Effect of Liquorice on Productive Performance of Broilers Exposed to Aflatoxin

Hazim J. Al-Daraji

Department of Animal Production, College of Agriculture, University of Baghdad, Baghdad, Iraq

ABSTRACT

This study was conducted to determine the effect of adding liquorice on productive performance of broilers. A total of 900 three weeks old, Fawbro broilers, were used to investigate the probable role of liquorice extract in suppressing the detrimental effects of aflatoxicosis on productive performance of broiler. Chicks were randomly allocated to 6 treatments of 3 replicates. Birds in the first treatment (T1) were fed a basal diet and used as control group. Birds in T2 treatment were fed a 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 levels of 150, 300 and 450 mg/kg of diet, respectively. Inclusion of the aflatoxin in the diet resulted in a significant (P<0.05) decreased in productive index, economic figure, dressing percentage with or without giblet. When mold killer (T3) or liquorice extract (T4, T5 and T6) were incorporated into the diet containing aflatoxin, they significantly (P<0.05) improved all these traits. However, liquorice treatments surpassed T3 in productive index and economic figure. It was concluded from this study that supplementation of liquorice extract particularly at a level of 450 mg/kg in the diet contaminated with aflatoxin can depress the adverse effects of aflatoxicosis on productive performance of broiler chickens.

Key words: Liquorice; aflatoxin; productive performance; broilers

Corresponding author: Prof. Dr. Hazim J. Al-Daraji, Department of Animal Production, College of Agriculture, University of Baghdad, Baghdad, Iraq

INTRODUCTION

The aflatoxin producing fungi have been found in large variety of commodities. Conditions favouring their growth and toxin production are high moisture content, high temperature, insect damage and the physical condition of the grain, weathering, mechanical handling and presence of cracked grains (Obioha et al., 1986). Reddy et al. (1982) reported that infestation of feeds with aflatoxins causes increased mortality, decreased growth rate and poor feed conversion in broiler chicken. However, aflatoxin was demonstrated to produce in broiler chicken a steatorrhea accompanied by a decrease in digestive enzymes elaborated by pancreas (Obsorna and Hamilton, 1981). Giambrone et al. (1985) indicated that aflatoxin treatment resulted in increase in the susceptibility of broiler chickens to salmonellosis, aspergillosis, coccidiosis, and Marek’s disease. The immuno depressive action in aflatoxins was primarily on the cell-mediated immune system (Giambrone et al., 1985).

Aflatoxin is the common name for a group of structurally related compounds (aflatoxin B1, B2, G1 and G2) produced by fungi of the Flavus parasiticus group of the genus Aspergillus. This mycotoxin is potentially a threat to poultry health and production through contaminated poultry feeds (Huff et al., 1986). Al-Daraji et al. (2004) reported that experimentally induced aflatoxicosis resulted in significant deterioration in erythrocytes, leucocytes, thrombocytes, haemoglobin concentration, heterophili/lymphocyte ratio, hematocrit and plasma uric acid, glucose, cholesterol, protein, calcium, phosphorus, GOT activity and alkaline phosphatase activity.

Liquorice exerts numerous beneficial effects on the body, making liquorice a valuable herb for treating a host of aliments. It can help reduce inflammation. It seems to prevent the breakdown of adrenal hormones such as cortisol (the body’s primary stress fighting adrenal hormone), making these hormones more available to the body and helps the body cope with stress (Utsunomia et al., 1999). Liquorice also appears to enhance immunity by boosting levels of interferon, a key immune system chemical that fights off attacking viruses (Fujioka et al., 2003). However, liquorice is also known to exhibit many pharmacological actions, including estrogenic activity, antinflamatory, antiallergic, antibacterial, antiviral, antiehepatotoxic, fungicide, anticancer and anti-Trichomonas (Newall et al., 1996).

The present study was undertaken to suppress the effect of aflatoxicosis on productive performance of broiler by using different levels of liquorice extract. Liquorice extract was supplemented at levels of 150, 300, and 450 mg/kg to the diet of birds which was previously contaminated with aflatoxin.
MATERIALS AND METHODS

This study was conducted to determine the effect of dietary supplementation of liquorice extract on productive performance of broilers. A total of 900 Fawbro broilers, three weeks of age were used. Birds were fed starter diet during the third week of age (beginning 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) until the marketing age (49 days of age). Chicks were randomly divided into 6 treated groups of 3 replicates per group; each replicate constitutes 50 chicks (150 chicks per treatment group).

