PRODUCTIVE AND PHYSIOLOGICAL TRAITS OF INSHAS LAYING HENS AS AFFECTED BY SOME ADDITIVES IN THE DIET

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ABSTRACT

In this research, our main objective was to examine the impact of various additives, specifically Synbiotic (SYN), Copper sulfate ($CuSO_4$), Yucca schidigera (YS), and Bentonite (BN), on the physiological parameters and productivity of Inshas laying hens. A total of 150 (54 week-old) hens from the Inshas local strain, were individually weighed and divided into five experimental groups with three replicates each (10 hens per group). The control group was given a basic diet (T1), while the other four groups were given the basic diet (T1) supplemented with SYN (at 0.5g/kg), $CuSO_4$ (at 50 ppm), YS (at 0.5g/kg), or BN (at 20g/kg). After implementing these dietary treatments, hens which received SYN showed the highest number of eggs (EN), egg mass (EM), and egg production rate (EPR). Overall, the productive traits (EN, EM and EPR) significantly increased, while the feed conversion ratio significantly improved ($p<0.05$) for hens which received the supplemented diets (T2:T5) compared to those who only had the T1 diet. Additionally, there was a significant increase in egg weight (EW) for those which had either $CuSO_4$ or BN added to their diet. The inclusion of YS or BN in the diet also resulted in a significant increase in yolk weight (%), while SYN or $CuSO_4$ led to an increase in albumen weight (%). Despite variations in dietary treatments, there were no notable discrepancies in the percentage and thickness of eggshells. Conversely, including SYN led to a decrease in yolk weight (%) as opposed to the control group. Generally, there were no significant differences in egg quality among groups with different additives, except for the significantly higher yolk and shell weight percentages in the control group. Hens on a diet supplemented with $CuSO_4$ had increased levels of total plasma protein (TP), while those on SYN had increased levels of both albumin (Alb) and total antioxidant capacity (TAC). However, the highest levels of plasma globulin (GLO) were observed in hens on a diet with BN, when compared to other treatments and the control. The addition of $CuSO_4$ to the diet redounded in a significantly higher H/L ratio compared to other treatments and the control. We recommend the use of additives in the feed such as synbiotics for positive effects on egg production, to improve egg quality; and copper sulphate to improve some chemical and immunological characteristics in blood parameters.

Key words: Feed additives; productive performance; egg quality; blood parameters

INTRODUCTION

The nutritional status of the layer affects both the quality of the eggs produced and the efficiency of production (Saldanha *et al*., 2009). According to Pandey *et al*. (2015), synbiotics (SYN) are a blend of probiotics like *Lactobacillus acidophilus* and *Bacillus subtilis* with prebiotics such β-glucans and Manan oligosaccharides. Fructooligosaccharide (FOS) and the synbiotic process work together to create a colonization system in the digestive tract that enhances metabolism and stimulates the balance of microbial population. According to Sjofjan *et al*. (2014), adding synbiotics to feeds can promote microbial activity and growth, both of which are beneficial to the digestive system. According to some research, adding synbiotic preparations to laying hens may enhance both their productivity and the quality of their eggs (Youssef *et al*., 2013; Zhang *et al*., 2012). Chen *et al*. (2005) demonstrated that feed conversion ratio and egg production are enhanced by prebiotic oligosaccharides like oligofructose of White Leghorn layer. Abdelqader *et al*. (2013) reported that supplementing laying hens with prebiotics and probiotics, either separately or in combination, enhanced their production efficiency and eggshell quality. However, Mohebbifar *et al*. (2013) found no discernible improvements in the laying hens' blood parameters, egg quality, or production performance after supplementing with probiotics and a prebiotic. Davis & Anderson (2002) discovered that, when compared to a control group fed a basic diet, chickens treated with Prima Lac (a commercial product containing *Lactobacillus* species) did not significantly increase their egg production.

According to Wen *et al*. (2019), copper (Cu) is a crucial trace element that is engaged in some physiological and biochemical processes in poultry. Copper is added to chicken diets to enhance performance (Skrivan *et al*., 2006; Wang *et al*., 2011). This also improved feed intake and feed conversion ratio (Attia *et al*., 2011). Pesti & Bakalli (1998) found that laying hens' egg production and egg weight improved when their meals were supplemented with 250 ppm of Cu from copper sulfate. However, a recent study (Li *et al*., 2018) found no effect between dietary supplementation of Cu and the cholesterol levels, egg quality, or productive performance of laying hens.

