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Role of Bioactive Lycopene in Mitigating the Impact of Aflatoxin B1 on Physiological Performance of Bbroiler Chickens

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Abstract

THIS study was conducted in poultry fields belonging to Animal Production Department at College of Agriculture / University of Anbar for period from 30/9/2023 to 10/11/2023 (42 days). The objective of this study was to study effect of adding different levels of lycopene (0, 50, 100, 150 and 200) mg/kg feed to broiler's diets contaminated with aflatoxin B1 (2 mg/kg) feed on physiological performance. One hundred-eighty chicks, one-day-old (unsexed), was distributed in a completely randomized design that were divided into six treatments with three replicates (10 chicks / replicate). All diets were formulated to meet the same requirements. Broilers were fed with water and food *ad libitum*. Results indicated the addition of lycopene to contaminated feeds with Aflatoxin B1 led to a significant improvement in cellular blood parameters without having an adverse on the health of the birds. Furthermore, results demonstrated that lycopene supplementation reduced levels of cholesterol, triglycerides, and low-density lipoproteins in serum of birds fed diets contaminated with mycotoxin. Also, increasing levels of high-density lipoproteins, which are considered a good indicator of blood lipid tests. Additionally, there was no significant effect of additions on creatinine and uric acid levels. The additions improved the concentration of glucose, total protein, globulin, albumin, and function of liver enzymes ALT and AST. The current results highlight the preventive role of lycopene supplementation in protecting against aflatoxin-contaminated feeds and reducing their harmful impact on the physiological performance and health status of broiler chickens.

Keywords: Lycopene, Aflatoxin B1, physiological performance, Broiler**.**

Introduction

Fungal toxins are widely spread in animal feed and have a tremendous ability to proliferate in grain crops. They are characterized by their ability to grow in processed and raw materials, which can lead to the deterioration of food products by causing changes in their quality and nutritional value, as well as the secretion of toxic substances harmful to public health [1]. Fungal toxins are considered highly hazardous due to the lack of immune response and their physiological effects on bird cells. They act as immune suppressants, mutagens, and carcinogens [2]. Furthermore, exposure of the digestive tract to fungal toxins can lead to damage to the lining membranes of the digestive system, which in turn affects the digestion and absorption of nutrients from the intestines [3].

Aflatoxin B1 is one of the most widespread and dangerous fungal toxins. It is a secondary metabolite produced primarily by *Aspergillus flavus* and *parasiticus fungi* under certain conditions, including suitable moisture and high temperature [4]. Aflatoxin toxins have been associated with various diseases such as, aflatoxicosis in poultry [5]. The presence of fungal toxin residues in poultry meat, eggs, and other products resulting from feeding on contaminated diets poses a clear threat to human health [6]. Lycopene is classified as a natural antioxidant that provides protection against cellular damage caused by free radicals and oxidative stress [7]. Karadas *et al.* [8] mentioned that lycopene is one of the most effective antioxidants within the carotenoid family. It has a stronger ability than α-tocopherol to scavenge reactive oxygen species (ROS) and is more than ten times more effective than β-carotene in reducing

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oxidative damage to tissues and cells. It also possesses anti-inflammatory properties. Karaca [9] further indicated that lycopene enhances the levels of enzymatic antioxidants such as glutathione and catalase, reduces hydrogen peroxide levels, and helps maintain cell membrane permeability. For these reasons, lycopene can considered a protective factor against aflatoxin poisoning [10].

Therefore, this study aimed to investigate the effect of adding pure lycopene and its role in reducing the contamination of feed with aflatoxin B1 and its impact on the physiological performance of broiler chickens.

Material and Methods

Birds and experimental design

This experiment was conducted at poultry field belong to Department of animal production , College of Agriculture , University of Anbar. The experiment was conducted from 30/9/2023 to 10/11/2023. One hundred-eighty unsexed chicks with an initial weight of 42 gm. were randomly distributed to six treatments with three replicates (10 chicks/ replicate). Temperature of the field was controlled by a thermostat and gradually decreased from 35°C at the beginning of the experiment to 22°C at 21 days of age. Diets were iso-caloric and iso-nitrogenous [11].

