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Effect of Replacing the Powder of the Larvae of the Black Soldier Fly with Protein Concentrate in the Diet on the Productive Traits of Laying Hens

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Abstract

The experiment was conducted in the poultry farm affiliated to Al-Amer Poultry Company in Al-Mahawil District of Babil Governorate, to study the effect of replacing black soldier fly larvae (BSF) powder in the place of protein concentrate in the diet on the productive characteristics of laying hens. 60 laying hens of 55 weeks of age of brown Lohmann strain were used for the period from 29/9/2020 to 18/1/2021, raised in cages and randomly distributed to five treatments and four replicates for each treatment (3 hens/ replicates). The replacement ratio according to the treatments was T1: control and contained 100% commercial protein concentrate without adding BSF larval powder, T2: BSF larval meal was partially replaced by 25% in the place of protein concentrate, T3: BSF larval meal was partially replaced by 50% in the place of protein concentrate, T4: Partially replace 75% BSF larval powder in protein concentrate, T5: completely replace 100% BSF larvae powder. The results showed during the total period of the experiment (56-71) weeks that there were no significant differences between the experiment treatments in the characteristic of egg production percentage (HD%), egg weight, egg mass, feed intake and feed conversion ratio.

Key words: Plack soldier fly powder (BSF), Protein concentrate, hen, Productive performance.

تأثير احلال مسحوق يرقات ذبابة الجندي الاسود محل المركز البروتيني بالعليقة في الصفات الانتاجية للدجاج البياض

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الخلاصة

أجريت التجربة في حقل الدواجن (حقل اهلي) التابع لشركة العامر للدواجن في قضاء المحاويل بمحافظة بابل، لدراسة تأثير احلال مسحوق يرقات ذبابة الجندي الأسود (BSF) محل المركز البروتيني بالعليقة في الصفات الإنتاجية للدجاج البياض. تم استخدام 60 دجاجة بياضة بعمر 55 أسبوع من سلالة لوهمان البني للفترة من 2020/9/29 إلى 2021/1/18 ، تم تربيتها في أقفاص وتوزيعها عشوائيا على خمسة معاملات وبواقع أربع مكررات (3 دجاجة/ مكرر). كانت نسبة الاحلال وفقا للمعاملات T1: السيطرة واحتوت على مركز بروتين تجاري بنسبة 100٪ دون إضافة مسحوق يرقات BSF، T2: احلال مسحوق يرقات BSF جزئيا بنسبة 25٪ محل المركز البروتيني، T3: احلال مسحوق يرقات BSF جزئيا بنسبة 50٪ محل المركز البروتيني، T4: احلال مسحوق يرقات BSF جزئياً بنسبة 75٪ محل المركز البروتيني، T5: احلال مسحوق يرقات BSF كلياً بنسبة 100٪ محل المركز البروتيني. واظهرت النتائج خلال المدة الكلية من التجربة (56-71) أسبوع الى عدم وجود فروق معنوية بين معاملات التجربة في صفة نسبة انتاج البيض (H.D%.) ووزن البيضة وكتلة البيضة واستهلاك العلف ومعامل التحويل الغذائي.

الكلمات المفتاحية: مسحوق ذبابة الجندي الأسود (BSF) ، تركيز البروتين ، الدجاجة ، الأداء الإنتاجي

1. Introduction

The cost of feeding is about 65-75% of the total cost of operating projects related to the production of eggs and meat [1]. Animal protein concentrates are used as a primary source of protein, minerals, vitamins and amino acids. But it is one of the most expensive feed ingredients in terms of cost that enters into the composition of poultry diets with the possibility of transmitting diseases to humans, The increasing demand for protein concentrates used in poultry diets encouraged researchers to think of using different alternative protein sources such as plant protein concentrates, poultry slaughterhouse waste and local fishmeal [2]. Insects are a good source of poultry nutrition because they are a good protein source and are rich in amino acids, vitamins and fatty acids [3].