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The *Yucca schidigera* (YS) began from lily plants. The excerpt of Yucca contains two different active composites, glycol that binds to the ammonia, and steroidal saponin fraction, which possesses face-active parcels. Due to these parcels of *Yucca schidigera*, experimenters concentrated on the operation of *Yucca schidigera* in poultry diet (Ayasan *et al*., 2005). Also, other experimenters reported that *Yucca schidigera* dropped the free ammonia position in the poultry barns, when used in the poultry diet (Erdogan *et al*., 2001). *Yucca schidigera* excerpt also maintained metabolic conditioning, controlled environmental ammonia levels, bettered feed conversion and product (Guclu, 2003). Wang & Kim (2011) reported that YS at 120 mg/ kg bettered feed conversion rate and egg weight. Ayasan *et al*. (2005) established in a different study that feeding *Yucca schidigera* improved feed conversion ratio, while feed intake and egg production weren't influenced.

Bentonite (BN), is a clay mineral, has been utilized as feed additive in chicken feeds with positive outcomes and no unfavorable side effects (Safaeikatouli *et al*., 2010). The bentonite lump slowed the rate at which feed passed through the digestive system, freeing up time for more efficient application (Damiri *et al*., 2010). The use of bentonite as poultry feed cumulative is to enhance product performances, nutrient insipidity, and poultry health has been extensively studied (Gul *et al*., 2017). Chen *et al*. (2020) showed that supplementation of 0.50 g/ kg bentonite in the laying hen diet bettered gut health and contributed to an increase in egg product. According to Nasir *et al*. (2000), adding bentonite 1% as feed cumulative to laying hens' diets increased their egg product by 15% and strengthened their eggshells. El-Abd (2014) found that, Japanese quail chicks supplemented with 4% and 6% bentonite showed improved feed conversion ratio, lower cholesterol, faster body weight gain, and lower feed intake at 42 days of age. Gilani *et al*. (2013) demonstrated that hens fed a diet containing 10 g/kg sodium bentonite had superior egg product and diurnal egg mass in marketable Hy-Line W-36 hen-days. Therefore, the objective of this investigation is to determine the effect of using Synbiotic, Copper Sulfate, *Yucca Schidigera*, and Bentonite into the laying hens’ diet on egg quality, productive traits, and certain blood components.

MATERIALS AND METHODS

The experimental framework of the present study was carried out at Inshas Poultry Research Station, Animal Production Research Institute, Agricultural Research Center, Giza, Egypt. All biological and biochemical analyses were performed at the laboratories of Animal Production Research Institute, Ministry of Agriculture.

Experimental birds and management

Out of a large marketable flock, 150 Inshas laying hens (54 weeks of age) were taken at random. All named hens were roughly equivalent body weight and analogous behavior. Birds were raised in floor pens with five hens per square meter. All Birds were reared under the same directorial and aseptic conditions throughout the trial period. Feed and water were offered for *ad libitum*. Table (1) displays the feed components and the chemical analysis of the basal laying ration. The photoperiod was set at 16 hours per day for the duration of the experiment.

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Table (1): Composition and Chemical analysis of the basal laying ration.

Ingredients	%
Yellow Corn	64.80
Soybean meal (44%)	22.20
Corn gluten meal (60%)	1.60
Di-calcium phosphate	3.50
Limestone ($CaCo_3$)	6.80
Choline chloride	0.10
DL-Methionine	0.30
Sodium chloride	0.40
Vitamin, Mineral (Premix*)	0.30
Total	**100.00**
Chemical analysis	
Crude protein (%)	16.02
ME (kcal/ kg)	2770
Crude fiber (%)	3.12
Calcium (%)	3.41
Available Phosphorous (%)	0.73
Lysine (%)	0.97
Methionine (%)	0.59
Methionine + cysteine (%)	0.85

*Premix,Supplied per Kg diet:Vit. A:10000 IU, Vit. D3:2000IU, Vit. E:10mg, Vit. K3:1mg, Vit. B1:1mg, Vit. B2:5mg, Vit. B6:1.5mg, Vit. B12:10mcg, Niacin,30 mg, Pantothenic acid, 10mg, Foacid,1mg, Biotin, 50 mcg, Choline, 260 mg, Copper, 4 mg, Iron, 30 mg, manganese, 60 mg, Zinc, 50 mg, Iodine,1.3 mg, Selenium, 0.1mg, Cobalt,0.1mg.

