Original Article

Astaxanthin Supplementation Mitigates the Adverse Effects of Aflatoxin B1 On Physiological Traits in Broiler Chickens

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Abstract

Aflatoxin B1 is one of the most widespread and dangerous mycotoxins. It is a secondary compound produced by fungi such as *Aspergillus flavus and A. parasiticus* under certain conditions, including adequate humidity and high temperature. This study evaluated whether dietary astaxanthin can mitigate the physiological, immunological, and biochemical parameter harms caused by aflatoxin B1 in broiler chickens. One hundred and fifty birds aged 7 days and weighing 40 g on average were randomly assigned to five treatment groups, each with three replicates. T1 served as a control, T2 was a positive control with 300 ppb aflatoxin B1, while T3, T4, and T5 had 300 ppb aflatoxin B1 and 0.750, 1.5 mg/kg astaxanthin, and 5 mg/kg vitamin E, respectively. The results indicated that the T5 group had the highest white blood cell count (33.33±8.14) while T3 had the lowest mean count (16.60±1.22) compared to other groups. Similarly, at day 42, T5 had the highest WBC count (30.33±5.08) while T3 had the lowest. Results of red blood cell, heterophil, and packed cell volume showed no differences during the 28 and 42-day periods of the experiments. The level of glucose, proteins, globulin, creatinine, and uric acid in the chickens during the first test (28 days) showed no differences between the treatment groups. In addition, there were no significant differences in lipid profile or liver function test during the two periods of drawing. The adverse effects of aflatoxin on broilers' productive performance are substantial. Astaxanthin may help broilers withstand aflatoxin better and lessen its negative effects.

Keywords: Broiler Chickens, Astaxanthin, Aflatoxin, vitamin E, Mycotoxins

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Introduction

Aflatoxins contamination is one of the serious threats to the global poultry industry. Most of these toxins are secondary metabolites, predominantly produced by fungi of the *Aspergillus*, Fusarium, Penicillium, Claviceps, and Alternaria genera, which contaminate various feed and forage crops, particularly maize, during harvest, processing, and storage (2,3,4,5). Aflatoxin B_1 (AFB_1), considered the most toxic and widespread mycotoxin that affects poultry, is primarily produced under warm and humid conditions by *Aspergillus flavus and A. parasiticus* (20). More than 85% of animal feed samples were reported to contain mycotoxins such as AFB_1, deoxynivalenol, zearalenone and fumonisins in a global survey of over 100 countries (12).

Aflatoxicosis is the toxic effect caused by AFB_1 in chickens, resulting in hepatotoxicity, immunosuppression, oxidative stress, and reduced growth performance. Long-term exposure to AFB_1 alters lipid metabolism, induces ROS production, and causes lipid peroxidation and damage to the liver and other organs. Furthermore, residues of aflatoxin and its metabolites can be detected in poultry meat and eggs, representing an important route of public health risk mediated through the food chain (22).

Natural antioxidant supplements that can scavenge the free radicals generated by aflatoxin metabolism and increase the antioxidant defense system are being investigated to alleviate their adverse effects. Compounds, including chlorophyll extract, vitamin A, and other biological antioxidants have been demonstrated to prevent oxidative damage and organ injury associated with mycotoxins (10).

Astaxanthin (3,3′-dihydroxy-β, β′-carotene-4,4′-dione; ASTA) is a natural xanthophyll family carotenoid and is known as a potent biological antioxidant among known carotenoids (22). Its main source is from the freshwater microalga *Haematococcus pluvialis* and found in certain aquatic animals, e.g., wild salmon. As a polar xanthophyll with an intricate chemical structure it contains both the hydroxyl and keto groups. Astaxanthin has been implicated as an effective quencher of the singlet oxygen and a good scavenger of hydrogen peroxide radicals and its antioxidant activity was shown to be greater than that of β-carotene (11,16).

Though aflatoxin toxicity is well-characterized, there is limited evidence of the protective effect of astaxanthin on AFB_1-induced physiological and biochemical changes in poultry. Hence, the objective of this study was to investigate the impact of dietary astaxanthin supplementation on haematological, immunological, and biochemical parameters in AFB_1-fed broiler chickens in relation to liver function and lipid metabolism. These results may help to clarify the utilization behaviour of astaxanthin as a functional feed additive to alleviate negative effects of mycotoxins and improve overall health status in poultry.

