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Productive Broiler Response to the Addition of Nano Selenium and Astaxanthin and Their Mixture to the Diet

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Abstract

This experiment was conducted in the poultry field of Al-Anwar Company in Babil governorate for a period from 11/8/2020 until 12/12/2020 (35 days). In this experiment, 315 chicks from the commercial hybrid (Ross-308) one day old without diagnosis their sex, Chicks were raised in cages with dimension of (1 x 1.5 m.). The chicks were divided randomly into 7 transactions, by 3 replicates for each treatment, and each one included 15 chicks, the experiment parameters were as follows: The first treatment T1: the control treatment without addition, the treatment T3, T2 addition of nano-selenium at a concentration of (0.3 and 0.5) mg / kg respectively, the treatment T5 and T4 addition of astaxanthin at a concentration of (60, 70) mg / kg respectively, while the sixth treatment, T6, included The mixture of nano-selenium with astaxanthin at a concentration of (0.3 + 60) mg / kg and the treatment T7 was the mixture of nano-selenium with astaxanthin at a concentration of (0.5 + 70) mg / kg. In this study, we reached the following results: A significant ($p < 0.05$) superiority was obtained in the live body weight of T7 and T4 in the fifth week of the experiment .It was found that there was a significant increase ($P < 0.05$) in the overall weight increase rate of treatment T7, and this treatment was also distinguished by the other transactions in the fifth week. It was evident that there was a significant decrease ($P < 0.05$) for the treatment T3 in the fifth week and the total feed consumption rate. There was a significant improvement ($P < 0.05$) in the total dietary conversion factor for the treatment T2. The percentage of total losses decreased in the two transactions T7 and T5 compared to the control treatment, with an increase in their ratios in treatment T2.

Introduction

Natural antioxidants play an important role in maintaining the health, productivity and reproductive performance of poultry, there is a large group of antioxidants in the form of molecules in vivo which are either synthesized in body tissues such as ascorbic acid, co-enzyme COQ, carnitine, antioxidant enzymes or are supplied. For birds in the diet, such as vitamin E, carotenoids, and Selenium (Se) is an essential and important mineral in poultry feed as it has biological importance in terms of regulating antioxidant activities, improving immune function, normal growth and sustaining the bird's body (Surai, 2002). Selenium is involved in the synthesis of selenocysteine,

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which is part of the active center of glutathione peroxidase. This enzyme has an antioxidant effect and contributes to oxidative defense by reducing the stimulation of hydrogen and lipid peroxides to the least harm (Arthur, 2000). The activity of this enzyme is concentrated in the liver and plasma. With the recent development of nanotechnology, nano-selenium (Nano-Se) has attracted attention because nanoparticles exhibit many properties including large surface area, high catalytic efficiency, strong absorption and low toxicity (Wang et al. 2007, Zhang et al., 2008). Nanoselenium has an important role in reducing oxidative stress, (Sonkusre et al., 2014) It showed the antioxidant properties of hollow spherical nanoselenium particles that also reduce the risk of selenium toxicity. Recent studies found that nano-selenium supplementation promoted Superoxide dismutase (SOD), Glutathione peroxidase (GSH-PX), Catalase (CAT), and reduced oxidative stress and lipid peroxidation (Cai and Cong, 2012). The addition of nano-selenium in broiler diets improved traits, Productivity and Physiology (Al-Khafaji and AL-Saidi, 2019). Astaxanthin are carotenoids within the xanthophyll group, a red pigment that is very common in marine organisms and microorganisms. It is a powerful antioxidant and anti-lipid peroxide due to the presence of two active groups (O_2 and OH) at the end of the molecule chain at each aromatic ring and is responsible for the dark red color (Gachev, 2015) , The main advantage of astaxanthin is its ability to capture free radicals and reaction oxygen species present in biological systems that are able to oxidize and dissolve nucleic acids, proteins and fats, causing many diseases. (Al-amen et al., 2016). The use of astaxanthin in poultry feed improved production performance and achieved high results in overweight rates (Kim and Jeong, 2014; Ulaiwi and AL-Khafaji, 2020). Therefore, the current study aims to know the response of broiler meat to improve some physiological characteristics and oxidation indicators to add nano-selenium and astaxanthin and their mixture in their diets.