Experimental design

The hens involved in this study were randomly divided into five equal groups thirty hens each. Three replicates, each with ten hens, were created for each group. The experiment was conducted on laying hens between the ages of 54 and 74 weeks for approximately 20 weeks.

The experimental design was as follows:

Group (T1): given the base diet without any additions (control).

Group (T2): given a base diet plus 0.5 g of synbiotic / kg diet.

Group (T3): given a base diet plus 50 ppm Copper sulfate / kg diet.

Group (T4): given a base diet plus 0.5 g *Yucca schidigera* / kg diet.

Group (T5): given a base diet plus 20 g Bentonite / kg diet.

The studied traits

1. Egg production traits

1.1. Egg number, egg weight, and egg mass

Every day, the specific egg counts of hen in every experimental group were recorded. Every four weeks, the egg product for every group was also calculated. This is how the egg product rate was determined:

Egg product rate (%) = Number of eggs produced/ Number of live hens x 100

Over the course of the experiment, the total number of eggs laid by the hens in each group was counted every day to the closest gram. Every four weeks, the average egg weight per hen for each experimental group was determined. The egg mass was calculated every four weeks by multiplying the average egg weight of each experimental group by the total number of eggs laid by the hens.

1.2. Feed consumption and feed conversion ratio

The amount of food consumed by every experimental group was noted. Additionally, it was equaled and expressed in grams for each bird per day between the ages of 54 and 74 weeks. Also, for every treatment group, the accumulated feed intake (FI) was computed.

For every experimental period, the feed conversion ratio (FCR) was also computed using the following formula:

Feed conversion ratio = Feed intake (kg)/ Egg mass (kg)

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2. Egg quality traits

To ascertain the parameters of egg quality, a total of 50 eggs (10 eggs from each treatment) were haphazardly collected at 62, 66, 70, and 74 weeks of age. The eggs were gathered, counted collectively, and cracked out onto a glass plate face down. They were then left to sit for five minutes. Albumen and yolks were manually separated, and each was counted. To calculate the percentage weights of the shell, albumen, and yolk, their respective weights were divided by the weight of the entire egg and then multiplied by 100. The thickness of the eggshell (without the inner and outer shell membranes) was measured in the central region of the eggshell, using a micrometer (QTC, Technical Services and inventories Ltd, England),

3. Blood constituents

3.1. Plasma total proteins, albumin, globulin, and total antioxidant capacity

At the end of experimental period (74 weeks), blood samples were collected by massacring three birds that were aimlessly taken from each treatment group. Blood samples were collected in castrated test tubes. Centrifugation was performed at 3000 rpm for 15 min also the serum samples were decanted into Eppendorf tubes and stored at −20 ^{o}C until the biochemical analyses using available marketable accoutrements. The serum total protein was determined methodology using Henry *et al*. (1974). The albumin level was measured according to Doumas, 1971. By reducing the albumin values from the matching total protein values, the globulin values were obtained. The total antioxidant capacity (TAC) was determined by measuring the samples antioxidants responded to a specific amount of exogenously administered hydrogen peroxide (Koracevic *et al*., 2001).

3.2. Heterophils to lymphocytes ratio (H/L)

Blood Smears were stained with May-Grünwald-Giemsa stain. Heterophils, lymphocytes, monocytes, basophils, and eosinophils are all included in the total leukocyte count. About 50 cells were counted for each rate. The heterophil/ lymphocyte (H/L) rates in each cell-counting system were determined by dividing the total number of heterophils by the total number of lymphocytes (Feldman *et al*., 2000).

4. Statistical Analysis

Data were statistically analyzed by ANOVA using General Linear Models (GLM) procedure of analysis (SAS, 2004). Duncan's multiple range test (Duncan, 1955) was used to determine differences among means when treatment effects were significant at level (p<0.05).

