and the weight of hatched chicks. Brosnan and Brosnan (2006) explained that methionine is the amino acid cysteine inside the body, which improves the growth of embryos and this is reflected in the growth of birds during the breeding period where
there is a positive correlation coefficient between the weight of chicks when hatching and their weight at marketing.

2- Biochemical characteristics

It is noted from Table (10) a significant superiority (P<0.05) of treatment T1 in the concentration of the enzyme glutathione peroxidase compared to the two treatments T4 and T2 and the superiority of the two treatments T2 and T3 compared to treatment T4. (P<0.05) the control treatment T1 compared to the treatments T4, T3, T2 and the treatment T2 also outperformed the two treatments T3 and T4. No significant difference was obtained between the two treatments T4 and T3. As for the concentration of the AST enzyme, the superiority of (P<0.05) treatment T1 compared to the treatments T4. The superiority of (P<0.05) treatment T1 in the concentration of the ALT enzyme was withdrawn from the two treatments, T2 and T3, over treatment T4, and the statistical analysis showed no significant differences between the two treatments, T2 and T3. There was no significant difference between the two treatments T3 and T4. That the decrease in the activity of the enzymes AST and ALT in the treatments T2, T3 and T4 may be due to the role of zinc in enhancing antioxidants and oxidative stress on birds, as the reason for the increase in the activity of the enzyme AST in the control treatment may be due to the exposure of the birds of this treatment to oxidative stress and thus it works to stimulate the increase of the corticosterone hormone, which rises due to stress on birds in this treatment, which affects many liver enzymes, including AST and ALT, which leads to an increase in their activity in the blood (Richard and Preston, 2006). Zinc may act as an antioxidant to reduce the stimuli of the oxidation process, such as metal ions, by preventing its release from the tissues and then breaking the chain of free radical interaction and stopping the production and formation of these radicals, especially free radicals of reactive oxygen species, thus protecting liver membranes as well as protecting polyunsaturated fatty acids from cell membranes from oxidative damage and thus preserving the facultative permeability characteristics of the liver membrane, which prevents enzymes from leaking from inside the cell to the outside (Dani et al., 2008), or it may be caused by methionine, which is included in the manufacture of the enzyme glutathione peroxidase, which improved the state of oxidation inside the body (Kidd, 2004).

The reduction of glutathione peroxidase in bird serum in the treatment of T4 and T2 may be due to the role of zinc-methionine as an antioxidant through its role in the synthesis of the protein metallothionein that works to suppress free radicals formed in cells (Oteiza, 1996) and the role of methionine as an antioxidant Nazem et al. (2017) and that the equal concentration of the enzyme glutathione peroxidase for the two treatments T3 and T1 is due to the exposure of treatment T1 to oxidative stress. As for the treatment T3, the reason may be due to the injection of methionine, which is included in the synthesis of the enzyme glutathione peroxidase, as indicated by Shen et al. (2015) that feeding birds a system A diet supplemented with 0.285% of methionine caused an increase in the concentration of glutathione peroxidase in the duodenal mucosa in chickens, which indicates the conversion of a large part of methionine to this enzyme in the chicken intestine. Zinc also works to prevent the formation of free radicals by replacing some of the mineral elements that zinc can replace, such as iron and copper, in the places of their union (Prasad and Kucuk, 2002). Zinc can also contribute to protecting the cell membranes from damage through its role as an antioxidant (Cunningham-Rundles et al., 1990). Prasad (1997) also stated that zinc inhibits glutathione depletion through its action in preventing lipid peroxidation, and this explains the low concentration of manaldehyde in zinc-methionine injection treatments.
Table (8) Effect of early zinc-methionine feeding on glutathione peroxidase, AST, ALT and molydehyde enzymes at 21 days of age of birds.

| Treatments | Average ± standard error |
|------------|--------------------------|
|            | Glutathione peroxidase | Monoaldehyde | AST       | ALT       |
| T1         | 3.10 ± 195.76a          | 0.41 ± 15.74a | 6.55 ± 50.76a | 0.15 ± 7.56a |
| T2         | 2.5 ± 182.75b           | 2.73 ± 12.95b | 0.93 ± 44.97b | 0.03 ± 6.81b |
| T3         | 4.96 ± 193.10 ab        | 1.51 ± 11.14c | 2.71 ± 43.72b | 0.28 ± 5.91c |
| T4         | 2.74 ± 179.61c          | ± 11.221.00 c | 1.58 ± 41.28c | 0.17 ± 6.92b |

The averages carrying different letters within the same column differ significantly between them at the level of * (P <0.05), ** (P <0.01). The treatments T1, T2, T3, and T4 are control treatments without injection, injection of 60,80,100 ppm of zinc-methionine into the hatching eggs, respectively.

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