Broilers were fed in three phases of feeding program starter, grower and finisher diets. The ingredients and chemical composition of diets are presented in Table 1.

Lycopene has been purchased from Guangzhou Ur, Trading. Co, Ltd, China. Groups were as follows: Control group with basal diet without any addition, T1: addition aflatoxin B1 with 2mg/kg feed, T2: addition lycopene 50 mg. / kg feed + addition aflatoxin B1 with 2mg/kg feed, T3: addition lycopene 100 mg. / kg feed + addition aflatoxin B1 with 2mg/kg feed, T4: addition lycopene 150 mg. / kg feed + addition aflatoxin B1 with 2mg/kg feed, T5: addition lycopene 200 mg. / kg feed + addition aflatoxin B1 with 2mg/kg feed.

At end of experiment 42 day, six birds were randomly selected from treatment were selected, fast for 12 hours, slaughtered. Chemical analyses of plasma were carried out for quantitative determination of blood parameters (Red Blood Cell , White Blood Cell, Packed Cell Volume, Hemoglobin, Heterophil /Lymphocyte ratio, glucose, protein, albumin, Globulin, Triglycerides, Cholesterol, High Density Lipoprotein, Low Density Lipoprotein and Very Low Density Lipoprotein), using commercial kits, following the same steps as described by manufactures.

Production of aflatoxin toxin B1

Isolation of Aspergillus flavus was obtained from the College of Veterinary Medicine, pathology department, University of Baghdad. The method of Shotwell *et al.* [13] and modified by West *et al*. [14] was used. The fungus was activated by the cultivation medium Potato Dextrose Agar (PDA), and then the strain was grown on the grains of corn as a primary development medium, while the main development medium was rice.

Estimating the amount of aflatoxin B1 poison in contaminated rice

Aflatoxin toxins were measured in the extract of each sample in two ways: The first method was by using (Enzyme-Linked Immune Sorbent (ELISA) according to the method of West *et al.* [14] where 5 grams of ground rice powder were weighed and then 25 ml of methanol 70: 30% distilled water was added to it with stirring the sample to ensure mixing with the extraction solution for three minutes.

Then the sample was filtered with Whitman No.1 filter paper to obtain the extract of each sample and the amount of aflatoxin B1 toxin was measured according to the method recommended by the company that supplied the aflatoxin measuring kit. The second method is high Performance Liquid Chromatography (HPLC) Adopting the method by Seitz and Mohr [15].

* Soybean meal 48% crude protein

** Protein concentrate contains: 40% Crude Protein, 5% Calcium,3.7% Meth., 4.12% Meth. + Cys., 3.85% Lys. , 4.68% Available Phosphorus, ME 2107 Kcal kg^(-1), 2.50 mg Na, 1.70 mg threonine, 0.42mg Tryp., 4.20 mg choline , each 1 kg of protein concentrate contain: 100000 IU vit. A, 33000; IU vit. D3, 100 mg; vit. E, 2.55 mg; vit. K3, 25 mg; vit. B1, 10 mg; B2, 50 mg; vit. B6, 24 mg vit. B12; 51 mg niacin; 1.5 mg folic acid; 15 mg; biotin,500 µg and 13.5 mg pantothenic acid.

***Calculated was basis on Tables of NRC [11].

Results were analyzed with Complete Randomized Design (CRD) to investigate the effect of treatments differ in the features studied. multivariate Duncan test was also used [12] to examine the differences between the averages in Average level 0.05 using Statistical Analysis System (SAS).