The following model used was:

$$\mathbf{Y_{ijk} = \mu + A_i + e_{ijk}}$$

Whereas
Y_{ijk} = the individual observation
μ = the overall mean
A_i = the impact of treatments (i = 1, 2, 3, 4 and 5)
e_{ijk} = residual error

RESULTS AND DISCUSSION

Productive traits:

The effect of salutary complements on productive traits of Inshas laying hens is presented in Table (2). The loftiest egg number (EN), egg mass (EM), egg production rate (EPR), and feed intake (FI) were displayed by hens fed the synbiotic (SYN) in their diet, followed by those given the bentonite (BN) supplement when compared to the control group during the experimental period (54-74 weeks of age). Synbiotic recorded the lowest egg weight of the laying hens. While the loftiest values were observed in hens fed diet added with copper sulfate ($CuSO_4$) compared with the control (p<0.05). On the other hand, *Yucca schidigera* (YS) treatment gave intermediate values for the former parameters.

Results also demonstrated that adding bentonite (BN) and copper sulfate ($CuSO_4$) to laying hen diets significantly (p<0.05) increased egg weight (EW) as compared to synbiotic (SYN), *Yucca schidigera* (YS) and control. Concerning feed intake (FI) and feed conversion rate (FCR), hens fed diet supplemented with synbiotic (SYN) consumed the most quantities of feed followed by those given bentonite (BN) while, the smallest quantities of feed consumed were recorded for hens of copper sulfate ($CuSO_4$) treatment compared with the control. Still, feeding laying hens on diets supplemented with copper sulfate ($CuSO_4$), *Yucca schidigera* (YS) and bentonite (BN) significantly bettered feed conversion rate (FCR) compared with synbiotic (SYN) treatment group.

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Regarding the effect of synbiotic (SYN), analogous results were attained by Sjofjan *et al*. (2020) who reported an increase in egg number (EN), egg mass (EM), and egg product rate (EPR) by feeding laying hens on diet supplemented with 0.8 synbiotic (SYN). Prasai *et al*. (2017) reported an increase in egg weight (EW) by adding bentonite (BN) to the laying hen diet. The enhancement in egg production and egg weight in the presence of bentonite may be due to a decrease in feed conveyance rate along the digestive tract, thereby allowing further time for nutrient immersion (Saçakli *et al*., 2015) similar as protein, energy, and linoleic acid that were honored as the most nutrient demanded for egg product and egg weight (Godbert *et al*., 2019).

Table (2). Effect of dietary treatments on productive traits of Inshas laying hens.

TREATMENTS	EN (EGG/HEN)	EW (G)	EM (G/HEN)	EPR (%)	FI (KG/HEN)	FCR (G FEED/G EGG)
Control	12.06 ^{b}	48.61 ^{b}	587.65 ^{b}	40.45^{d}	2.572 ^{a}	4.213 ^{b}
Synbiotic	12.39 ^{a}	48.17 ^{d}	597.05 ^{a}	44.16^{a}	2.519 ^{a}	4.257 ^{a}
Copper sulfate	11.49 ^{c}	48.89 ^{a}	561.77 ^{c}	41.13^{c}	2.284 ^{c}	4.177 ^{b}
Yucca	11.76 ^{b}	48.43 ^{c}	570.50 ^{b}	41.59^{b}	2.396 ^{b}	4.200 ^{b}
Bentonite	12.03 ^{b}	49.27 ^{a}	592.70 ^{a}	42.97^{a}	2.444 ^{b}	4.140 ^{c}
SEM	0.753	0.469	53.92	2.690	0.095	0.197

a, b,.... = Means within the same column with different superscripts are significantly different ($p \leq 0.05$). SEM=Standard error of means.

The results of feed conversion rate (FCR) agree with those of Kim *et al*. (2016) who attained a significant enhancement in FCR by adding copper sulfate ($CuSO_4$) to layers diet. Aminullah *et al*. (2021) reported that treating laying hen diets with copper nanoparticles (Cu-NP) 15 ppm significantly increased EW and FI and bettered FCR as compared to 10 and 5 ppm Cu. Ramesh (2014) reported that Cu-NP salutary inclusion at 25-50 of demand can reduce feed intake and ameliorate FCR in laying hens. On the other hand, Al-Ankari *et al*. (1998) reported that adding copper sulfate ($CuSO_4$) to laying hen diets did not affect egg number (EN), egg mass (EM) and egg product rate (EPR). According to Balevi and Coskun (2004), egg mass and egg product were unaffected by the addition of 50, 100, 150, or 200 mg/kg copper to laying hen diets.

