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International Journal of Pharmaceutical and Phytopharmacological Research

(ICV-5.09)

ISSN (Online) 2249 – 6084

ISSN (Print) 2250 – 1029

Int.J.Pharm.Phytopharmacol.Res. 2012, 2(2): 87-91

(Research Article)

Effect of Liquorice Extract Supplemented Diet on Aflatoxin Degradation and Blood Parameters in Broiler Chickens

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Received on: 02/10/2012 ***Accepted on:*** 29/10/2012

ABSTRACT

This study was carried out to determine the expected role of liquorice to be involved in alleviate the detrimental effects of aflatoxicosis on physiological performance of broiler chickens. A total of 900 Fawbro broiler chicks, three weeks old were used in this study. Chicks were randomly allocated to 6 treatments of 3 replicates per each treatment. Birds in the first treatment (T1) were fed a basal diet and used as control group. Birds in T2 treatment fed a basal diet contaminated with aflatoxin , while birds in T3 treatment were fed a diet contaminated with aflatoxin and treated with mold killer. However, birds in T4, T5 and T6 treatments were fed a diet contaminated with aflatoxin and supplemented with liquorice extract at the levels of 150, 300 and 450 mg / kg of diet, respectively.Results of this study revealed that dietary aflatoxin (T2) significantly ($p < 0.05$) decreased erythrocyte counts (RBC), haemoglobin concentration (Hb) , hematocrit (PCV), thrombocyte counts (Thr), leukocyte counts (WBC), plasma glucose (Glu), plasma protein (Pro), plasma calcium (Cal), plasma phosphorous (Pho) and alkaline phosphatase (ALP) activity, while significant ($p < 0.05$) increases were found in heterophil / lymphocyte ratio (H / L), plasma uric acid (Uri), plasma cholesterol (Cho) , and aspartate aminotransaminase (AST) activity compared with control group (T1) .The addition of liquorice extract (T4, T5 and T6) or mold killer (T3) to an aflatoxin – containing diet significantly improved the adverse effects of aflatoxin on haematological and biochemical traits. However, results of the current study clearly show that liquorice extract, especially at the level of 450 mg / kg effectively diminished the detrimental effects of aflatoxicosis on the general physiological status of broiler chickens.

Keywords: Liquorice, Aflatoxin, Blood Parameters, Broiler Chickens.

INTRODUCTION

Mycotoxins are structurally diverse secondary fungal metabolites that occur worldwide as contaminants of grain. Among the various mycotoxins identified especially affecting poultry, aflatoxin, ochratoxin, T-2 toxin, are often encountered in feedstuffs at alarming concentrations in different parts of the world[1]. These mycotoxin contaminated feedstuffs when consumed, produce a range of sever devastating effects on the general well – being and productivity of farm animals and poultry[2].

Aflatoxins, potent mycotoxins produced by *Aspergillus flavus* and *Aspergillus parasiticus*, are a major concern in poultry production. Aflatoxins contamination causes reduced feed quality and reduced animal efficiency either through poor conversion of nutrients or problems such are reproductive abnormalities[3]. Aflatoxicosis in poultry also causes listlessness, anorexia with lowered growth rate, poor feed utilization, decreased egg production and increased mortality. Additionally, anemia[4], reduction of immune function[5], hepatotoxicosis and hemorrhage[6] are associated with aflatoxicosis. Huff et al.[7] found that aflatoxin treatment significantly decreased body weight, weight gain, increased relative weights of spleen, liver, kidney, gizzard, proventriculus, decreased activity of ALP, AST and lactic dehydrogenase and decreased levels of protein, albumin, triglycerides, calcium and phosphorous. Altered activities of enzymes, Viz., serum AST, ALT, ALP and gamaglutamyl transferase (GGT) have been noticed during aflatoxicosis[8]. Birdane et al.[9] found that RBC, PCV, Hb, Thr, and lymphocyte counts were significantly reduced by aflatoxin treatmen, while increases were seen in heterophil counts.

At the present time there dose not appear to be any way of preventing or ameliorating the disease other than avoiding conditions conductive to the formation of aflatoxin in feedstuffs and avoiding fed with performed aflatoxin. Because of the nature of the feed distribution system in the poultry industry, this avoidance is difficult. A more economical solution would be the development of a dietary additive or modification that would make the bird more resistant to aflatoxin.