Materials and methods

This experiment was conducted in the fields of Al-Anwar Company in Babil governorate for a period of 35 days from the date of 11/8/2020 until 12/12/2020, to demonstrate the response to some physiological characteristics and oxidation indicators of broilers when adding nano-selenium, astaxanthin and their mixture to their diets, 315 chicks were used type (Ross 308) aged one day without a diagnosis their gender was divided randomly into 7 transactions and by 3 replicates for each treatment, each one contained 15 chicks and the replicates were distributed within two cages of(1 × 1.5 m) dimensions, nano-selenium and astaxanthin were added to the feed according to the following transactions:

T1 control / without any addition

T2 Add nano-selenium at a concentration of 0.3 mg / kg

T3 Add nano-selenium at a concentration of 0.5 mg / kg

T4 Add astaxanthin at a concentration of 60 mg / kg T5 Add astaxanthin at a concentration of 70 mg / kg

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T6 Add a mixture of nano selenium and astaxanthin at a concentration of (0.3 + 60) mg / kg feed, respectively.

T7 Add a mixture of nano selenium and astaxanthin at a concentration of (0.5 + 70) mg / kg feed, respectively**.**

Chicks were fed on starter diets (protein ratio 23.04% and energy amount 3027.45 kilocalories / kg feed) from one day to the third week of life of birds, after that the feed was replaced by growth diet (protein ratio 20.06 and energy amount 3194. 92 kcal / Kg. Feed) until the end of the fifth week, and the feed with additives of nano-selenium and astaxanthin mixed with the concentrations indicated above and water were provided freely. the feed used as shown in Table (1).

Table (1) shows the percentages of the components of the diet used in the study and their chemical composition

Feed material	**Feed startup**	**Feed growth**
Yellow corn	30	40
Wheat	28.25	24
(48% protein)soybean	31.75	24.8
Protein concentrate	5	5
Sunflower oil	2.9	4.4
limestone	0.9	0.6
Dicalcium phosphate (DCP)	0.7	0.9
A mixture of vitamins and minerals	0.2	0.2
Nacl	0.3	0.1
Total	100	100
Crude Protein (%)	23.04	20.06
Calculated representative energy (kcal / kg feed)	3021.45	3194.92
Lysine %	1.27	1.07
Methionine%	0.41	0.38
cysteine %	0.35	0.30
Methionine+cysteine %	0.82	0.78
Phosphorous %	0.41	0.43
c/p Energy Ratio: Protein%	131.14	159.77

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Protein concentrate type Brocon-5 Special W: Chinese origin: Each kg of it contains (40% crude protein, 3.5% fat, 1% fiber, 6% calcium, 3% available phosphorous, 3.25% leucine, 3.90% methionine + cysteine, 2.2% sodium, 2100 kcal / kg representative energy, 20000 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 mg B12, 10 mg folic acid, 100 micrograms butene, 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)

Chemical analysis of the suspension was calculated according to NRC (1994).

1 - **The materials used in the experiment**

The organic nano-selenium material was obtained from (Nanosany Corporation) in Iran, with a size of 30 nm, with a purity of 99%.

The synthetic dye astaxanthin was used from American origin with 100% purity, and the dye was in the form of a red powder

Live body weight and weight gain (gm / bird)

The average live body weight of each replicating at the end of each week and for (1-5)weeks, was calculated by weighing all birds per repeater, and the average live weight of the bird was calculated as follows (Fayyad and Naji 1989):

$$\text{Average live weight (g / bird)} = \frac{\text{Total live weights of replicate birds at weekend (gm)}}{\text{Number of birds in the replicate}}$$

As for the average weekly weight gain (gm / replicate) it was calculated as follows (Al-Fayyad and Naji 1989 :

Average live body weight at the end of the week (gm) - Average live body weight at the beginning of the week (gm)

2- Feed consumption (g / bird)

The rate of feed consumption per week was calculated for the birds of one replicate for weeks (1-5) by the weight of the feed provided to them at the beginning of the week minus the weight of the feed remaining at the end of the week, but in the case of loss in any replicate, the feed consumption was calculated according to the following equation (Al-Zubaidi 1986)

$$\text{Average daily feed consumption (g / bird)} = \frac{P}{H \times 7 + x}$$

Where *p* .. is the amount of feed consumed during the week

H .. Represents the number of live chicks at the end of the week

x .. The number of days that the dead birds fed

3- the feed conversion factor (gm feed / gm weight gain)

The food conversion factor was calculated according to the equation referred to

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(Al-Zubaidi,1986)