Egg quality traits

Data in Table (3) showed the effect of salutary feed complements on some egg quality traits. The laying hens fed the salutary supplementation diet were significantly better than those fed the control diet during the entire experimental period, but there was no significant difference in yolk and eggshell weight percentages (p>0.05). It could be observed that hens of synbiotic (SYN) treatment had recorded the lowest percentages of yolk weight and the highest percentages of eggshell weight when compared to other treatments and the control group. On the other hand, there were slight differences in eggshell thickness between salutary treatments. Eggshell thickness was bettered by YS and $CuSO_4$ treatments when compared with the control. The loftiest percentage of egg albumen was recorded for eggs of SYN and $CuSO_4$ salutary treated hens compared with YS, BN, and control; conversely, the smallest percentage of eggshell weight was recorded for eggs of $CuSO_4$ salutary treated hens when compared with the control group.

These results were consistent with the findings of Kaya and Macit (2012), who observed that the supplementation of copper sulfate ($CuSO_4$) in laying chicken diets numerically lower eggshell weight in comparison with the control. Alagawany *et al*. (2016) used *Yucca schidigera* up to 100 mg/ kg diet in laying hen diets and recorded an enhancement in eggshell thickness might be a consequence of the increased calcium and protein deposits, which also help to perfect the quality and likelihood of increased shell weight and thickness.

Sjofjan *et al*. (2021) reported that adding probiotics to layer diets increased eggshell weight, eggshell thickness, and albumen weight. Świątkiewicz *et al.* (2010) suggested that the reason for the increased eggshell thickness could be the turbulent effect in the gut, which promotes mineral submerged and storage with a consequent effect on the shell gland. However, no significant perceptible advancements in egg quality parameters due to adding *Yucca schidigera* (YS) to laying hen diets were reported (Kutlu *et al*. 2001; Nazeer *et al*., 2002; El- Shafei *et al*., 2022).

Table (3): Effect of dietary treatments on some egg quality traits of Inshas laying hens.

TREATMENTS	YOLK WEIGHT (%)	ALBUMEN WEIGHT (%)	SHELL WEIGHT (%)	SHELL THICKNESS (MM)
Control	35.89 ^{a}	53.59 ^{c}	10.52^{a}	0.307 ^{b}
Synbiotic	33.77 ^{b}	56.26 ^{a}	9.95 ^{b}	0.321 ^{a}
Copper sulfate	34.08 ^{ab}	56.33 ^{a}	9.58 ^{b}	0.324 ^{a}
Yucca	34.71 ^{ab}	55.42 ^{b}	9.87 ^{b}	0.328 ^{a}
Bentonite	34.70 ^{ab}	55.55 ^{b}	9.74 ^{b}	0.320 ^{a}
SEM	0.604	0.557	0.158	0.003

a, b,…. = Means within the same column with different superscripts are significantly different ($p \leq 0.05$). SEM= Standard error of means.

Blood parameters

<u>Plasma total proteins, albumin, globulin, and total antioxidant capacity</u>

Results presented in Table (4) showed that there were no perceptible differences in plasma total protein (TP) attention due to salutary treatments, except for hens of $CuSO_4$ or BN salutary traits which recorded significantly advanced attention of plasma total protein (TP) compared with other treatments and control. A nearly analogous trend was attained for plasma globulin (GLO) attention. On the other hand, the loftiest plasma albumin (Alb) attention was recorded for hens which entered synbiotic (SYN) in their diets, while the smallest attention was recorded for those fed diet supplemented with bentonite (BN) compared with other treatments and control. These findings corroborate those of Dibaji *et al*. (2012), who found that supplementing broiler diets with synbiotic showed a significant increase in plasma Alb concentration. El- Sherif *et al*. (2019) found that laying hens supplemented with 15, 60 mg/ kg copper sulfate exhibited significantly higher levels of TP and GLO. However, Kutlu *et al*. (2001) found no increase in blood GLO because of supplementing laying hen diets with *Yucca schidigera* powder.