Materials and Methods

Laboratory Experiments

The experiments involved identifying the fungal genera associated with maize grains and the proportions of aflatoxin-producing fungi (*Aspergillus flavus and A. parasiticus*). They also included identifying the proportions of aflatoxin-producing isolates from the two aforementioned species, selecting the one with the highest toxin production, molecularly confirming it using polymerase chain reaction (PCR), and using it to produce aflatoxin. Aflatoxin was obtained from the Postgraduate Laboratory of the Department of Plant Protection and the Central Laboratory of the College of Agriculture, University of Anbar, at a concentration of 300 ppb.

Experimental Design

A total of 150 birds were randomly assigned to five treatments, each containing three replicates, with 10 birds distributed among the cages. This experiment was conducted for 42 days, from February 9, 2025, to March 22, 2025. The treatments began during the second week of the trials on February 15, 2025 when the birds were provided the basal diets supplemented with the additives described below.

Experimental Treatments (T)

T1: Basal feed without any additives, and considered the negative control

T2: Positive control, involving a basal feed supplemented with AFB1 at a concentration of 300 ppb

T3: Basal feed supplemented with AFB1 at a concentration of 300 ppb and astaxanthin at a concentration of 0.750 mg/kg

T4: Basal feed supplemented with AFB1 at a concentration of 300 ppb and astaxanthin at a concentration of 1.5 mg/kg

T5: Basal feed supplemented with AFB1 at a concentration of 300 ppb and vitamin E at a concentration of 5 mg/kg.

Experimental Materials

The following materials were used to determine their effect on AFB1:

- Antifungal: prepared as mentioned above.

- Vitamin E: vitamin E powder prepared by the Jordanian company Fabco.

- Astaxanthin: 100% pure natural astaxanthin was obtained in powder form, extracted from the aquatic alga *Haematococcus pluvialis*, imported from China via DHL, and produced by Xi'an Changyue Phytochemistry Co., Ltd.

Blood Characteristics

Blood samples were obtained at 28 and 42 days of age after 15 birds from each treatment group were euthanized. Three birds were chosen from each treatment group, one from each replicate. Blood samples were obtained in tubes containing ethylenediaminetetraacetic acid (EDTA) as an anticoagulant. Red blood cells (RBC), packed cell volume (PCV), and total white blood cells (WBC) were quantified utilizing a blood counter (Coulter STKS model, Coulter Electronics, Ltd, Luton,

UK) with modified dilutions. The second half was collected in anticoagulant-free white tubes to obtain blood serum for biochemical analysis.

The blood components were isolated from extraneous constituents using centrifugation at 3,000 rpm for 15 minutes. The serum was obtained with a micropipette and preserved in a freezer at -20 °C. The activities of enzymes, including aspartate amino transferase (AST), alanine aminotransferase (ALT), and alkaline phosphatase (ALP), as well as serum metabolites such as blood urea nitrogen (BUN) and glucose (GLU), were assessed using an automatic clinical chemistry analyzer (Hitachi 7020 automatic biochemical analyzer, Hitachi, Tokyo, Japan) (1,11).

Weight of Internal Organs

The weight of the internal organs were estimated as described by (8).

Statistical Analysis

A one-way analysis of variance (ANOVA) was conducted, including the effect of the experimental treatments on the studied traits, using the General Linear Model (GLM) and SAS statistical software version 9. Significant differences between means were tested using Duncan's multiple range test (7) at a significance level of P≤0.05 according to the following mathematical model:

$$Yij = \mu + Ti + Eij$$

Where,

Yij: observation value for the studied trait associated with treatment i

μ: overall mean for the trait

Ti: effect of treatment i

Eij: random error, which is assumed to be normally distributed with a mean of zero and a variance of 2