Food conversion factor= $\frac{The\ average\ amount\ of\ feed\ consumed\ (gm)\ during\ the\ week}{Average\ weight\ gain\ (gm)\ during\ the\ week}$

feed / gm weight gain)

4- The percentage of total losses :

Cases of fatalities were recorded from the start of the experiment until its end, i.e. at the end of the fifth week and were calculated according to the following:

Total loss rate%=$\frac{The\ number\ of\ dead\ birds\ for\ the\ duration\ of\ the\ experimenty}{The\ total\ number\ of\ birds}$

5- Production Index (P. I) and Economic Figure (E.F)

Nagy and Hanna (1999) referred to methods of calculating the production index and the economic index, as follows:

Production Index(PI)=$\frac{Average\ body\ weight\ (gm)\times vital\ ratio}{Number\ of\ breeding\ days\ \times\ food\ conversion\ factor\ \times 10}$

Results

Table (2) indicates the effect of adding nano-selenium and astaxanthin and their mixture to a broiler diet on the average live body weight (gm). In the first week of the bird's life, we notice a significant increase ($p < 0.05$) in the mean live body weight of treatment T4 surpassed The transactions(T5, T3, T2 , T6). followed by the treatment T7 in terms of superiority and the same quality but over the transactions T1, T3, T5, T6. There were no significant differences between the two transactions T4 and T7. The treatment T2 showed significant superiority ($P < 0.05$) over the transactions T5, T3, and T1. Also, the treatment T6 was better in live body weight than the transactions T5, T3, and T1. No significant differences were found between the two transactions T7 and T2 and between the two transactions T6 and T2. On the other hand, there are also no significant differences between the parameters T5, T3, and T1 in the same characteristic. In the second week, we notice the highest rate of live body weight was in favor of treatment T7 and with a significant level ($P < 0.05$) on all transactions, followed by treatment T4 when compared with transactions T6, T5, T2, T1, and no significant difference was found between the two transactions T4 and T3.The treatment T3 outperformed with a significant level ($P < 0.05$) on treatment T6 in the live body weight characteristic, there were no significant differences between the transactions T2, T1, T6, and T5 for the same trait .The third week observed significant superiority ($P < 0.05$) for the two transactions T7 and T1 over the transactions T6, T5, T4, T3, and T2. No significant differences were observed between the two transactions T7 and T1 . It was followed by the treatment T4, which recorded a significant increase ($P < 0.05$) for the live weight characteristic over the

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transactions T2, T3, T5, and T6. We also note that the treatment T5 outperformed the transactions T6, T3, and T2, and then the treatment T2 outperformed each of T3 and T6. Treatment T6 recorded a decrease in the body weight characteristic in the third week, which was not significantly different from T3. The fourth week, we notice that treatment T7 continued to outperform the transactions T6, T5, T3, T2, and T1 with a significant level (P <0,05). It did not show a significant difference between it and treatment T4, which outperformed the other transactions. The two transactions T5 and T1 did not show any significant difference between them in the body weight characteristic, but it was superior to the transactions T6, T3, and T2, and a significant (P <0.05) superiority was observed in favor of treatment T3 over the transactions T2 and T6, followed by treatment T2 superior to treatment T6 in the aspect of body weight. The fifth week, T7, T1, and treatment were significantly higher (P <0.05) than T6, T5, T3, and T2. Treatment T7 did not show a significant difference with treatment T1, and did not show a significant difference between it and treatment T4. On the other hand, treatment T4 was superior. Significantly and with a level of (P <0.05) on the parameters T6, T3, and T2, but no significant differences between them and treatment T5 were shown.

Table 2: Effect of addition of nano-selenium and astaxanthin and their mixture in broiler diets on the mean live body weight (gm / bird) for weeks 1-5 of the bird's life.

Averages ±standard error					**
Fifth week	**Fourth week**	**Third week**	**Second week**	**First week**	**Transactions**
±2276.33 6.83 A	2.00±1542.00 B	4.48± 958.67 A	2.08± 451.00 CD	± 189.00 1.52 D *	**T1**
±2170.00 10.00 C	2.02±1479.67 D	4.48± 897.67 D	1.45± 449.67 CD	± 208.33 3.38 BC *	**T2**
±2092.33 7.66 E	6.33±1496.33 C	2.40 ±883.67 E	2.90± 454.67 BC	± 187.67 1.85 D	**T3**
±2266.33 9.13 AB	8.66±1571.33 A	0.88± 940.33 B	1.52± 461.00 B	± 223.00 1.52 A	**T4**
±2250.67 5.20 B	3.05±1554.00 B	5.00± 925.00 C	3.60± 448.00 CD	± 187.67 6.17 D	**T5**
±2146.67 7.12 D	±1446.00 2.08 E	± 882.00 1.73 E	3.51± 444.00 D	± 201.00 1.00 C	**T6**
±2280.67 6.69 A	±1575.33 3.92 A	±967.00 2.08 A	± 492.00 1.15 A	± 216.33 1.85 AB	**T7**
		*	*	*	