Among these insects is the black soldier fly, whose larvae feed on organic waste and can be given as feed for poultry directly or after drying or grinding and adding it to diets [4]. The larvae of the black soldier fly contain crude protein (35-57%) and contain a high percentage of lysine and methionine, which are necessary in poultry feed [5]. In addition to containing large amounts of fatty acids up to 35%, It is also rich in calcium (5-8% on a dry matter basis) and phosphorous (0.6-1.5% on a dry matter basis) [6]. It contains chitin, which is an important substance to stimulate the immune system. There are many studies in which the larvae of the black soldier fly were used as a substitute for soybean meal and protein concentrate in the diets of broilers and laying hens, and the results were positive and the replacement was successful [7].

2. Materials and Methods

This study was conducted in a private field (Al-Amer Poultry Company) affiliated to Al-Mahaweel District in Babylon Governorate for the period from 29-9-2020 to 18-1-2021. 60 laying hens of the breed (Lohman Brown) were used in this experiment, 55 weeks old. The birds were randomly distributed to five treatments, each treatment included four replicates (cages) and 3 hens were placed in one cage. The experimental treatments were the following: The first treatment (T1): the control group, the second treatment (T2): BSF larval meal was partially replaced by 25% in the place of protein concentrate, the third treatment (T3): BSF larval meal was partially replaced by 50% in the place of protein concentrate, the fourth treatment (T4): Partially replace 75% BSF larval powder in protein concentrate. Fifth treatment (T5): completely replace 100% of the larval powder (BSF) in the place of the protein concentrate. Powder of black soldier fly larvae was added to the diet two weeks before the beginning of the experiment until the end of the experiment period. The birds were fed on a diet that contained all the required nutrients and according to the recommendations of the company producing this strain (Table 2). The chemical analysis of larvae powder imported from China was carried out at (Erbil Feed) Company for Feed Industry and General Trading Co., Ltd. located in Erbil Governorate, northern Iraq, and table (1) shows the chemical analysis calculated for larval powder of the black soldier fly (BSF).

Table 1- The diet provided to laying hens at 55 weeks of age used in the experiment

The components	T1 (control) kg	T2 25% (BSF) kg	T3 50% (BSF) kg	T4 75% (BSF) kg	T5 100% (BSF) Kg
yellow corn	57.75	58.2	58.45	58.65	59.00
soybean meal 48%	24	23.55	23.55	23.55	23.40
protein concentrate *	5	3.75	2.5	1.25	-
Larvae powder (BSF)	-	1.25	2.5	3.75	5.00
vegetable oil	2.2	2.2	1.5	1.00	1.00
D.C.P	0.5	0.5	0.8	1.00	1.3
Limestone	10.25	10.25	10.4	10.30	10
salt	0.3	0.3	0.3	0.5	0.3
Total	100	100	100	100	100
Computed chemical analysis**					
crude protein %	18.3	18.10	18.20	18.2	18.2
Metabolizable energy (kilo calories / kg of feed)	2824	2854	2826	2813	2847
Calcium	4.26	4.25	4.36	4.36	4.31
Phosphorous	0.43	0.38	0.38	0.37	0.37
Methionine	0.41	0.38	0.35	0.32	0.30
Lysine	1.00	1.00	1.00	1.00	1.00
methionine + cysteine	0.43	0.40	0.37	0.35	0.30

*Al-Wafi protein concentrate contains: 40% crude protein, 2120.6 kilocalories/kg, 3.50% calcium, 4.75% phosphorous, 3.75% lysine, 2.85% methionine, 3.27% methionine + cysteine, 5% fat, 2.57 % fibre.
**Chemical analysis of diet components, according to the [8].

Table 2- Chemical Analysis of Black Soldier Fly Larvae Powder (BSF)

Chemical composition	Result
protein %	40.8
fat %	25.7
Ash %	13.6
fiber %	7.8
Humidity %	4.32
Metabolizable energy (kilocalories/kg)	4195
Calcium %	2.94
Phosphorous %	0.80
Lysine %	2.52
methionine %	0.69
methionine + cysteine %	1.24

The eggs were collected once at two o'clock in the afternoon and the egg production was estimated according to the equation he mentioned [9]. and the egg mass was estimated according to the equation he mentioned [10]. As for the average egg weight, the eggs were weighed individually for three consecutive days at the end of each 28 days using a sensitive electronic balance, and the feed conversion ratio was also calculated.