Results and Discussion

Table 1 shows the effect of astaxanthin and vitamin E on cumulative productive performance. There were a significant difference ($P \leq 0.05$) in weekly body weight between the groups, while increases were noted in the T1 (negative control) group and a decrease in the T5 group (300 ppb aflatoxin B1+ 5 mg/kg vitamin E). Also, feed conversion ratios increased significantly in the T5 group while they decreased in the T1 group. Other properties had non-significant differences. Pertiwi et al. (19) showed that astaxanthin improves the performance of broiler chickens by increasing their daily feed intake, followed by improvements in the FCR while Li et al. (15) found that liver damage and oxidative stress caused by AFB1 exposure lowered broiler chicken body weight and increased FCR. Hassan et al. (18) found that adding vitamin E to aflatoxin-contaminated chicken feed improved antioxidant status and reduced lipid peroxidation markers in liver and muscle tissue, improving growth and production.

Table 1. Effect of adding astaxanthin to broiler diets contaminated with aflatoxins on productive performance at 28 and 42 days of age

Properties	T1	T2	T3	T4	T5	P-value
Weekly body weight	3266.7±74.1 ^{a}	3085.6±56.4 ^{ab}	3073.5±90.5 ^{ab}	3068.7±64.1 ^{ab}	2897.2±97.9 ^{b}	0.05
Weight gain	3087.6±74.2	2904.7±35.2	2882.6±115.1	2884.8±25.5	2717.5±142.0	NS
Feed intake rate	4096.1±215.5	4224.4±41.8	4075.8±186.6	4162.1±66.7	4013.8±265.7	NS
Feed conversion ratio	1.32±0.04 ^{b}	1.45±0.01 ^{a}	1.41±0.01 ^{a}	1.44±0.01 ^{a}	1.47±0.02 ^{a}	0.05

T1: negative control, T2: positive control (300 ppb AFB1), T3: 300 ppb AFB1+0.750 mg/kg astaxanthin, T4: 300 ppb AFB1+1.5 mg/kg astaxanthin, T5: 300 ppb AFB1+ 5 mg/kg vitamin E

The results in Table 2 showed the effects of astaxanthin and vitamin E on cumulative production performance. There were significant differences in relative growth between the groups, increasing in T1 and decreasing in T5, while other properties had no significant differences. Also, AFB1 gradually decreased the performance and economic productivity of the broilers, while the antioxidants astaxanthin or vitamin E improved productivity and reduced economic losses, with astaxanthin being the most effective (13).

Table 2. Effect of adding astaxanthin to broiler diets contaminated with aflatoxin on production index and economic index at 28 and 42 days of age

Properties	T1	T2	T3	T4	T5	P-value
Relative growth	178.89±0.45	177.72±0.24	177.52±0.83	177.59±0.18	176.28±1.07	0.05
Production index	634.0±34.8* [a]	585.7±15.1 [ab]	600.0±38.9 [ab]	587.2±20.8 [ab]	523.4±21.9 [b]	NS
Economic indicators	705.4±8.6 [a]	606.5±10.5 [b]	619.4±19.8 [b]	607.4±0.7 [b]	561.1±19.7 [c]	NS

T1: negative control, T2: positive control (300 ppb AFB1), T3: 300 ppb AFB1+0.750 mg/kg astaxanthin, T4: 300 ppb AFB1+1.5 mg/kg astaxanthin, T5: 300 ppb AFB1+ 5 mg/kg vitamin E

Table 3 shows that the hematological parameters of the broilers during the first draw (28 days) had significant differences ($P \leq 0.05$) in WBC count between the treatment groups. The T5 group recorded the highest WBC means (33.33±8.14) while T3 had the lowest (16.60±1.22). Also, WBC showed no significant differences during the second test (42 days); the highest (30.33±5.08) and lowest (16.87±1.75) means were detected in T5 and T3, respectively. RBC, HL, and PCV showed no significant differences during between the groups for both tests. The nutraceutical applications of astaxanthin previously reported include anticancer and antidiabetic applications, and it has also been reported to have gastro-, hepato-, neuro-, cardio-, ocular, and skin-protective properties (14).

The findings of (6) demonstrated that the total WBC count elevated due to the consumption of an AFB1-contaminated diet. Astaxanthin mitigated the changes in WBC induced by an AFB1-contaminated meal. The lack of significant difference in blood characteristics between the experimental treatments may be due to the ability of the chickens to tolerate the presence of mycotoxins in feed, but within certain limits. Also, they may avoid consuming feed contaminated with mycotoxins, and the lack of a significant effect of the toxin on blood characteristics, especially fats and liver enzymes, negatively affected growth and reduced production.