*The different letters within the same column indicate the presence of significant

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differences (P <0.05.(

** Transactions T1: control treatment (without addition), T2 and T3, addition of nano selenium at a ratio of 0.3 and 0.5 mg / kg feed respectively, T4 and T5 with addition of 60 and 70 mg / kg of fodder, T6: 0.3 mg. Nano selenium + 60 mg astaxanthin / kg feed, T7: 0.5 mg nanoselenium + 70 mg astaxanthin / kg feed.

Average weekly weight gain (gm / bird)

Table (3) The effect of adding nano-selenium, astaxanthin and their mixture to the broiler diet on the weekly weight gain of the studied birds, it was observed in the first week of the birds' life that it outperformed a significant level (P <0.05) in the mean weight increase of the treatment T4 over the other transactions, while Treatment T4 did not show any significant difference between it and treatment T7, which in turn was significantly superior to the transactions T6, T5, T3, and T1. A significant superiority (P <0.05) was observed for treatment T2 over transactionsT5, T3, and T1. otherwise, this treatment did not show significant differences with treatment T6 in weight gain, also no significant differences were observed between the transactions T5, T3, and T1 for the same characteristic. In the second week, the highest rate of weight gain was observed in favor of treatment T7 and at a significant level (P <0.05) over all transactions, followed by T5, T3, and T1 transactions that did not show a significant difference between them, but outperformed with a significant level (P <0.05) over the transactions T6, T4, T2 for the same characteristic, the treatment T2 showed a decrease in the rate of weight gain compared with the transactions T6, T4, which did not show a significant difference between them. In the third week, It was noted that the treatment T1 superiority in the weight gain over all transactions. We also note that the transactions T7, T5, T4 did not have any significant differences between them, but they outperformed the transactions T2, T3, T6 for the same characteristic and also recorded Treatment T2 significantly outperformed the transactions T6, T3, while treatment T6 outperformed treatment T3 in terms of overweight. In the fourth week, the statistical analysis showed a significant (P <0.05) superiority in the weight increase of the treatment T4 on all treatments, the two transactions T5 and T3 recorded the highest rate of weight increase after treatment T4, where it outperformed the transactions T7, T6, T2, T1. At the same time, it did not appear any significant differences between T3 and T5, the two treatments T6, T2 showed a decrease in the weight gain rate compared to the treatments T7, T1, while the last two treatments did not show any significant difference between them, and also no significant differences were found between the two treatments T2 and T6 for the same characteristic.. The significance difference continued until the fifth week, which recorded the highest rate of weight increase for the two transactions T7 and T5, with a significant difference (P <0.05) over the rest of the transactions, and no significant difference between them was shown. It also outperformed with a significant level (P <0.05) the treatment T4, T1 over the transactions T2 , T3, T6, and there were no

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significant differences between them. Also, treatment T6 was superior to treatment T3, T2, followed by treatment T3, which outperformed treatment T2, which gave the lowest values for the rate of weight gain in the fifth week. As for the total weight increase, the weight increase of the treatment T7 birds increased by a significant level (P <0.05) over all the experimental transactions, followed by this increase by the treatment T5, T4, which did not show any significant difference between them, but it outperformed with a significant level (P <0.05) over the transactions T1. T2, T3, T6 and the treatment T1 outperformed the transactions T6, T3, and T2. As for the total weight increase, it decreased in the treatment of T2 birds by a significant level (P <0.05) compared to the treatment T6, T3, which showed no differences between them and for the same characteristic.

Table 3: The effect of adding nano-selenium and astaxanthin and their mixture to broiler diets on the rate of weight gain (g / bird) for weeks (1-5) of the bird's life.