Regarding plasma TAC, data in Table (4) indicated that there were no significant differences in TAC among all salutary treatments used in this study. Generally, hens of salutary SYN treatment recorded the loftiest plasma TAC followed by those entered BN in their diets. This increase in TAC might be reflected on egg product, as the same treatment displayed the loftiest egg number and egg mass compared with other groups. Analogous results were reported by Obianwuna ***et al*. (2023)**, who stated that adding synbiotic ($p \leq 0.05$) increased plasma total antioxidant capacity (TAC) to laying hen diet. Song *et al*. (2022) reported that adding synbiotics to layer's diet significantly increased TAC levels in their blood. Consistent with our findings, research has demonstrated that laying hens' total antioxidant capacity (TAC) was increased by salutary synbiotics (Song *et al*., 2022). Still, some authors have refocused out that the supplementation with synbiotic didn't affect TAC (Liu *et al*., 2019; Wang *et al*., 2021).

Table (4). Effect of dietary treatments on some blood constituents of Inshas laying hens.

TREATMENTS	**TOTAL PROTEINS (G/DL)**	**ALBUMIN (G/DL)**	**GLOBULIN (G/DL)**	**TAC (MM/L)**
Control	5.53^{b}	1.67^{ab}	3.87^{c}	1.89^{a}
Synbiotic	5.90^{ab}	1.80^{a}	4.10^{b}	1.90^{a}
Copper sulfate	6.43^{a}	1.63^{ab}	4.80^{a}	1.69^{ab}
Yucca	5.60^{b}	1.26^{bc}	4.33^{ab}	1.64^{ab}
Bentonite	6.10^{a}	1.16^{c}	4.93^{a}	1.77^{a}
SEM	0.36	0.20	0.37	0.17

a, b,…. = Means within the same column with different superscripts are significantly different ($p \leq 0.05$). SEM= Standard error of means.

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3.2. Heterophils to lymphocytes rate (H/L)

The effect of salutary complements on hematological parameter of Inshas laying hens is presented in Table (5). Results demonstrated that adding copper sulfate ($CuSO_4$) to diets had significantly bettered heterophils, lymphocytes, H/ L rate when compared to the control and other groups. Still, adding synbiotics (SYN) dropped H/ L rate compared to the control. According to Makaraski and Zdura (2006), adding copper to the diet of turkey had a significant impact on the hematological indicators, which is closely aligned with the current findings. Ali (2018) indicated that quails fed salutary supplements containing up to 100 mg/kg of copper sulfate had significantly increased lymphocyte (%) and H/L rate. The evidenced by the low H/L rate that salutary copper supplementation up to 150 mg/kg may have a beneficial effect on a variety of stressors, including oxidative stress on blood homeostasis. According to Tang *et al*. (2017), laying hens' H/L rate decreased when prebiotics, probiotics, and symbiotic were added to their diets. Therefore, the reduced H/ L rate indicates that probiotics have an immunostimulatory effect and that animal health is stable (Salah *et al*., 2018). The present study yielded different results regarding heterophil count than did Saqib's (1993) investigation, which noted a flash depression in heterophil count at 14 days after treatment with 250, 500, and 1000 ppm salutary copper sulphate. While Nobakht *et al*. (2013) reported that adding copper up to 300 mg/ kg of broiler diets had no significant effects on immunity cells. Our study recommends the use of additives in the feed such as synbiotics for positive effects on egg production, to improve egg quality; and copper sulphate to improve some chemical and immunological characteristics in blood parameters.

Table (5). Effect of dietary treatments on hematological parameter of Inshas laying hens.

TREATMENTS	HETEROPHIL (%)	LYMPHOCYTE (%)	HETEROPHIL / LYMPHOCYTE
Control	8.98 ^{b}	17.60 ^{b}	0.51^{ab}
Synbiotic	6.88 ^{c}	16.00 ^{c}	0.43 ^{c}
Copper sulfate	10.44^{a}	18.00 ^{a}	0.58 ^{a}
Yucca	7.56 ^{b}	16.80 ^{b}	0.45 ^{b}
Bentonite	8.20 ^{b}	16.40 ^{b}	0.50 ^{ab}
SEM	0.615	0.371	0.026

a, b,…. = Means within the same column with different superscripts are significantly different ($p\leq0.05$). SEM= Standard error of means.