Table 3. Effect of adding astaxanthin to broiler diets contaminated with aflatoxin on hematological parameters at 28 and 42 days of age

Traits	First draw (28 days)					P-value
	Treatments					
	T1	T2	T3	T4	T5	
RBC (1012/L)	3.33±0.9	3.47±0.23	3.83±0.64	3.37±0.03	3.27±0.28	NS
WBC (109/L)	21.07±1.75 ab	21.87±3.43 ab	16.60±1.22 b	25.87±2.54 ab	33.33±8.14 a	0.1393
PCV	32.00±0.58	34.00±2.00	36.67±5.70	32.33±0.33	31.33±2.67	NS
HL	0.35±0.08	0.34±0.06	0.34±0.08	0.40±0.09	0.78±0.32	NS
Second draw (42 days)						
RBC	3.17±0.39	3.30±0.30	3.53±0.75	2.97±0.23	3.10±0.25	NS
WBC	23.60±1.64 ab	21.13±3.05 ab	16.87±1.75 b	24.47±1.28 ab	30.33±5.08 a	0.0812
PCV	32.00±3.46	32.33±2.19	34.33±6.98	29.33±1.67	31.33±2.33	NS
HL	0.47±0.03	0.51±0.06	0.46±0.09	0.51±0.13	0.71±0.18	NS

T1: negative control, T2: positive control (300 ppb AFB1), T3: 300 ppb AFB1+0.750 mg/kg astaxanthin, T4: 300 ppb AFB1+1.5 mg/kg astaxanthin, T5: 300 ppb AFB1+5 mg/kg vitamin E

For the biochemical blood characteristics of the broilers, Table 4 shows significant differences in mean glucose levels between the treatment groups during the first draw (28 days) with T2 registering the highest level at 182.53±3.95 and T5 the lowest (170.12±2.49). However, they did not show any difference during the second drawing (42 days). Also, protein, albumin, globulin, uric acid, and creatinine levels showed no significant differences during two periods of drawing.

The elevated glucose experienced in T2 may be from increased carbohydrate turnover and/or hormonal level regulation, specifically of insulin and glucagon.

Postprandial glucose concentration is highly dependent upon dietary composition; easily fermentable carbohydrates or metabolic modulators result in increased postprandial glucose concentrations. Conversely, T5 had lower glucose levels, which may be the result of enhanced glucose uptake by peripheral tissues or increased insulin sensitivity. The lack of changes in total protein, albumin and globulin indicate that the treatments employed did not markedly alter hepatic protein synthesis or plasma protein turnover. In general, protein metabolism is more stable than for carbohydrates except in cases of extreme nutritional imbalance or hepatic dysfunction. Additionally, the stabilization of uric acid and creatinine levels suggest that purine metabolism and kidney function were normal, meaning the treatments were not harmful to renal health.

The results in the table indicate that treating broiler chickens with aflatoxin significantly elevated glucose levels. This may be attributed to the toxic effect of aflatoxin on the liver, and that liver damage reduces the efficiency of sugar metabolism. The results of this study are consistent with (23) but differ from (6), who showed no significant differences in glucose levels when broiler chickens were exposed to AFB1 or treated with astaxanthin.

Table 4. Effect of adding astaxanthin to broiler diets contaminated with aflatoxin on serum biochemical parameters at 28 and 42 days of age