Averages±standard error						treatment
Total weight gain	Week fifth	Fourth week	Third week	Srcond week	First week	
2142.00 12.76± C	±659.66 1.33 B	±585.33 2.60 C	±496.67 3.84 A	±258.00 2.64 B	144.66 ± 5.17 D	T1
1990.67 7.96± E	±577.00 4.61 E	±564.66 3.71 D	±460.00 2.88 C	±221.66 1.66 D	167.33 ± 3.33 BC	T2
2030.67 3.17± D	±594.66 2.90 D	±612.33 2.84 B	±428.67 3.17 E	±249.66 4.91 B	145.33 ± 3.33 D	T3
2189.00 15.39± B	±659.66 6.74 B	±630.33 10.17 A	±479.33 3.48 B	±238.00 3.51 C	180.00 ± 0.57 A	T4
±2182.33 8.29 B	±697.00 2.08 A	±607.00 3.51 B	±477.00 0.57 B	±255.00 2.88 B	146.33 ± 2.72 D	T5

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± 2035.0 6.42 D	±640.33 4.84 C	±563.66 3.17 D	±438.00 2.08 D	±235.33 2.33 C	157.66 ± 3.92 C	T6
±2222.33 7.53 A	±705.66 3.48 A	±587.00 1.15 C	±481.00 2.64 B	±276.00 2.30 A	172.67 ± 5.04 AB	T7
*	*	*	*	*	*	

The different letters within the same column indicate the presence of significant differences (P <0.05).

**** Transactions T1: control treatment (without addition), T2 and T3, addition of nano selenium at a ratio of 0.3 and 0.5 mg / kg feed respectively, T4 and T5 with addition of 60 and 70 mg / kg of fodder, T6: 0.3 mg. Nano selenium + 60 mg astaxanthin / kg feed, T7: 0.5 mg nanoselenium + 70 mg astaxanthin / kg feed**

Feed consumption rate

Table (4) shows the effect of the addition of nano-selenium and astaxanthin and their mixture in the diets of broiler chickens on the rate of feed consumption for birds for a period of five weeks, where a significant increase in the first week of life of birds was observed (P <0.05) in the characteristic of feed consumption for treatment T6, T1. On the parameters T7, T4, and T3, there were no significant differences between the transactions T6, T5, T2, and T1, but they were significantly superior to the treatment T4. There were no significant differences between the parameters T7, T5, T3, and T2 in the rate of feed consumption. In the second week, an increase in the rate of feed consumption was observed in treatment T7 and T1, with a significant level (P <0.05) over the remaining transactions, and no significant difference between the two above transactions was also observed. There were also no significant differences between the two transactions T4 and T2. On the other hand, it exceeded a significant level. (P <0.05) on the transactions T6, T5, and T3 with no significant differences between the last transactions in the feed consumption rate. In the third week, treatment T1 (p <0.05) significantly outperformed all transactions, followed by treatment T7, T4, compared with transactions T6, T5, T3, and T2, and no significant differences were found between treatment T4 and T7, the rate of feed consumption for treatment T3 decreased significantly. (P <0.05) when compared with treatment T6, but no significant difference was found between treatment T6 and transactions T5, T2 on the one hand and between transactions T5, T3, and T2 on the other hand, and for the same characteristic .In the fourth week, the statistical analysis table recorded a significant increase (P <0.05) for the treatment T4, T7 over the rest of the transactions, and no

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significant difference between them was shown, as well as the two transactions T1, T5 outperforming the transactions T6, T3, T2, the two transactions T3, T2 outperformed the two transactions. Treatment T6 did not show any significant difference between the two transactions T5 and T1 on the one hand and between the two transactions T3 and T2 furthermore as for the fifth week, the same table showed a significant increase (P <0.05) in the rate of feed consumption for the treatment T5, T1 over the remaining transactions, and no significant difference between them was shown. As for the transactions T7, T4, and T2, they significantly outperformed the transactions T6, T3 and did not show any Significant differences between them in the rate of feed consumption, followed by the treatment T6, which outperformed the treatment T3, which recorded a decrease in the feed consumption rate of the birds of this treatment for the fifth week. The weight gain of the treatment T7 birds increased significantly (P <0.05) on all the experimental treatments followed by the treatment T5, T4, which did not show any significant difference between them, but it outperformed the treatments T1, T2, T3, T6. Also, the treatment T1 outperformed the treatments T6, T3. , T2, as for the total weight increase, it decreased in the treatment T2 birds compared to the treatment T6 and T3, which did not show any significant difference between them.

Table 4: The effect of adding nano-selenium and astaxanthin and their mixture to the diets of broilers on the feed consumption rate (g / bird) for weeks (1-5) of the bird's life.