Results and Discussion

Hematological tests

Results of Table 2 indicate significant differences between the different treatments in cellular blood characteristics. It is evident that the red blood cells of birds in T5 (addition of 200 mg/kg feed of lycopene) recorded the highest value (4.07 million cells/ml) and a significant increase ($P \leq 0.05$) compared to T1 (addition of 2 mg/kg feed of aflatoxin), which

recorded 2.75 million cells/ml. However, no significant differences (P≤0.05) were observed between T2, T3, T4, and control group, which recorded 3.25, 3.60, 3.54, and 3.78 million cells/ml, respectively. The results also showed significant differences in packed cell volume (PCV) values between the lycopene addition treatments at concentrations of 200 and 150 mg/kg feed. Birds in T4 and T5 recorded PCV values of 29.87% and 30.33%, respectively, which were significantly higher compared to birds in T1, which recorded 23.0%. It is worth noting that T4 and T5 did not differ significantly from T2, T3, and control group in packed cell volume, as these treatments recorded rates of 24.13%, 26.67%, and 25%, respectively. Table 2. also includes values of blood hemoglobin, and it is evident that T4 and T5 recorded highest values with significant increases (P≤0.05) of 9.37 and 9.67 g/100 ml of blood, respectively, compared to T1, T2, and control group, which recorded 7.57, 7.53, and 7.67 g/100 ml of blood, respectively. However, T3 which recorded 8.06 g/100 ml of blood, did not differ significantly from other treatments. The statistical analysis results indicated significant differences (P≤0.05) in white blood cell count, T1 (addition of 2 mg/kg feed of aflatoxin) achieved a significant increase of 29.43 thousand cells/ml compared to T3, T4, and T5, which recorded 27.03, 27.66, and 24.23 thousand cells/ml, respectively. It is also noteworthy that T1 did not differ significantly from control group and T2, which recorded 28.70 and 28.03 cells/ml, respectively. Furthermore, T5 recorded a significant decrease (P≤0.05) with a rate of 24.23 thousand cells/ml compared to control group and T2, which recorded white blood cell counts of 28.70 and 28.03 cells/ml, respectively. The table also includes the H/L ratio, which is one of stress indicators in birds. It is observed that birds in T1 (addition of 2 mg/kg feed of aflatoxin) recorded the highest value of 0.810 compared to T2, T3, T4, and T5, which recorded 0.496, 0.450, 0.440, and 0.426, respectively. No significant differences were found between birds in these treatments and birds in the control. The results also indicate that addition of lycopene at high concentrations resulted highest benefits, increasing the concentration of red blood cells, hemoglobin value, and packed cell volume.

Mozos *et al.* [16] indicated that lycopene helps protect red blood cells from oxidation, thereby prolonging their lifespan and reducing their breakdown and degradation. This is evident in the results of the current study, as an increase in lycopene supplementation is directly proportional to red blood cell parameters. Birds in T5 and T4 achieved the highest values for packed cell volume and blood hemoglobin, which may be attributed to the role of lycopene in combating free radicals and reducing lipid oxidation in the cell membranes. This is evident in the H/L ratio results, as treatments with lycopene supplementation did not show any signs of stress, as indicated by the low H/L values in the table. Considering that H/L ratio is a measure of stress in birds, which can be caused by disease, heat, or oxidative stress, it is noteworthy that birds in T1 recorded the highest value. This could be attributed to the exposure of birds to aflatoxin B1 toxins without the presence of antioxidants or detoxifying agents, unlike the other treatments that were exposed to the same level of contamination but with the addition of lycopene to their diets. The results are consistent with Zeweil *et al.* [17], who reported an improvement in the blood profile of rabbits raised in the summer season. The results also align with Ogundeji *et al.* [18], who demonstrated that adding 10 mg lycopene/kg feed broiler diets reduce stress and improve health status of birds, as indicated by the lower H/L values compared to control group. On the other hand, results do not agree with Skevchenko *et al.* [19], who did not observe any effects of lycopene supplementation on red blood cell concentration, packed cell volume, or blood hemoglobin in laying hens.