The objective of this investigation was to explore way that a broiler diet might be modified to enhance resistance to aflatoxin. This was done by studying the effect of the inclusion of different levels of liquorice extract in the diet

on the blood characteristics of broilers receiving diet which contaminated with aflatoxin.

MATERIALS AND METHODS

This experiment was conducted to determine the effect of dietary liquorice extract on certain blood characteristics of broiler chickens exposed to aflatoxin. Atotal of 900 Fawbro broiler chicks, three weeks old were used. Birds were fed starter diet during the third week of age (starting date of experiment ; 22.7 % crude protein and 2867.4 Kcal / Kg of diet) and finisher diet (20.6 % crude protein and 2922 kcal / kg of diet) till the marketing age (49 days of age). Chicks were allocated at random to 6 treatment groups of 3 replicate per group, each replicate constitutes 50 chicks (150 chicks per treatment group).

Birds in the first treatment were fed a basal diet and used as control group (T1). The second treatment (T2) was fed a basal diet contaminated with aflatoxin, while birds in the third treatment (T3) were fed a diet contaminated with aflatoxin and treated with mold killer. The type of mold killer used in this study was manufactured by Korean company that called Choong ang Biotech. However, birds in fourth, fifth, and sixth treatments were fed a diet contaminated with aflatoxin and supplemented with liquorice extract. Liquorice extract was added to the diet of birds throughout the total period of investigation at levels of 150 mg / kg (T4), 300 mg / kg (T5) and 450 mg / kg of diet (T6).

Aflatoxin used in the present study was aflatoxin B1 which prepared and incorporated into basal diet by method previously reported[10]. Aflatoxin was produced by growing *Aspergillus flavus* on rice. The moldy rice was dried and ground to a fine powder and analyzed spectrophotometrically for its total aflatoxin content by the method of Nabney and Nesbitt[11]. The moldy rice then added and well mixed with the yellow corn that involved in the basal diet. The final concentration of aflatoxin introduced to the birds was determined to be equal to 2 mg aflatoxin / kg of diet.

At the end of experiment (7 weeks of age), blood samples were collected into a vacutainer (containing heparin) by vein puncture of brachial vein of 24 birds in each treatment (12 males and 12 females). The haematological traits evaluated in the present investigation and which have been shown to indicate general physiological status of birds consisted of the following : Erythrocyte counts – RBC and leucocyte counts – WBC[12], haemoglobin concentration – Hb and plasma alkaline phosphatase activity – ALP[13], hematocrit – PCV[14], thrombocyte counts – Thr [15], heterophil to lymphocyte ratio – H / L[16], plasma glucose – Glu[17], plasma protein – Pro[18], plasma uric acid – Uri[19], plasma aspartate aminotransaminase – AST activity[20], plasma cholesterol – Cho [21], plasma calcium – Cal[22], and plasma phosphorous – Pho[23].

Significance of data was determined at the 5 % level of probability by analysis of variance (ANOVA) using the Statistical Analysis System[24]. Significance of the differences between treatments means was determined by Duncan's multiple range test [24].

RESULTS AND DISCUSSION

The influence of liquorice extract as an ameliorating agent in broilers fed dietary aflatoxin B1 on various blood parameters have been presented in Tables 1 to 4. Feeding aflatoxin alone (T2) caused significant ($p < 0.05$) decrease in RBC, Hb, PCV, Thr, and WBC, while significant increase was found in H / L ratio in both of males, females and both sexes (Tables 1 and 2). These finding agree with the other reports that explain the suppressive effects of aflatoxin on hematopoiesis and immune response[5]. Broiler chicks given 2.5 to 3.5 g aflatoxin / kg diet have shown not only decreased amount of Hb, PCV, Thr, and lymphocyte and monocyte counts[25] but also increased heterophils[4]. Aflatoxin might have affected the tissue of haemopoietic and immune system thereby the production of cells might have been affected. Various studies have reported that PCV, RBC and Thr counts were decreased by aflatoxin and aflatoxicosis caused lymphocytopenia and heterophilia in broiler chickens[26]. However, Gross and Siegel[16] reported a positive correlation between plasma corticosterone and H / L, and that H / L ratio is a good indicator of physiological stress. Therefore, increasing H / L ratio indicated that the birds were under acute stress.