Averages ±standard error						transactions **
Total fodder consumed	Fifth week	Fourth week	Third week	Second week	First week	
3325.33 9.59± A	±1188.00 4.35 A	±915.66 4.48 B	±694.00 3.78 A	±383.00 4.04 A	±144.66 2.33 A *	T1
3204.67 6.98± D	±1160.66 4.84 B	±891.66 1.76 C	±642.00 1.73 CD	±367.00 1.00 B	±143.33 1.45 AB	T2
3090.33 7.83± F	±1023.67 5.84 D	±890.66 2.33 C	±632.66 5.04 D	±344.67 1.67 C	±138.66 1.45 BC	T3
3253.33 8.00± C	±1158.66 1.33 B	±930.66 1.76 A	±666.00 5.03 B	±363.66 3.17 B	±134.33 2.02 C	T4
±3221.00 8.73 D	±1191.67 2.72 A	±917.00 2.08 B	±641.00 4.58 CD	±354.00 4.35 C	±142.00 1.15 AB	T5

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± 3143.67 6.93 E	±1136.67 6.43 C	±865.66 2.96 D	±647.66 2.40 C	±353.33 3.38 C	±145.33 1.76 A	T6
±3292.00 13.20 B	±1169.33 6.17 B	±935.00 3.21 A	±673.00 5.13 B	±388.33 1.20 A	±138.00 1.52 BC	T7
*	*	*	*	*	*	

***The different letters within the same column indicate the presence of significant differences (P <0.05.(**

**** Transactions T1: control treatment (without addition), T2 and T3, addition of nano selenium at a ratio of 0.3 and 0.5 mg / kg feed respectively, T4 and T5 with addition of 60 and 70 mg / kg of fodder, T6: 0.3 mg. Nano selenium + 60 mg astaxanthin / kg feed, T7: 0.5 mg nanoselenium + 70 mg astaxanthin / kg feed.**

Food conversion factor

Table (5) indicates the effect of adding nano-selenium and astaxanthin and their mixture to the broiler diet on the nutritional conversion factor, it was found that in the first week of life the birds of treatment T5 were more efficient in the feed conversion factor, outperforming the treatments T2, T3, T4, and T6. Significant differences between the treatments T6, T5, and T1, there are no significant differences between the birds of the treatments T6, T3, and T1, but they are better than the treatments T7, T4, T2 It was observed that treatment T2 was better in terms of food conversion than treatments T7, T4, followed by treatment T7, then treatment T4**.**. In the second week, we notice an improvement in the food conversion factor for treatment T2 over all treatments, while the two treatments T6, T4 outperformed T7 and T3. No significant differences were observed between the treatments T6, T5, T4, T1, and no significant differences were also found between the treatments T7, T5. In the third week, the two treatments T6 and T3 (in which there were no significant differences between them) were the best in the food conversion factor compared with the treatments T7, T5, T4, T2, T1, which did not have any significant differences between them for the same trait. In the fourth week, there was an improvement in favor of the transactions T7, T2, and T1 in the characteristic of the food conversion compared to the transactions T3, T4, and there was no significant difference between the transactions T7, T6, T5, T2, T1, and no significant difference was also found between the transactions T6. T5, T4, T3. It was noticed that treatment T2 was the best in the characteristics of the food conversion factor compared with all the studied transactions, followed by treatment T3, which was more improved than treatment T7. The table did not appear any significant differences between the transactions T7, T6, T5, T4, and T1 for the same trait in the fifth week. Regarding the total food conversion factor, treatment T2 was significantly higher ($p < 0.05$) on all transactions. Likewise, treatment T6, T1 was more improved for the food conversion characteristic than transactions T7, T5, T4, T3, while there was no significant difference

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between the two transactions T6, T1 was followed by the treatment T3, which was more improved than the transactions T7, T5, and T4. These factors were similar with each other in the total food conversion factor.