3. Results and Discussion

Table (3) shows that there was no significant effect between treatments on egg production rate when BSF larval powder replaced the protein concentrate in laying hens' diets throughout the experiment. In general, during the total period (56-71 weeks), the T1, T2, T3, T4 and T5 treatments recorded a production rate of 79.02, 79.46, 78.94, 79.09 and 79.02%, respectively. The results were in agreement with what was found by [11, 12, 13,14] who noted that there were no significant differences between the experimental treatments when BSF larvae replaced fishmeal or commercial feed. For the diets of laying hens and Japanese quail laying. Table (4) shows the effect of replacing BSF larvae powder with protein concentrate in laying hens' diets on the average egg weight. It is noted from the table that there are no significant differences between the different treatments and for all experimental periods. In general, the total period (56-71 weeks) arithmetic superiority of the second, third, fourth and fifth substitution treatments, which recorded 63.84, 64.40, 64.12 and 64.49 g egg weights, respectively, higher than the control treatment, which recorded 62.89 g egg weight. These results agree with what was found by [12, 14] who noticed that there were no significant differences between the experimental treatments in the average egg weight. It is noted from Table (5) that there are no significant differences between the experimental treatments throughout the period of the experiment in the average egg mass.

Table 3- Effect of replacing BSF larvae powder on egg production rate (H.D.%).

Treatments	Period (age in weeks)				Total period (56 - 71)
	First period (56 – 59)	Second period (60 – 63)	Third period (64 – 67)	Fourth period (68 – 71)	
T1	83.93 ± 0.59	81.55 ± 2.03	76.19 ± 2.75	74.41 ± 3.78	79.02 ± 1.18
T2	84.82 ± 1.02	80.35 ± 1.85	77.08 ± 2.30	75.60 ± 1.85	79.46 ± 1.05
T3	84.52 ± 4.06	79.76 ± 1.75	77.08 ± 3.27	74.41 ± 2.10	78.94 ± 1.24
T4	84.82 ± 0.57	82.14 ± 0.49	75.60 ± 1.14	73.81 ± 2.00	79.09 ± 0.43
T5	84.23 ± 0.57	81.25 ± 1.02	76.49 ± 2.49	74.11 ± 2.68	79.02 ± 0.79
Significant level	N.S	N.S	N.S	N.S	N.S

Table 4- Effect of replacing BSF larvae powder on average egg weight (g).

Treatments	Period (age in weeks)				Total period (56 - 71)
	First period (56 – 59)	Second period (60 – 63)	Third period (64 – 67)	Fourth period (68 – 71)	
T1	62.34 ± 0.22	63.47 ± 0.61	62.05 ± 2.25	63.68 ± 0.85	62.89 ± 0.50
T2	62.95 ± 2.40	64.35 ± 0.90	63.45 ± 1.12	64.60 ± 1.86	63.84 ± 0.42
T3	64.33 ± 1.91	65.15 ± 2.66	63.95 ± 1.75	64.17 ± 2.47	64.40 ± 1.19
T4	62.75 ± 1.60	63.40 ± 0.46	64.87 ± 2.32	65.45 ± 2.08	64.12 ± 0.61
T5	62.66 ± 0.47	65.19 ± 2.54	65.55 ± 2.08	64.54 ± 1.55	64.49 ± 0.29
Significant level	N.S	N.S	N.S	N.S	N.S

Table 5 Effect of replacing BSF larvae powder on the average egg mass (g/bird/day).

treatments	period (age in weeks)				Total period (56 - 71)
	first period (56 – 59)	second period (60 – 63)	third period (64 – 67)	fourth period (68 – 71)	
T1	52.32 ± 0.37	51.72 ± 0.83	47.39 ± 3.10	47.30 ± 1.84	49.71 ± 1.10
T2	53.33 ± 1.47	51.67 ± 0.86	48.99 ± 2.34	48.94 ± 2.65	50.72 ± 0.51
T3	54.24 ± 2.09	51.83 ± 1.03	49.38 ± 3.03	47.90 ± 3.24	50.85 ± 1.39
T4	53.25 ± 1.69	52.07 ± 0.22	49.07 ± 2.15	48.29 ± 1.79	50.72 ± 0.70
T5	52.78 ± 0.55	52.99 ± 2.31	50.24 ± 2.89	47.79 ± 1.70	50.96 ± 0.59
Significant level	N.S	N.S	N.S	N.S	N.S