Blood traits	First draw (28 days)					P-value
	Treatments					
	T1	T2	T3	T4	T5	
Glucose	176.33±3.2 ab	182.53±3.95 a	177.57±0.18 ab	173.58±1.78 ab	170.12±2.49 b	0.0700
Protein	3.07±0.10	2.93±0.07	3.00± 0.20	3.18±0.15	2.99±0.09	NS
Albumin	1.61±0.08	1.44±0.01	1.53±0.11	1.62±0.02	1.37±0.11	NS
Globulin	1.46±0.04	1.49±0.08	1.47±0.12	1.56±0.17	1.62±0.20	NS
Uric acid	4.65±0.37	4.36±0.22	4.59±0.15	4.75±0.03	4.99±0.64	NS
Creatinine	0.20±0.03	0.28±0.03	0.31±0.06	0.39±0.10	0.36±0.07	NS
Second draw (42 days)						
Glucose	177.72±6.71	178.55±4.05	177.89±1.88	183.20±2.16	181.04±2.9	NS
Protein	3.74±0.28	3.32±0.07	3.19±0.04	3.51±0.17	3.35±0.18	NS
Albumin	1.87±0.11	1.69±0.05	1.65±0.05	1.89±0.11	1.79±0.04	NS
Globulin	1.87±0.18	1.63±0.11	1.53±0.02	1.63±0.09	1.56±0.14	NS
Uric acid	4.77±0.39	5.04±0.54	4.68±0.27	5.5±0.27	5.18±0.43	NS
Creatinine	0.24±0.11	0.23±0.04	0.21±0.02	0.17±0.02	0.26±0.08	NS

T1: negative control, T2: positive control (300 ppb AFB1), T3: 300 ppb AFB1+0.750 mg/kg astaxanthin, T4: 300 ppb AFB1+1.5 mg/kg astaxanthin, T5: 300 ppb AFB1+ 5 mg/kg vitamin E

Table 5 indicates the effect of the experimental treatments on the lipid profile for the two periods. There were no significant ($P > 0.05$) differences among treatments for total cholesterol, triglycerides, HDL-C, LDL-C, or VLDL-C concentrations at either sampling period. Astaxanthin helps cholesterol migrate to HDL (9). The study by (12) showed increased levels of cholesterol and triglycerides in broiler chickens fed aflatoxin-contaminated diets.

Table 5. Effect of adding astaxanthin to broiler diets contaminated with aflatoxin on lipid profile at 28 and 42 days of age

Blood traits	First draw (28 days)					P-val.
	Treatments					
	T1	T2	T3	T4	T5	
Cholesterol	154.56±8.69	159.78±4.65	165.36±5.71	159.22±5.97	146.93±6.16	NS
TG	87.93±7.84	101.08±14.97	98.93±7.18	103.46±3.45	89.84±4.39	NS
NHDL	83.59±6.23	93.03±4.64	93.20±4.72	88.08±5.78	82.40±1.66	NS
HDL	70.97±3.18	66.75±0.30	72.16±1.48	71.14±5.27	64.53±5.47	NS
LDL	66.00±5.92	72.81±6.11	73.41±3.55	67.39±5.51	64.43±0.96	NS
VLDL	17.59±1.57	20.22±2.99	19.79±1.44	20.69±0.69	17.97±0.88	NS
Second draw (42 days)						
Cholesterol	145.75±1.14	161.10±2.74	146.30±7.36	165.12±19.35	165.66±6.22	NS
TG	116.91±4.51	117.15±6.07	107.49±12.01	149.03±16.35	120.05±21.82	NS
NHDL	74.21±3.73	85.87±1.27	74.22±12.70	88.92±18.26	90.44±11.51	NS
HDL	71.55±4.36	75.23±1.82	72.08±6.20	76.19±4.55	75.23±6.14	NS
LDL	50.83±2.90	62.44±1.28	52.72±10.30	59.12±16.27	66.42±7.94	NS
VLDL	23.38±0.90	23.43±1.22	21.50±2.40	29.81±3.27	24.01±4.37	NS

T1: negative control, T2: positive control (300 ppb AFB1), T3: 300 ppb AFB1+0.750 mg/kg astaxanthin, T4: 300 ppb AFB1+1.5 mg/kg astaxanthin, T5: 300 ppb AFB1+ 5 mg/kg vitamin E

The result in **Table 6** demonstrate that alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP) were not significantly ($P > 0.05$) affected by the dietary treatments at either 28 or 42-days of age. Incorporating vitamin E into broiler feeds contaminated with aflatoxin may alleviate certain adverse effects of aflatoxin on biochemical blood parameters. It may also assist in normalizing liver enzyme activity (AST, ALT, ALP) and possibly mitigate liver damage induced by aflatoxins (**21**). The findings of (**17**) demonstrate that aflatoxins are among the most significant mycotoxins in broilers due to their toxicity, inflicting significant detrimental effects on the productive performance of broilers.