Compared to control group (T1), Glu, Pro, Cal, Pho, and ALP were significantly ($p < 0.05$) decreased and Uri, AST and Cho were significantly ($p < 0.05$) increased by aflatoxin treatment (T2; Tables 3 and 4). Chronic and sub – clinical aflatoxicosis cases may be diagnosed by determining serum biochemical and haematological alterations before major symptoms became apparent[4]. Şehu et al.[27] indicated that aflatoxin toxicity in broilers may be manifested by decrease serum concentration of total protein, albumin, inorganic phosphorous and calcium. Afzali and Devegowda[28] concluded that the most important sequelae of aflatoxicosis in poultry are impairment of immune system resulting in high mortality. Aflatoxin inhibits protein synthesis, and resulting in lowered level of antibody production. The reduction in total serum protein is due to impairment of amino acid transportation at mRNA transcription level and then by inhibiting protein synthesis[29]. Bridane et al.[9] reported that inclusion of aflatoxin into the diet caused significant decreases in serum total Pro, albumin, triglyceride, Glu, inorganic Pho and creatinine values, while significant increases were recorded for Cho and AST activity. However, those authors concluded that the decrease in serum Pro, albumin and Glu values and increases Cho and AST activity are due to the hepatotoxic effects of aflatoxin characterized by inhibition of protein synthesis and the impairment of carbohydrate and metabolism. However, the decrease in serum inorganic Pho and the increase in Uri may be related to the nephrotoxic effects of aflatoxin in agreements with other studies[30]. Bailey et al.[31] found acute elevation in the levels of serum Uri, AST and ALT activities of broilers fed a diet contaminated with ochratoxin, and explained these changes by the large lesions occurred for heart, kidney and liver organs as a result of aflatoxicosis. Furthermore, altered activities of enzymes, *viz*., serum AST, ALT and ALP have been noticed during aflatoxicosis[32, 33]. Huff et al. [7]reported that aflatoxin treatment significantly decreased activity of ALP and decreased serum levels of Pro, albumin, Glu, Cal and Pho.

The addition of liquorice extract to aflatoxin – containing diet (T4, T5 and T6) completely ameliorated the adverse effects of aflatoxin on haematological parameters included in this study. Supplementation of liquorice to the diet significantly ($p < 0.05$) increased RBC, Hb, PCV, Thr, and WBC and reduced the H / L ratio compared with T2 group in both of males , females and both sexes (Tables 1 and 2).

However, T6 group surpasses other treatments as regards all of these blood characteristics. On the other hand, T4 and T5 were in general superior to T3 group in relation with these traits.

With incorporation of gradual levels of liquorice extract (T4 , T5 and T6) or mold killer (T3) into the aflatoxin – contaminated diet, Glu, Pro, Cal, Pho and ALP significantly ($p < 0.05$) increased, whereas Uri, Cho, and AST significantly ($p < 0.05$) decreased in both males, females, and both sexes (Tables 3 and 4). However, T6 recorded the best results in regard to these traits compared with all other treatments. Additionally, there were no significant differences between T4, T5 and T3 regarding Glu, Uri, Pro, Cho, Cal and Pho in both of males, females, and both sexes.

The beneficial counteraction of liquorice extract with aflatoxin molecules in the diet and gastrointestinal tract have been clearly observed in our study as predicted. The role of liquorice extract in aflatoxin detoxification might be attributed to two mechanisms, as we expected. First, it may have selective binding capacity for aflatoxin molecules in gastrointestinal tract, and the second that liquorice shows some anti – infective properties. In laboratory and animal studies, it has stopped or slowed the growth of certain bacteria, fungi, and parasites. Several animal studies have also revealed a possibly strong antiviral and fungicide effects for true liquorice. In these studies, true liquorice component that belong to isoflavonoid class of chemicals, appear to have several anti – infective effects that include interference with oxygen utilization by infective – organisms. Additionally, true liquorice may have some ability to improve functioning of the immune system[34, 35, 36]. However, by functioning as anti – fungal agent, this herb destroys or prevents the growth of fungi[37].

Table 1: Effect of dietary licorice on RBC, Hb and PCV of broilers fed a diet contaminated with aflatoxin.