Blood Biochemical test

The results in Table 3. demonstrate a significant decrease in glucose concentration for treatments that received lycopene supplementation: T2, T3, T4, and T5, with recorded values of 151.67, 147, 144, and 143.33 mg/dl, respectively, compared to T1 (2 mg/kg aflatoxin B1 supplementation), which recorded the highest value of 180 mg/dl. There were no significant differences between T1 and the control, which recorded a glucose concentration of 159.67 mg/dl. Additionally, results showed significant differences between various experimental treatments. Control group and T2 exhibited a significant decrease (P≤0.05) in protein values, both recording 4.4 g/dl, compared to T5 (200 mg lycopene/kg feed), which showed a significant increase of 5.7 g/dl. There were no significant differences between T2 , T3 and T4, which recorded 4.7, 4.8, and 4.9 g/dl, respectively. Regarding albumin measurement, it is evident from the results that treatment T5 (200 mg lycopene supplementation) recorded the highest value of 3.0 g/dl compared to other treatments. There were no significant differences between T3 and T4, which recorded 2.8 and 2.7 g/dl, respectively. From the results table, it can also be noted that ALT measurement recorded the highest value in serum of birds in T1 (2 mg/kg aflatoxin B1 supplementation), with a significant increase (P≤0.05) to 190 IU/L compared to treatments T2, T3, T4 and T5 which recorded values of 156.6, 143.31, 143.12, and 123.33 IU/L, respectively. The results also indicated that lycopene supplementation resulted in a significant decrease (P≤0.05) in ALT concentration compared to the control group, which recorded 170 IU/L. The results did not include any significant differences between treatments in uric acid and creatinine concentrations.

Lycopene plays a positive role and decrease in blood glucose levels may be attributed to the protective effect of lycopene on the liver and pancreas against the damage caused by free radicals resulting from high oxidation or aflatoxin contamination, especially β-cells in the pancreas, which are responsible for the secretion of insulin hormone, the regulatory factor and hormone responsible for blood sugar regulation. Furthermore, the high ability of lycopene to reduce blood lipids and cholesterol causes insulin receptors to close when fat and cholesterol levels are high, which in turn affects glucose metabolism and representation [20]. This result is consistent with what Sahin *et al.* [21] mentioned regarding the high ability of lycopene to reduce blood glucose and cholesterol levels. On the other hand, several researchers have indicated that lycopene works to preserve the pancreas and protect its cells from oxidation, free radicals, and the preservation of liver cells during glucose metabolism and storage of excess glucose in form of glycogen [22,23]. In addition, lycopene helps maintain blood glucose levels within the normal range to ensure a continuous supply of glucose, which is the cornerstone of cellular energy. The results are consistent with what Noaman [24] mentioned, that the addition of lycopene at levels of 225, 150, and 75 mg/kg to broiler feed had a significant effect on reducing blood glucose levels. Similarly, the results are in line with findings [25] that adding 100 mg/kg of lycopene had a role in reducing blood glucose levels and preserving liver cells from oxidative damage caused by oxidative stress. Regarding the protein concentration, it is noted that the addition of lycopene had a positive effect on increasing the crude protein values. Lycopene stimulates liver to produce and increase the concentration of Insulin-like growth factor (IGF-1), which is responsible for increasing protein [26]. This finding is consistent with results of [23], who found that increasing lycopene concentration in the blood leads to an increase in blood protein concentration. The results also showed a significant decrease ($P \leq 0.05$) in liver enzymes ALT and AST. It is observed that addition of lycopene in feeds led to a decrease in concentration of these enzymes in blood serum, and the decrease was directly proportional to the increase in lycopene concentration in feeds. Also, decrease may be attributed to fact that lycopene is a fat-soluble antioxidant that is present in cell membranes and plays a role in protecting cell walls from the damage caused by peroxides. Increase in ALT and AST enzyme concentrations in blood of birds in treatment fed aflatoxin supplementation may be due to damage to organs rich with enzymes. The breakdown or death of these tissues leads to leakage or increased permeability of these cells into the blood. It is important to note that the liver is the main source of several enzymes, including ALT and AST and the activity of these enzymes is an indicator of stress occurring in cells or resulting from oxidative damage or stress [27]. These findings are in agreement with Hussein and Ali [28], who found that adding 250 and 500 mg/kg of lycopene to diets affected decreasing the concentration of ALT and AST enzymes. The researchers attributed the decrease to the ability of lycopene to reduce oxidative damage resulting from stress and oxidation in birds. The results also align with Al-Dawoodi [29] who reported that birds fed aflatoxin-contaminated diets showed a significant increase in ALT and AST concentrations compared to birds fed on diets supplemented with 10 g/kg of lycopene. The researcher attributed the decrease to role of lycopene in protecting liver cells, suggesting that mycotoxins caused liver damage or cell death, leading to increased permeability of cell membranes and leakage of ALT and AST enzymes from liver into bloodstream [30]. Lycopene can accumulate in liver and lungs, and it remains in tissues, especially liver, for a longer period compared to carotenoids. This makes it more effective in protecting these tissues from damage [22].