Table 6. Effect of adding astaxanthin to broiler diets contaminated with aflatoxin on liver enzyme at 28 and 42 days of age

Blood traits	First draw (28 days)					P-value
	Treatments					
	T1	T2	T3	T4	T5	
AST	37.64±2.62	29.36±2.15	33.60±2.84	33.70±3.48	38.92±7.74	NS
ALT	13.81±1.47	11.99±0.76	12.35±1.09	12.23±0.95	14.05±0.74	NS
ALP	363.28±22.65	367.00±14.26	389.92±6.84	343.11±41.43	355.64±28.30	NS
Second draw (42 days)						
AST	36.74±2.46	38.69±2.88	37.67±2.00	42.60±1.56	36.99±1.21	NS
ALT	9.66±0.67	11.98±0.97	9.66±1.02	11.46±1.45	9.66±1.24	NS
ALP	248.60±18.58	284.44±42.12	329.54±13.68	303.05±20.33	264.55±29.69	NS

T1: negative control, T2: positive control (300 ppb AFB1), T3: 300 ppb AFB1+0.750 mg/kg astaxanthin, T4: 300 ppb AFB1+1.5 mg/kg astaxanthin, T5: 300 ppb AFB1+ 5 mg/kg vitamin E

Table 7 shows the substantial differences across treatments in the glandular stomach weight, with a rise in T2 (0.39±0.02) and decreases in T1 and T5 at 0.32±0.03 and 0.32±0.006, respectively. Intestinal weight increased in T1 (0.60±0.08), followed by T2 (0.56±0.02), but decreased significantly in T3, T4, and T5 at 0.44±0.02,

0.44±0.02, and 0.46±0.02, respectively. The weight of the ileum decreased for T4 (0.62±0.04). However, no discrepancies were noted in the weights of the dressing, liver, pancreas, spleen, heart, bursa of Fabricius, gizzard, jejunum, cecum, and gallbladder.

This investigation concurs with (17), which showed no impact of AFB1 on dressing, liver, spleen, gizzard, heart, pancreas, or abdominal fat. To date, numerous facets of aflatoxicosis in chicken farming, including its impact on broiler performance and carcass characteristics, have been the focus of several extensive reviews. The internal components of the carcass (gizzard, liver, and pancreas weight) were seen to diminish in broilers administered 0.5g/kg of AFB1 in comparison to the control diet.

Table 7. The effect of adding astaxanthin to broiler feed contaminated with aflatoxin on Relative weights of internal organs

Traits	Treatments					P- Value
	T1	T2	T3	T4	T5	
Dressing	76.49±0.92	73.54±2.31	75.94±1.88	76.27±0.26	78.21±1.08	NS
Liver	3.31±0.38	3.57±0.21	3.08±0.15	3.46±0.20	3.38±0.13	NS
Pancreas	0.28±0.05	0.24±0.03	0.24±0.02	0.24±0.02	0.22±0.01	NS
Spleen	0.11±0.01	0.14±0.02	0.10±0.02	0.11±0.009	0.14±0.02	NS
Heart	0.59±0.15	0.57±0.03	0.59±0.05	0.56±0.03	0.56±0.04	NS
Bursa of Fabricius	0.14±0.02	0.19±0.03	0.17±0.02	0.19±0.03	0.19±0.05	NS
Glandular stomach	0.32±0.03 b	0.39±0.02 a	0.39±0.01 ab	0.33±0.03 ab	0.32±0.006 b	0.05
Gizzard	1.12±0.23	1.23±0.25	1.20±0.06	1.15±0.14	1.19±0.09	NS
Intestinal	0.60±0.08 a	0.56±0.02 ab	0.44±0.02 b	0.44±0.02 b	0.46±0.02 b	0.05
Jejunum	1.17±0.21	0.99±0.05	1.09±0.04	0.86±0.04	0.95±0.009	NS
Ileum	1.32±0.11 a	0.88±0.11 b	0.84±0.02 bc	0.62±0.04 c	0.77±0.07 bc	0.0008
Cecum	0.62±0.08	0.53±0.07	0.48±0.07	0.53±0.09	0.46±0.04	NS
Gallbladder	0.07±0.01	0.03±0.008	0.07±0.03	0.04±0.01	0.04±0.01	NS