Treatments	RBC ($\times 10^6$ / µL)			HB (g / dL)			PCV (%)		
	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes
T1	2.49 ± 0.19 ^{b}	2.36 ± 0.10 ^{b}	2.43 ± 0.19 ^{b}	8.27 ± 1.48 ^{b}	8.39 ± 1.45 ^{b}	8.33 ± 1.39 ^{b}	24.41 ± 1.98 ^{b}	23.29 ± 2.03 ^{b}	23.85 ± 1.90 ^{b}
T2	2.11 ± 0.10 ^{e}	2.05 ± 0.13 ^{d}	2.08 ± 0.12 ^{d}	7.96 ± 1.35 ^{d}	8.01 ± 1.40 ^{e}	7.99 ± 1.42 ^{e}	20.13 ± 1.95 ^{d}	18.27 ± 1.90 ^{d}	19.20 ± 2.01 ^{e}
T3	2.34 ± 0.18 ^{d}	2.26 ± 0.11 ^{c}	2.30 ± 0.10 ^{c}	8.13 ± 1.46 ^{c}	8.21 ± 1.38 ^{d}	8.17 ± 1.44 ^{d}	23.17 ± 1.97 ^{c}	22.66 ± 2.02 ^{c}	22.92 ± 1.98 ^{d}
T4	2.37 ± 0.10 ^{cd}	2.28 ± 0.12 ^{c}	2.33 ± 0.11 ^{c}	8.18 ± 1.38 ^{c}	8.30 ± 1.39 ^{c}	8.24 ± 1.43 ^{c}	23.34 ± 2.0 ^{c}	23.09 ± 1.95 ^{bc}	23.22 ± 1.88 ^{c}
T5	2.41 ± 0.12 ^{c}	2.30 ± 0.12 ^{c}	2.36 ± 0.19 ^{c}	8.24 ± 1.40 ^{b}	8.35 ± 1.36 ^{bc}	8.30 ± 1.37 ^{b}	24.36 ± 2.02 ^{b}	22.12 ± 2.00 ^{c}	23.24 ± 1.89 ^{c}
T6	2.55 ± 0.18 ^{a}	2.48 ± 0.19 ^{a}	2.52 ± 0.19 ^{a}	8.34 ± 1.33 ^{a}	8.45 ± 1.35 ^{a}	8.40 ± 1.39 ^{a}	26.37 ± 1.87 ^{a}	24.29 ± 1.89 ^{a}	25.33 ± 2.0 ^{a}

T1= Birds fed a basal diet; T2= Birds fed diet contaminated with aflatoxin; T3= Birds fed diet contaminated with aflatoxin and treated with mold killer; T4, T5 and T6= Birds fed diet contaminated with aflatoxin and supplemented with liquorice extract at levels of 150, 300 and 450 mg / Kg of diet, respectively.

* Values in a column with different superscripts differ significantly ($p < 0.05$).

Table 2: Effect of dietary licorice on THR, WBC and H / L ratio of broilers fed a diet contaminated with aflatoxin.

Treatments	Thr ($\times 10^3$ / µL)			WBC ($\times 10^3$ / µL)			H / L ratio		
	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes
T1	24.17 ± 1.83 ^{b}	22.81 ± 1.92 ^{b}	23.49 ± 1.95 ^{b}	25.97 ± 1.90 ^{b}	24.04 ± 1.87 ^{b}	25.0 ± 1.96 ^{b}	0.23 ± 0.09 ^{c}	0.22 ± 0.08 ^{c}	0.23 ± 0.01 ^{c}
T2	19.0 ± 1.13 ^{e}	18.36 ± 2.11 ^{e}	18.68 ± 2.11 ^{e}	20.11 ± 2.0 ^{d}	19.63 ± 1.95 ^{e}	19.87 ± 1.93 ^{e}	0.29 ± 0.01 ^{a}	0.28 ± 0.01 ^{a}	0.29 ± 0.01 ^{a}
T3	20.96 ± 1.90 ^{d}	20.03 ± 1.93 ^{d}	20.50 ± 2.0 ^{d}	23.85 ± 1.46 ^{c}	22.80 ± 1.91 ^{d}	23.33 ± 1.88 ^{d}	0.23 ± 0.01 ^{c}	0.25 ± 0.01 ^{b}	0.24 ± 0.01 ^{c}
T4	22.09 ± 1.88 ^{c}	21.78 ± 2.01 ^{c}	21.94 ± 1.90 ^{c}	24.36 ± 1.84 ^{c}	23.51 ± 1.79 ^{c}	23.94 ± 1.90 ^{c}	0.26 ± 0.08 ^{b}	0.24 ± 0.07 ^{b}	0.25 ± 0.01 ^{bc}
T5	24.33 ± 1.95 ^{b}	22.82 ± 1.89 ^{b}	23.58 ± 1.86 ^{b}	25.71 ± 1.88 ^{b}	24.83 ± 1.92 ^{b}	25.27 ± 1.96 ^{b}	0.23 ± 0.09 ^{c}	0.24 ± 0.09 ^{b}	0.24 ± 0.07 ^{c}
T6	25.51 ± 1.80 ^{a}	24.07 ± 1.91 ^{a}	24.79 ± 1.89 ^{a}	26.42 ± 1.86 ^{a}	25.79 ± 1.77 ^{a}	26.11 ± 1.90 ^{a}	0.20 ± 0.06 ^{d}	0.19 ± 0.08 ^{c}	0.20 ± 0.01 ^{d}