Lipid Profile tests

Results in Table 4 indicate significant differences between the different experimental treatments in measuring blood cholesterol concentration. The results showed a significant decrease ($P \leq 0.05$) in favor of treatments with addition of lycopene, T4 and T5 (lycopene additions of 150 and 200 mg/kg, respectively). These treatments recorded cholesterol concentrations of 185.93 and 187.43 mg/100 ml respectively, with a significant difference compared to treatment T1 (addition aflatoxin B1 2mg/kg), which recorded highest value of 251.12 mg/100 ml. The results also indicated that T4 and T5 did not show a significant difference compared to treatments control group, T2, and T3 which recorded 199.6, 190.06 and 193.63 mg/100 ml respectively.

The results also showed a significant decrease ($P \leq 0.05$) in the concentration of triglycerides in favor of the combination of lycopene additions (50, 100, 150, 200) mg/kg feed which recorded 205.33, 204.67, 203.0, and 195.67 mg/100 ml respectively compared to T1 (addition of aflatoxin B1 2 mg/kg) which recorded highest value of 287.33 mg/100 ml, and did not differ significantly from the control group, which recorded 215.33 mg/100 ml. It is also noteworthy that decrease in triglyceride concentration was directly proportional to increase in lycopene concentration in different additive treatments. From the observation of the results in Table (4), results indicated a significant increase in concentration of high-density lipoproteins (HDL) for

the treatments with addition of lycopene. The treatments T2, T3, T4 and T5 which recorded 57.33, 53.33, 57.33, and 59.00 mg/100 ml respectively, with a significant increase (P≥0.05) compared to control group, which recorded lowest value with 42.67 mg/100 ml, and did not differ significantly with T1 (aflatoxin addition without lycopene) which recorded 50.5 mg/100 ml. As for low-density lipoproteins (LDL), results indicated that addition of lycopene to broiler diets resulted a significant decrease (P≤0.05) compared to T1 (aflatoxin addition without lycopene). Treatments T2, T3, T4, and T5 recorded values of 91.67, 103.3, 88.00, and 89.30 mg/100 ml respectively, while T1 treatment recorded a highest value with 143.66 mg/100 ml, and did not show any significant difference with control group, which recorded 113.33 mg/100 ml. The results also showed that T4 and T5 did not differ significantly with T1. The results also included significant differences in VLDL values of experimental treatments. Also, results showed decrease in VLDL value for treatments T2, T3, T4, and T5, with values 41.06, 37.00, 40.60, and 39.13 mg/100 ml, respectively, compared to treatment T1, which recorded highest value of 57.46 mg/100 ml, without any significant difference (P≤0.05) between it and the control, which recorded VLDL value with 43.06 mg/100 ml.