During the total period (56-71 weeks), the average egg mass for the replacement treatments was 50.72, 50.85, 50.72 and 50.96 for the treatments T2, T3, T4 and T5, respectively, compared to the control treatment, which recorded the lowest value for the egg mass characteristic of 49.71 g/bird/day. The results of this study were in agreement with [12, 14]. It is noted from Table (6) that there are no significant differences between the replacement treatments compared to the control treatment during all periods of the experiment in the rate of feed intake, In the total period, the treatments of larvae substituting protein concentrate T2, T3, T4 and T5 recorded the lowest value for the feed intake rate, which amounted to 114.38, 113.98, 114.04 and 113.92 g, respectively, compared to the control treatment, which recorded 114.58 g. These results were in agreement with what was found by [12, 15, 16, 17, 18] who noticed no significant differences between the experimental treatments in feed intake. Table (7) shows that there were no significant differences between the treatments during the period of the experiment in the feed conversion ratio. Where during the total period (56-71 weeks) T1, T2, T3, T4 and T5 recorded 2.31, 2.26, 2.25, 2.25 and 2.24 respectively in the feed conversion ratio. These results were in agreement with [12, 15, 16, 17, 18].

Table 6- Effect of replacing BSF larvae powder on feed intake rate (g/bird/day).

Treatments	Period (age in weeks)				Total period (56 - 71)
	First period (56 – 59)	Second period (60 – 63)	Third period (64 – 67)	Fourth period (68 – 71)	
T1	116.28 ± 0.35	115.77 ± 0.79	113.45 ± 0.90	112.80 ± 0.64	114.58 ± 0.60
T2	116.35 ± 0.31	115.26 ± 0.66	113.15 ± 0.48	112.77 ± 0.62	114.38 ± 0.16
T3	115.85 ± 0.07	114.53 ± 0.28	113.18 ± 0.39	112.35 ± 0.22	113.98 ± 0.05
T4	116.09 ± 0.41	114.07 ± 0.56	113.25 ± 0.25	112.76 ± 0.48	114.04 ± 0.17
T5	115.64 ± 0.50	114.15 ± 0.41	113.02 ± 0.41	112.85 ± 0.48	113.92 ± 0.34
Significant level	N.S	N.S	N.S	N.S	N.S

Table 7- Effect of replacing BSF larvae powder on the feed conversion ratio (g of feed/g of egg mass).

Treatments	Period (age in weeks)				Total period (56 - 71)
	First period (56 – 59)	Second period (60 – 63)	Third period (64 – 67)	Fourth period (68 – 71)	
T1	2.22 ± 0.02	2.24 ± 0.05	2.42 ± 0.13	2.39 ± 0.08	2.31 ± 0.04
T2	2.19 ± 0.06	2.23 ± 0.03	2.33 ± 0.11	2.33 ± 0.11	2.26 ± 0.02
T3	2.15 ± 0.08	2.21 ± 0.04	2.32 ± 0.15	2.38 ± 0.15	2.25 ± 0.06
T4	2.19 ± 0.08	2.19 ± 0.01	2.32 ± 0.10	2.35 ± 0.09	2.25 ± 0.03
T5	2.19 ± 0.03	2.17 ± 0.09	2.27 ± 0.14	2.37 ± 0.08	2.24 ± 0.03
Significant level	N.S	N.S	N.S	N.S	N.S

4. Conclusion and Recommendation

The use of feeding on black soldier fly larvae (BSF) is one of the useful global in recycling organic waste and converting it into protein concentrates with high nutritional value for feeding poultry, fish and farm animals. We conclude that replacing the protein concentrate partially and completely with BSF larval powder in the diets of laying hens leads to the absence of significant differences between the experimental treatments in productive traits. We recommend conducting further studies on adding BSF and house fly larvae powder to laying hens diets to replace protein concentrate at different ages.

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