T1= Birds fed a basal diet; T2= Birds fed diet contaminated with aflatoxin; T3= Birds fed diet contaminated with aflatoxin and treated with mold killer; T4, T5 and T6= Birds fed diet contaminated with aflatoxin and supplemented with liquorice extract at levels of 150, 300 and 450 mg / Kg of diet, respectively.

* Values in a column with different superscripts differ significantly ($p < 0.05$).

Table 3: Effect of dietary licorice on Glu, Uri, Pro and AST of broilers fed a diet contaminated with aflatoxin.

Treatments	Glu (mg / dL)			Uri (mg / dL)			Pro (g / dL)			AST (IU / L)		
	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes
T1	172.3 ± 17.1 [b]	170.1 ± 18.5 [b]	171.2 ± 19.9 [b]	7.55 ± 0.47 [c]	7.69 ± 0.46 [c]	7.62 ± 0.49 [c]	5.20 ± 0.30 [b]	5.15 ± 0.25 [b]	5.18 ± 0.24 [b]	95.26 ± 9.17 [b]	97.12 ± 8.45 [b]	96.19 ± 9.36 [b]
T2	158.2 ± 20.7 [d]	160.5 ± 19.9 [c]	159.4 ± 21.1 [c]	7.83 ± 0.50 [a]	8.01 ± 0.48 [a]	7.92 ± 0.53 [a]	4.92 ± 0.28 [d]	4.88 ± 0.33 [d]	4.90 ± 0.31 [d]	96.02 ± 10.42 [a]	100.1 ± 11.37 [a]	98.07 ± 11.63 [a]
T3	168.1 ± 17.6 [c]	172.0 ± 18.4 [b]	170.1 ± 18.2 [b]	7.67 ± 0.39 [b]	7.79 ± 0.42 [b]	7.73 ± 0.40 [b]	5.08 ± 0.30 [c]	5.03 ± 0.21 [c]	5.06 ± 0.27 [c]	95.14 ± 9.41 [b]	96.90 ± 8.52 [b]	96.02 ± 10.32 [b]
T4	171.9 ± 20.0 [b]	170.4 ± 19.3 [b]	170.8 ± 18.4 [b]	7.69 ± 0.44 [b]	7.75 ± 0.50 [b]	7.72 ± 0.47 [b]	5.05 ± 0.28 [c]	5.00 ± 0.30 [c]	5.03 ± 0.23 [c]	95.30 ± 8.97 [b]	97.18 ± 9.35 [b]	96.24 ± 9.41 [b]
T5	172.6 ± 17.8 [b]	171.4 ± 18.0 [b]	172.0 ± 18.7 [b]	7.64 ± 0.36 [b]	7.82 ± 0.40 [b]	7.73 ± 0.42 [b]	5.06 ± 0.25 [c]	5.02 ± 0.27 [c]	5.04 ± 0.20 [c]	95.19 ± 9.11 [b]	96.84 ± 8.99 [b]	96.02 ± 9.27 [b]
T6	181.9 ± 20.5 [a]	177.1 ± 19.3 [a]	179.5 ± 18.0 [a]	7.27 ± 0.40 [d]	7.29 ± 0.38 [d]	7.28 ± 0.45 [d]	5.29 ± 0.20 [a]	5.25 ± 0.22 [a]	5.27 ± 0.24 [a]	94.38 ± 9.21 [c]	95.15 ± 8.78 [c]	94.77 ± 9.05 [c]

T1= Birds fed a basal diet; T2= Birds fed diet contaminated with aflatoxin; T3= Birds fed diet contaminated with aflatoxin and treated with mold killer; T4, T5 and T6= Birds fed diet contaminated with aflatoxin and supplemented with liquorice extract at levels of 150, 300 and 450 mg / Kg of diet, respectively.