Lycopene is considered a natural antioxidant that works to reduce cholesterol levels in the blood of poultry. The mechanism involved in this process is the reduction of mevalonate concentration, which is an intermediate product of the enzyme hydroxymethyl glutaryl-CoA reductase. Lycopene also inhibits cholesterol acyltransferase, which reduces cholesterol esters in tissues. Additionally, lycopene increases the activity of low-density lipoprotein (LDL) receptors, thereby reducing LDL concentration in the blood [31]. The addition of lycopene has had a positive role in improving the lipid profile of serum contaminated with aflatoxin in birds. Lycopene acts as a potent antioxidant, scavenging free radicals generated from lipid oxidation and preserving the lipids transported to the responsible organ for their representation in the liver [32]. This effect can be observed in the results of the previous table, where the addition of lycopene contributed to reducing the damage caused by aflatoxin in treatments T2, T3, T4, and T5. It also reduced concentration of cholesterol, triglycerides, low-density lipoproteins (LDL), and very low-density lipoproteins (VLDL), while increasing concentration of high-density lipoproteins (HDL). These effects have a significant impact on overall health, which positively influences productivity and improves liver function. These findings are consistent with several studies that have indicated role of lycopene in reducing triglyceride and cholesterol levels birds due to its inhibition or obstruction of their production [33]. Low-density lipoproteins (LDL) are the main carriers of triglycerides, cholesterol, and phospholipids in blood, while high-density lipoproteins (HDL) are main carriers of these lipids, transporting them from tissues to liver for processing and conversion into bile acids [34]. The addition of lycopene to feeds helped reduce concentration of triglycerides, cholesterol, and lipoproteins, which contributed to significant differences between different treatments. Our study's results are consistent with Englmaierová *et al.* [35], who reported that adding lycopene to broiler feed with 75 mg/kg resulted in a significant decrease (P≥0.05) in VLDL, LDL, cholesterol, and triglyceride levels, while increasing HDL concentration. The results also align with Bander *et al.* [33], who found that adding lycopene to the feed of broilers at rates of 300, 200, and 100 mg/kg led to a significant improvement in HDL levels and a decrease in cholesterol, triglycerides, VLDL, and LDL concentrations. Similarly, AL-Dawoodi [29] reported that adding tomato powder rich in lycopene improved lipid profile of broilers fed aflatoxin contaminated feed. In the same topic, Albrahim [25] mentioned that lycopene supplementation reduces triglyceride and cholesterol levels, as well as VLDL and LDL concentrations, while increasing HDL levels. This may be attributed to role of lycopene in activating production of cholesterol, triglycerides, and LDL in liver.

Conclusions

Lycopene extract demonstrated a significant effect in alleviating the harmful effects of aflatoxin B1 toxins in broiler feed. Additionally, the physiological condition of the birds improved with the supplementation of lycopene. We recommend adding lycopene or its supplements as natural additives to mitigate the impact of common fungal toxins in poultry feed and to control the pathological effects resulting from aflatoxin poisoning, thereby improving the health and physiological state of broiler chickens.

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The authors declare that the present study hasno financial issues to disclose.

Conflict of interest

The authors declares that there is no conflict interest.

TABLE 1. Ingredient and Chemical composition calculated of experimental diets

Ingredients	Starter 1-14 day	Grower 15-28	Finisher 29-42 day
Yellow corn	55.5	60.4	64.8
Soybean *	35	30	25
Protein concentrate **	5	5	5
Oil	2.2	2.67	3.6
Dicalcium phosphate	0.7	0.5	0.3
Limestone	1.2	1.1	1
DL-methionine	0.2	0.15	0.12
Lysine	0.1	0.08	0.08
Salt	0.1	0.1	0.1
Total	100	100	100
Chemical composition, Calculated * **			
Crude protein	23.52	21.53	19.51
ME, kcal/kg	3017	3101	3210
Methionine + Cystine	1.09	0.99	0.91
Calcium	0.97	0.88	0.78
phosphorus	0.48	0.43	0.39
Available phosphorus	0.39	0.35	0.30

TABLE 2. Effect of lycopene supplementation to broiler diets contaminated with aflatoxin B1 on Blood hematological parameters