Birds in the first group was fed a commercial broiler ration and used as a control group (T1). The second treatment (T2) was fed a diet contaminated with aflatoxin, while birds in the third treatment (T3) were fed a diet contaminated with aflatoxin and treated with mold killer (Choong and Biotech Company, Korea). However, birds in fourth, fifth, and sixth treatments were fed a diet contaminated with aflatoxin and supplemented with liquorice extract. Liquorice extract was supplemented to the diet of birds throughout the total period of experiment 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 was obtained from the Department of Plant Protection, College of Agriculture, University of Baghdad. Aflatoxin was prepared and incorporated into basal diet by method previously reported (Shotwell et al., 1995). 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 (1965). The moldy rice then was added to the yellow corn of the basal diet. The final level of aflatoxin introduced to the birds was determined to be equal to 2 mg aflatoxin/kg of diet.

Productive characteristics were measured in this study include mortality, productive index and economic figure. Productive index and economic figure were determined according to Naji and Hana (1999) method. At the end of experiment, 18 birds per each treatment (6 birds per each replicate) were sacrificed to determine dressing percentage with or without giblet, and weights of certain organs, viz. liver, heart, gizzard, spleen, in addition to abdominal fat.

Significance of data was determined at the 5% level of probability by analysis of variance (ANOVA) using the Statistical Analysis System (SAS, 1989). Significance of the differences between treatments means was determined by Duncan’s multiple range test (SAS, 1989).

RESULTS

Dietary aflatoxin (T2) significantly (P<0.05) depressed productive index, economic figure and liveability, starting from the fourth week of age through the seventh week of age in comparison with control group (T1; Table 1). When mold killer (T3) or liquorice extract (T4, T5 and T6) were added to the diet containing aflatoxin, they significantly (P<0.05) increased these traits. There were no significant differences between liquorice treatments (T4, T5, and T6) and T3 throughout the experimental period in relation to mortality (Table 1). The addition of 450 mg/kg liquorice extract to the diet containing aflatoxin restores productive index and economic figure to the control values (Table 1).

Inclusion the aflatoxin into the diet (T2) resulted in a significant reduction in both dressing percentage with or without giblet compared with control group (T1; Table 1). However, the supplementation of mold killer (T3) and liquorice extract (T4, T5, T6) to the aflatoxin–contaminated diet significantly improved these two traits in comparison with T2 treatment. T6 treatment surpassed other treatments in relation to dressing percentage with or without giblet and it restored the means of these two traits to the control values.

The effects of different treatments on the relative weight of certain organs are presented in Table 2. With incorporation of aflatoxin into the diet (T2), giblet organs such as liver, heart, gizzard and spleen significantly (P<0.05) increased in comparison with control group (T1). However, administration of graded levels of liquorice extract (T4, T5, and T6) or mold killer (T3) resulted in significant reduction in the relative weight of these organs compared with T2 treatment. Furthermore, there was a trend that T6 recorded the lowest (P<0.05) means regarding the relative weights of liver, heart, gizzard and spleen comparing with other treatments (T3, T4 and T5).

Table 1: The effect of different levels of liquorice extract on some productive traits of broiler fed a diet contaminated with aflatoxin

<table>
<thead>
<tr>
<th>Treatments</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Productive Index</td>
<td>195.28 ± 12.21ab</td>
<td>161.60 ± 15.69ab</td>
<td>180.55 ± 14.53ab</td>
<td>183.14 ± 13.99ab</td>
<td>185.02 ± 14.03ab</td>
<td>190.18 ± 12.71ab</td>
</tr>
<tr>
<td>Economic Figure</td>
<td>196.04 ± 13.47ab</td>
<td>162.14 ± 17.15ab</td>
<td>181.08 ± 15.32ab</td>
<td>183.63 ± 16.01bc</td>
<td>185.49 ± 15.44b</td>
<td>191.01 ± 14.8ab</td>
</tr>
<tr>
<td>Total mortality (%)</td>
<td>2.69 ± 0.11a</td>
<td>2.69 ± 0.11a</td>
<td>1.62 ± 0.06a</td>
<td>1.59 ± 0.06a</td>
<td>1.48 ± 0.06a</td>
<td>1.41 ± 0.05b</td>
</tr>
<tr>
<td>Dressing percentage (with giblet) (%)</td>
<td>51.14 ± 3.95a</td>
<td>63.92 ± 5.64c</td>
<td>64.72 ± 4.63b</td>
<td>64.77 ± 4.49b</td>
<td>64.97 ± 5.02b</td>
<td>65.1 ± 4.11a</td>
</tr>
<tr>
<td>Dressing percentage (without giblet) (%)</td>
<td>65.14 ± 3.95a</td>
<td>63.92 ± 5.64c</td>
<td>64.72 ± 4.63b</td>
<td>64.77 ± 4.49b</td>
<td>64.97 ± 5.02b</td>
<td>65.1 ± 4.11a</td>
</tr>
</tbody>
</table>