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تأثير بعض الإضافات في العليقة على الصفات الإنتاجية والفسيولوجية لدجاج أنشاص البياض

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المستخلص

هدفت هذه الدراسة الى تقييم تأثير بعض المواد المضافة مثل السينبيوتيك، كبريتات النحاس، اليوكا، البنتونيت في العليقة على الأداء الإنتاجي وبعض التغيرات الفسيولوجية في دجاج إنشاص المحلى البياض. استخدم في هذه الدراسة 150 دجاجة بياضة من سلالة إنشاص المحلية عمر 54 أسبوع، تم وزنها فرديا وتوزيعها عشوائيًا إلى خمس مجموعات تجريبية متساوية بثلاث مكررات (10 دجاجات لكل منهما). المجموعة الأولى: العليقة الأساسية (T1)، والثانية (T2)، والثالثة (T3)، والرابعة (T4)، والخامسة (T5) تم تغذيتها على العليقة الأساسية المضاف إليها السينبيوتيك (SYN) عند 0.5 جم/كجم، وكبريتات النحاس ($CuSO_4$) عند 50 جزء في المليون، واليوكا (YS) عند 0.5 جم/كجم والبنتونيت (BN) عند 20 جم/ كجم على التوالي. أشارت النتائج في المعاملات الغذائية إلى أن الدجاج الذي حصل على السينبيوتيك في العليقة أظهر أعلى عدد من البيض وكتلة البيض ومعدل إنتاج البيض. بشكل عام، زادت متوسطات الصفات الإنتاجية عدد البيض وكتلة البيض ومعدل إنتاج البيض زيادة معنوية وتم تحسين معنوي لكفاءة تحويل الغذاء مقارنة بتلك التي تغذت على العليقة الأساسية. من ناحية أخرى، هناك زيادة معنوية في نسبة وزن البيض بإضافة كل من كبريتات النحاس والبنتونيت في العليقة. أدت إضافة اليوكا والبنتونيت للعليقة إلى زيادة معنوية في نسبة وزن الصفار بينما أدى السينبيوتيك وكبريتات النحاس إلى زيادة نسبة وزن البياض. لكن، لا توجد فروق معنوية فى نسبة وزن قشرة البيض والسمك بين معاملات الإضافات الغذائية. من ناحية أخرى، أدت إضافة السينبيوتيك إلى إنخفاض نسبة وزن الصفارمقارنة بتلك التى تغذت على العليقة الأساسية. ومع ذلك، فإن الدجاج الذي يتم تغذيته باليوكا ينتج بيضًا بقشرة أكثر سمكًا من بقية المجموعات المعاملة. بشكل عام، لم تكن هناك فروق معنوية فى صفات جودة البيض بين الإضافات فى العليقة باستثناء نسبة صفاروقشرة البيض والتى كانت أعلى معنوياً بالنسبة للدجاج الذي يتم تغذيته على العليقة الأساسية. سجلت نسبة البروتين الكلى للبلازما زيادة للدجاج الذي حصل على عليقة تحتوي على كبريتات النحاس، بينما إزداد كل من الألبيومين والقدرة الكلية المضادة للأكسدة بالنسبة للطيورالمغذاه على السينبيوتيك في العليق. ومع ذلك، تم تسجيل أعلى تركيز في البلازما من الجلوبيولين للدجاج الذي حصل على عليقة تحتوي على البنتونيت. كما أدت إضافة كبريتات النحاس إلى زيادة معنوية في نسبة المناعة الخلوية مقارنة بتلك التي تغذت على العليقة الأساسية والإضافات الأخرى. توصي الدراسة باستخدام الإضافات في العليقة كالسينبيوتيك للتأثيرات الإيجابية على إنتاج البيض، لتحسين جودة البيض وكبريتات النحاس لتحسين بعض الصفات الكيميائية والمناعية في مقاييس الدم.

الكلمات المفتاحية: الإضافات الغذائية، الدجاج البياض، الأداء الإنتاجى، جودة البيض، بعض الصفات الكيميائية للدم.