Table (5): The effect of adding nano-selenium and astaxanthin and their mixture in a broiler diet on the feed conversion factor (gm feed / g weight gain) for weeks (1-5) of the bird's life

Averages ±standard error						transactions
total food conversion factor	Fifth week	Fourth week	Third week	Second week	First week	
1.55 0.005 ± B	±1.80 0.02 BC	±1.56 0.04 A	±1.39 0.01 B	±1.47 0.01 BC	±1.00 0.01 AB	T1
1.61 0.005± A	±2.02 0.01 A	±1.59 0.02 A	±1.40 0.02 B	±1.66 0.02 A	±0.85 0.02 C	T2
1.52 0.005± C	±1.84 0.03 B	±1.45 0.01 C	±1.48 0.03 A	±1.39 0.04 D	±0.96 0.02 B	T3
1.48 0.005± D	1.75 0.05 BC	±1.48 0.02 C	±1.39 0.003 B	±1.52 0.008 B	±0.74 0.01 E	T4
± 1.47 0.01 D	±1.71 0.08 BC	±1.51 0.03 ABC	±1.35 0.01 B	±1.45 0.02 BCD	±1.02 0.01 A	T5
± 1.54 0.006 B	±1.78 0.05 BC	±1.53 0.01 ABC	±1.48 0.02 A	±1.51 0.01 B	±0.99 0.006 AB	T6
± 1.47 0.003 D	±1.67 0.04 C	±1.59 0.02 A	±1.39 0.02 B	±1.41 0.02 CD	±0.79 0.02 D	T7
*	*	*	*	*	*	

The different letters within the same column indicate the presence of significant differences (P <0.05).

**** Transactions T1: control treatment (without addition), T2 and T3, addition of nano selenium at a ratio of 0.3 and 0.5 mg / kg feed respectively, T4 and T5 with addition of 60 and 70 mg / kg of fodder, T6: 0.3 mg. Nano selenium + 60 mg astaxanthin / kg feed, T7: 0.5 mg nanoselenium + 70 mg astaxanthin / kg feed.**

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Percentage of losses%

Table 6 shows the effect of adding nano-selenium and astaxanthin and their mixture in the diet on the total mortality rate of chicks. A significant decrease ($p < 0.05$) was observed in the mortality rate of birds of the two treatments T7 and T5 when compared with other treatments and did not show any significant difference between them in the same percentage. Also, a significant decrease was recorded for the two treatments T6 and T4 when compared with the treatments T3, T2, and T1, and no significant difference was found between treatment T4 and T6. It did not show any moral difference between them

Table 6: The effect of adding nano-selenium and astaxanthin and their mixture to a broiler diet on the total mortality of chicks

المعاملات	نسبة الهلاك ± الخطأ التجريبي (%)
T1	0.66 ± 7.13 A
T2	0.78 ± 8.83 A
T3	1.86 ± 4.46 B
T4	0.64 ± 2.06 C
T5	0.00 ± 0.00 D
T6	1.03 ± 2.06 C
T7	0.00 ± 0.00 D
مستوى المعنوية	*

***The different letters within the same column indicate the presence of significant differences (P <0.05.(**

**** Transactions T1: control treatment (without addition), T2 and T3, addition of nano selenium at a ratio of 0.3 and 0.5 mg / kg feed respectively, T4 and T5 with addition of 60 and 70 mg / kg of fodder, T6: 0.3 mg. Nano selenium + 60 mg astaxanthin / kg feed, T7: 0.5 mg nanoselenium + 70 mg astaxanthin / kg feed.**

Production Index and Economic Figure

Table (7) shows the effect of adding nano selenium and astaxanthin and their mixture to the diet on the values of the production index and the economic figure of broiler, The feed additives referred to in the table led to a significant increase in the values of the production index scale and the economic figure scale, so the two parameters T5 and T7 were the best in the values of the scale. The evidence by achieving a significant difference at the level of ($P < 0.05$) compared with the parameters T6, T3, T2, there was no significant difference between the parameters T7, T5, T4, T1, and also no significant differences were shown between the parameters T6, T3, T2 for the

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values of the production index. The treatment T4 gave an advantage over the transactions T6 and T3 in terms of the economic figure, which showed no significant difference between them, furthermore , The treatment T4 and the transactions T7, T5, T2, T1 did not have any significant difference in the economic figure values. Predominantly , all the addition factors for Nano selenium and Astaxanthin and their mixture were not better than the control treatment.

Table 7: The effect of adding nano-selenium and astaxanthin and their mixture to the broiler diet in the production index and the economic index.

Averages ±standard error		Transctions
Economic Figure	**Production Index**	
7.68 ± 446.33 AB	17.57 ± 414.53 ABC	T1
11.67 ±421.00 ABC	9.25 ± 382.70 C	T2
8.87 ± 399.33 C	22.01 ± 382.00 C	T3
15.34 ± 452.67 A	10.00 ± 445.40 AB	T4
13.77± 450.33 AB	2.85 ±449.67 A	T5
9.71 ± 418.00 C	11.91 ± 409.67 BC	T6
9.82 ± 451.33 AB	3.84 ±451.53 A	T7
*	*	

The different letters within the same column indicate the presence of significant (P <0.05) differences.