Groups	RBC($\times 10^6$ µl)	PCV (%)	Hb (g/dl)	WBC($\times 10^3$ µl)	H/L
(Control)	3.25±0.22 ab	25.00 ±2.0 ab	7.67 ±0.63 b	28.70 ±0.66 ab	0.516 ±0.04 b
T1	2.78±0.18 b	23.00 ±0.58 b	7.57 ±0.14 b	29.43 ±0.62 a	0.810 ±0.05 a
T2	3.60±0.30 ab	24.13 ±2.67 ab	7.53 ±0.82 b	28.03 ±0.63 ab	0.496 ±0.05 b
T3	3.54±0.15 ab	26.67 ±0.89 ab	8.067 ±0.24 ab	27.03 ±1.02 b	0.450 ±0.04 b
T4	3.78±0.13 ab	29.87 ±0.67 a	9.37 ±0.15 a	27.66 ±1.12 b	0.440 ±0.03 b
T5	4.07±0.48 a	30.33 ±4.33 a	9.67 ±1.42 a	24.23 ±0.88 c	0.426 ±0.07 b
P- Value	0.001	0.014	0.201	0.075	0.001

* T1(addition Aflatoxin B1 2 ppm),T2: (addition Aflatoxin B1 2 ppm + lycopene 50 mg / kg feed), T3: (addition Aflatoxin B1 2 ppm + lycopene 100 mg / kg feed), T4 (addition Aflatoxin B1 2ppm + lycopene 150 mg / kg feed), T5: (addition Aflatoxin B1 2ppm + lycopene 200 mg / kg feed).

** The various letters indicate significant differences between treatments within one column's at ($P \leq 0.005$).

TABLE 3. Effect of lycopene supplementation to broiler diets contaminated with aflatoxin B1 on biochemical parameters

Groups	Glucose (100g/ml)	Protein (100 g/ml)	Albumin (100 g/ml)	Globulin (100 g/ml)	ALT (IU/L)	AST (IU/L)	Uric acid	Creatinine (µmol/L)
(Control)	159.67± 6.69 ab	4.4 ±0.27 b	2.1 ± 0.8 b	2.3 ± 0.1 ab	170.0 ±20.0 ab	469.7 ±20.1 ab	1.483 ±0.037	0.3933 ±0.05
T1	180.0 ± 2.31 a	4.4 ±0.26 b	2.3 ±0.7 b	2.1 ± 0.3 b	190.0 ±5.7 a	568.0 ±10.6 a	1.470 ±0.25	0.4267 ±0.06
T2	151.67± 4.48 b	4.7 ±0.11 ab	2.1 ± 0.1 b	2.6 ± 0.1 a	156.6 ±18.6 b	381.0 ±85.0 b	1.503 ±0.047	0.4333 ±0.021
T3	147.00± 1.53 b	4.8 ±0.12 ab	2.8 ±0.1 ab	2.0 ± 0.2 b	143.31 ±12.1 bc	370.7 ±70.1 b	1.510 ±0.104	0.4000 ±0.023
T4	144.00± 0.57 b	4.9 ±0.41 ab	2.7 ±0.1 ab	2.2 ± 0.8 ab	143.122 ±0.3 bc	370.0 ±27.1 b	1.490 ±0.015	0.4167 ± 0.021
T5	143.33± 1.76 b	5.7 ± 0.26 a	3.0 ± 0.2 a	2.7 ± 0.3 a	123.33 ±26.0 c	315.0 ±49.3 c	1.473 ±0.037	0.3833 ±0.024
P- Value	0.000	0.004	0.000	0.000	0.227	0.049	N.S	N.S

* T1(addition Aflatoxin B1 2 ppm),T2: (addition Aflatoxin B1 2 ppm + lycopene 50 mg / kg feed), T3: (addition Aflatoxin B1 2 ppm + lycopene 100 mg / kg feed), T4 (addition Aflatoxin B1 2ppm + lycopene 150 mg / kg feed), T5: (addition Aflatoxin B1 2ppm + lycopene 200 mg / kg feed).
** The various letters indicate significant differences between treatments within one column's at (P≤0.005).