[*] Values in a column with different superscripts differ significantly ($p < 0.05$).

Table 4: Effect of dietary licorice on Cho, Cal, Pho and ALP of broilers fed a diet contaminated with aflatoxin.

Treatments	Cho (mg / dL)			Cal (mg / dL)			Pho (mg / dL)			ALP (King Armstrong Unit)		
	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes	Males	Females	Both sexes
T1	128.1 ± 15.4 [c]	128.2 ± 16.1 [c]	128.2 ± 16.3 [c]	7.21 ± 0.39 [b]	7.10 ± 0.43 [b]	7.16 ± 0.40 [b]	3.47 ± 0.21 [b]	3.26 ± 0.27 [b]	3.37 ± 0.19 [b]	43.02 ± 4.63 [b]	39.91 ± 4.52 [b]	41.47 ± 4.44 [b]
T2	141.4 ± 17.1 [a]	138.1 ± 16.3 [a]	139.8 ± 16.9 [a]	6.79 ± 0.50 [c]	6.77 ± 0.55 [c]	6.78 ± 0.49 [c]	3.21 ± 0.25 [c]	3.07 ± 0.25 [c]	3.14 ± 0.23 [c]	39.06 ± 4.81 [c]	36.30 ± 4.65 [d]	37.68 ± 5.11 [d]
T3	135.7 ± 15.9 [b]	133.6 ± 14.8 [b]	134.7 ± 15.5 [b]	7.23 ± 0.38 [b]	7.16 ± 0.45 [b]	7.20 ± 0.41 [b]	3.51 ± 0.20 [b]	3.30 ± 0.21 [b]	3.41 ± 0.18 [b]	42.36 ± 4.49 [b]	38.14 ± 3.91 [c]	40.25 ± 5.03 [c]
T4	136.0 ± 16.2 [b]	133.1 ± 15.7 [b]	134.6 ± 15.5 [b]	7.17 ± 0.42 [b]	7.11 ± 0.51 [b]	7.14 ± 0.46 [b]	3.44 ± 0.17 [b]	3.26 ± 0.20 [b]	3.35 ± 0.19 [b]	42.30 ± 5.07 [b]	38.11 ± 4.57 [c]	40.21 ± 4.33 [c]
T5	131.2 ± 15.9 [b]	129.8 ± 14.7 [b]	130.5 ± 15.5 [b]	7.20 ± 0.44 [b]	7.14 ± 0.43 [b]	7.17 ± 0.48 [b]	3.52 ± 0.20 [b]	3.29 ± 0.24 [b]	3.41 ± 0.21 [b]	42.98 ± 5.01 [b]	39.94 ± 4.13 [b]	41.46 ± 4.20 [b]
T6	124.5 ± 14.8 [d]	119.9 ± 15.0 [d]	122.2 ± 15.1 [d]	7.40 ± 0.40 [a]	7.33 ± 0.47 [a]	7.37 ± 0.47 [a]	3.75 ± 0.17 [a]	3.67 ± 0.20 [a]	3.71 ± 0.18 [a]	49.15 ± 3.96 [a]	46.23 ± 4.19 [a]	47.64 ± 4.27 [a]

T1= Birds fed a basal diet; T2= Birds fed diet contaminated with aflatoxin; T3= Birds fed diet contaminated with aflatoxin and treated with mold killer; T4, T5 and T6= Birds fed diet contaminated with aflatoxin and supplemented with liquorice extract at levels of 150, 300 and 450 mg / Kg of diet, respectively.

[*] Values in a column with different superscripts differ significantly ($p < 0.05$).

CONCLUSION

In conclusion, haematological and plasma biochemical traits were significantly affected by aflatoxin treatment. The addition of liquorice extract to the aflatoxin – containing diet significantly recovered the adverse effects of aflatoxin on haematological parameters – plasma biochemical of broiler. The protective effect of 450 mg / kg liquorice extract used in this study against the toxic effects of aflatoxin was greater than that of 150 and 300 mg / Kg. Liquorice extract was non – toxic and non – detrimental for broiler chicken and these improvements should contributes to a solution of aflatoxin problem in broiler chickens.

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