****Transactions T1: control treatment (without addition), T2 and T3, addition of nano selenium at a ratio of 0.3 and 0.5 mg / kg feed respectively, T4 and T5 with addition of 60 and 70 mg / kg of fodder, T6: 0.3 mg. Nano selenium + 60 mg astaxanthin / kg feed, T7: 0.5 mg nanoselenium + 70 mg astaxanthin / kg feed .**

Discussions

The main objective of this study is to show the effect of adding nano-selenium and astaxanthin and their mixture in improving the growth of broilers in terms of live weight gain and weight gain as well as the rate of feed consumption and the feed conversion factor. The addition of nano selenium at a concentration of 0.5 mg / kg to the feed led to an improvement weight gain, as well as the rate of feed consumption,

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as for the feed conversion factor was better at a concentration of 0.3 mg / kg, due to the fact that selenium promotes natural antioxidants that can protect the intestinal mucosa from oxidation and pathogens, the results agreed with the findings of the researchers. (Saleh, 2014; Dlouha, 2008), in addition, the reason may be due to the high absorption capacity of nanoselenium, thus increasing the selenium content sufficient to saturate the selenoenzymes, and this in turn increases the growth and development of tissues i.e. increases the protein content in them (Cai et al., 2012), or It is due to the association of nano-selenium with proteins within the body that have antioxidant properties, thus reducing fat oxidation, i.e. improving the metabolism within the body of the Birds, which leads to an improvement in live weight and weight gain. These results are in agreement with (Dlouha et al., 2008; Upton et al., 2008; Saidi, 2019). The improvement in growth performance can be attributed to the participation of nano-selenium in the activity of several enzyme systems, which in turn regulate the metabolism as well as interfere with the formation of prostaglandins hormon and the metabolism of essential fatty acids (Zhou and Wang, 2014). Selenium participates in growth regulation by affecting triiodothyronine (T3) (a major hormone that regulates protein production and metabolism (Preter, 2000)) and growth hormone. Studies have shown that nano-selenium supplementation has a positive effect on mRNA expression of growth hormone and insulin receptors, which in turn They regulate apoptosis (Ren et al., 2016). Moreover, growth hormone plays an essential role in maintaining muscle mass and integrity and protecting against oxidative stress (Arvat et al., 2000) i.e. promoting live weight or weight gain of birds in broilers. Nanoselenium affects the activity of antioxidant enzymes and improves the state of antioxidants by stimulating the activity of the enzyme glutathione peroxidase, and thus works to protect the protein and fat tissues from hydroxyls and peroxides that have a high capacity to destroy vital molecules (Yoon et al., 2007; Ebeid) Others, 2013). As for the improvement of the live bird's weight and the increase in weight by adding astaxanthin to the diet, it may be the reason that astaxanthin enhances antioxidants in the body of broiler chickens (Kim and Jeong, 2014) and also leads to improvement of basic metabolic functions and protection from diseases by removing the free radicals and supporting the immune system (Goodwin, 1986; Bendich and Olson, 1989), it is protects cells from oxidative damage and lipid peroxidation (Naguib, 2000; Aliwi, 2020). By and large and in recapitulation of the above, the addition of nano-selenium in the diets of broiler meat at a concentration of 0.3 mg / kg of feed caused an improvement in the total food conversion factor due to the activation of nano-selenium for the thyroid hormones, which increases the process of food metabolism, which leads to an improvement in the use of feed for the purpose of growth and increase. In vivo weight (He- Jianhua, 2000), the reason for the improvement in the growth performance of the treated birds may also be due to the nature of the astaxanthin pigment, which is more polar than the rest of the carotenoids and which improves the absorption rate because it is one of the fat soluble compounds (; Ranga et al., 2013; Kidd, 2011) and thus operate on an increase in vivo weight. But

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the main and effective role in improving the growth performance of the birds under trial is the joint cooperation of both nano-selenium and astaxanthin as antioxidants by increasing the activity of the enzyme glutathione peroxidase, which has an effect on resistance to oxidation, fat oxidation, elimination of free radicals, reducing the harmful effects resulting from them, and protecting proteins from oxidation. (Yamashita, 2018).

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