T1: negative control, T2: positive control (300 ppb AFB1), T3: 300 ppb AFB1+0.750 mg/kg astaxanthin, T4: 300 ppb AFB1+1.5 mg/kg astaxanthin, T5: 300 ppb AFB1+ 5 mg/kg vitamin E

Conclusion

Toxic aflatoxins rank high among mycotoxins affecting broilers. The adverse effects of aflatoxin on broilers' productive performance are substantial. Astaxanthin may help broilers withstand aflatoxin better than vitamin E, and mitigate the negative effects of aflatoxin B.

Supplementary Materials

None.

Author Contributions: Waleed Ismail Al-Jugifi methodology, writing , original and draft preparation; Abdulla Hassan Hussein and Salim Hasan Al-Warshan: writing, review and editing. All authors have read and agreed to the published version of the manuscript.

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مقالة أصيلة

اضافة الأستازانثين للتقليل من الآثار السلبية للأفلاتوكسين B1 في الصفات الفسلجية لفروج اللحم

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الخلاصة

يُعد الأفلاتوكسين B1 من أكثر السموم الفطرية انتشارًا وخطورة، وهو مركب ثانوي تُنتجه فطريات مثل *Aspergillus flavus* و *Aspergillus. parasiticus* تحت ظروف معينة، تشمل الرطوبة الكافية ودرجة الحرارة المرتفعة. هدفت هذه الدراسة إلى تقييم ما إذا كان الأستازانثين الغذائي يمكن أن يخفف من الأضرار الفسيولوجية والمناعية والكيميائية الحيوية التي يسببها الأفلاتوكسين B1 في دجاج فروج اللحم. تم توزيع 150 طائرًا بشكل عشوائي على خمس معالجات، كل منها يحتوي على ثلاث مكررات. شملت الدراسة 150 طائرًا تم توزيعها عشوائيًا على خمس معاملات، تحتوي كل معاملة على ثلاث مكررات. شملت الدراسة الحالية خمس مجموعات، حيث كانت T1 مجموعة ضابطة، وT2 مجموعة ضابطة إيجابية، بتركيز300ppb من الأفلاتوكسين B1. وT3 مجموعة ضابطة بتركيز300ppb من الأفلاتوكسين B1 والأستازانثين بتركيز 0.750 ملغم/كغم. T4: مع الأفلاتوكسين 1B بتركيز 300 ppb والأستازانثين بتركيز 1.5 ملغم/كغم. T5: مع الأفلاتوكسين 1B بتركيز 300ppb وفيتامين E بتركيز 5 ملغم/كغم. أظهرت النتائج ارتفاع في عدد خلايا الدم البيضاء في مجموعة (33.33±8.14) T5 بينما انخفضت في مجموعة (16.60±1.22) T3. كما تم الكشف عن فروقات معنوية خلال السحب الثاني (42 يومًا)، فقد اظهرت ارتفاع في مجموعة (30.33±5.08) T5 وانخفاض في مجموعة (16.87±1.75) T3. أظهرت خلايا الدم الحمراء والهيتروفيل وحجم خلايا المرصوصة عدم وجود دلالة إحصائية خلال فترتي السحب. كما وأظهر مستوى الكلوكوز والبروتينات والغلوبيولين والكرياتينين وحمض البوليك في دجاج الفروج خلال السحب الأول (28 يومًا) فرقًا معنوية بين مجموعات العلاج. بالإضافة إلى ذلك، لم تُلاحظ فروق جوهرية في مستوى الدهون، واختبارات وظائف الكبد خلال فترتي السحب. للأفلاتوكسين B1 آثار سلبية كبيرة على الأداء الإنتاجي لدجاج الفروج. قد يُساعد فيتامينا هـ والأستاسانثين على تحمل الأفلاتوكسين بشكل أفضل، ويُخففان من آثاره السلبية

الكلمات المفتاحية: فروج اللحم، استازانثين، أفلاتوكسين B1، فيتامين هـ، السموم الفطرية