TABLE 4. Effect of lycopene supplementation to broiler diets contaminated with aflatoxin B1 on lipid profile parameters

Groups	Cholesterol (mg/100ml)	Triglycerides (mg/100ml)	HDL (mg/100ml)	LDL (mg/100ml)	VLDL (mg/100ml)
(Control)	199.60 ±3.84 ab	215.33±4.17 ab	42.67 ± 1.76 b	113.3 ±3.33 ab	43.06 ±2.6 ab
T1	251.12 ± 3.33 a	287.33 ±7.8 a	50.00 ± 1.0 ab	143.66 ±2.18 a	57.46 ± 1.50 a
T2	190.06 ±2.33 ab	205.33 ± 2.7 b	57.33 ±1.20 a	91.67 ±2.15 bc	41.06 ±0.57 b
T3	193.63 ±2.89 ab	204.67±2.02 b	53.33 ±2.19 a	103.30 ± 2.8 b	37.00 ± 2.00 b
T4	185.93 ±2.03 b	203.00 ± 3.6 b	57.33 ± 3.50 a	88.00 ± 4.04 c	40.60 ± 1.20 b
T5	187.43 ±2.89 b	195.67 ± 1.7 b	59.00 ± 0.57 a	89.30 ± 5.20 c	39.13 ±0.89 b
P- Value	0.000	0.000	0.000	0.000	0.000

* T1: (addition Aflatoxin B1 2 ppm),T2: (addition Aflatoxin B1 2 ppm + lycopene 50 mg / kg feed), T3: (addition Aflatoxin B1 2 ppm + lycopene 100 mg / kg feed), T4 (addition Aflatoxin B1 2ppm + lycopene 150 mg / kg feed), T5: (addition Aflatoxin B1 2ppm + lycopene 200 mg / kg feed).
** The various letters indicate significant differences between treatments within one column's at (P≤0.005).

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دور اللايكوبين الحيوي في التقليل من تأثير ألافلاتوكسين B1 في الأداء الفسيولوجي لفروج اللحم

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المستخلص

تمت هذه الدراسة في حقول الدواجن التابعة لقسم إلانتاج الحيواني في كلية الزراعة / جامعة الأنبار للفترة من 2023/9/30 إلى 2023/11/10 (42 يومًا). كان الهدف من هذه الدراسة هو دراسة تأثير إضافة مستويات مختلفة من اللايكوبين 0، 50، 100، 150 و 200 ملغم/كغم علف إلى أعلاف فروج اللحم الملوثة بأفلاتوكسين B1 بنسبة 2 ملغم/كغم علف في الأداء الفسيولوجي. تم توزيع 180 فراخ في عمر يوم واحد (غير مجنسة) وفقًا لتصميم عشوائي كامل على ستة معاملات بواقع ثلاث مكررات (10 فراخ/ مكررة). تم صياغة جميع الاعلاف لتلبية متطلبات التربية. تم تغذية الطيور بالماء والعلف وبصورة حرة . أظهرت النتائج أن إضافة اللايكوبين إلى الأعلاف الملوثة بأفلاتوكسين B1 أدت إلى تحسين ملحوظ في الصفات الدموية الخلوية ولم تظهر تأثيرات سلبية على الدجاج أو حالتهم الصحية. علاوة على ذلك ، أظهرت النتائج أن إضافات اللايكوبين قللت من مستويات الكولسترول والدهون الثلاثية والليبوبروتينات ذات الكثافة المنخفضة في مصل الطيور التي تتناول أعلافًا ملوثة بالسموم. كما زادت مستويات الليبوبروتينات ذات الكثافة العالية ، والتي تُعتبر مؤشرًا جيدًا لاختبارات الدهون في الدم. بالإضافة إلى ذلك ، لم يظهر أي تأثير ملحوظ للإضافات على مستويات الكرياتينين وحامض اليوريك. تحسنت صفات كل من الكلوكوز والبروتين الكلي والكلوبيولين والألبومين ووظائف إنزيمات الكبد ALT و AST. تسلط النتائج الحالية الضوء على الدور الوقائي لمستخلص اللايكوبين في الحماية من تاثيرات الاعلاف الملوثة بالسموم الفطرية وتقليل تأثيرها الضار على الأداء الفسيولوجي والحالة الصحية لفروج اللحم.

الكلمات الدالة: اللايكوبين ، الافلاتوكسين B1، الاداء االفسيولوجي ، فروج اللحم.