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= Birds fed diet contaminated with aflatoxin and supplemented with liquorice extract at level of 150 mg/kg, T5= Birds fed diet contaminated with aflatoxin and supplemented with liquorice extract at level of 300 mg/kg, T6= Birds fed diet contaminated with aflatoxin and supplemented with liquorice extract at level of 450 mg/kg; *Values in a row with different superscripts differ significantly (P<0.05)
Table 2: The effect of different levels of liquorice extract on certain organ weights of broiler fed a diet contaminated with aflatoxin

<table>
<thead>
<tr>
<th>Traits</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal fat (%)</td>
<td>1.04 ± 0.09(^{a})</td>
<td>1.11 ± 0.01(^{a})</td>
<td>1.09 ± 0.01(^{a})</td>
<td>1.05 ± 0.01(^{a})</td>
<td>1.08 ± 0.08(^{b})</td>
<td>1.05 ± 0.01(^{a})</td>
</tr>
<tr>
<td>Liver weight (%)</td>
<td>3.01 ± 0.08(^{d})</td>
<td>3.89 ± 0.16(^{a})</td>
<td>3.17 ± 0.07(^{b})</td>
<td>3.16 ± 0.09(^{b})</td>
<td>3.15 ± 0.09(^{b})</td>
<td>3.05 ± 0.07(^{c})</td>
</tr>
<tr>
<td>Heart weight (%)</td>
<td>0.51 ± 0.05(^{d})</td>
<td>0.68 ± 0.01(^{a})</td>
<td>0.60 ± 0.08(^{b})</td>
<td>0.60 ± 0.09(^{b})</td>
<td>0.58 ± 0.08(^{b})</td>
<td>0.54 ± 0.06(^{c})</td>
</tr>
<tr>
<td>Spleen weight (%)</td>
<td>0.10 ± 0.003(^{d})</td>
<td>0.28 ± 0.009(^{a})</td>
<td>0.17 ± 0.005(^{b})</td>
<td>0.16 ± 0.005(^{b})</td>
<td>0.15 ± 0.004(^{b})</td>
<td>0.12 ± 0.03(^{c})</td>
</tr>
<tr>
<td>Gizzard weight (%)</td>
<td>2.60 ± 0.01(^{a})</td>
<td>3.03 ± 0.03(^{a})</td>
<td>2.84 ± 0.02(^{b})</td>
<td>2.79 ± 0.02(^{b})</td>
<td>2.81 ± 0.02(^{b})</td>
<td>2.66 ± 0.02(^{c})</td>
</tr>
</tbody>
</table>

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= Birds fed diet contaminated with aflatoxin and supplemented with liquorice extract at level of 150 mg/kg, T5= Birds fed diet contaminated with aflatoxin and supplemented with liquorice extract at level of 300 mg/kg, T6= Birds fed diet contaminated with aflatoxin and supplemented with liquorice extract at level of 450 mg/kg; *Values in a row with different superscripts differ significantly (P<0.05)

DISCUSSION

The results of this experiment clearly demonstrated that aflatoxicosis in broiler chickens can be influenced by supplementation the liquorice extract to the contaminated diet. Increasing the liquorice content of the diet to 450 mg/kg essentially negated the effects of aflatoxin. An obvious explanation to the protective effects of liquorice is that liquorice shows some antineoplastic properties. In laboratory and animal studies, it has stopped or slowed down the growth of certain bacteria, fungi, and parasites. Several animal studies have also revealed a possibly strong antiviral and fungicide effects for true liquorice (Duke, 1985). In these studies, true liquorice component that belong to the isoflavonoid class of chemicals, appeared to have several antineoplastic effects like interference with oxygen utilization by infective organisms. Additionally, true liquorice may have some ability to improve functioning of the immune system (Adam, 1997; Shibata, 2000).

Newall et al. (1996) reported that medicinal use of liquorice in both Western and Eastern cultures dates back several thousands years. Liquorice is known to exhibit many pharmacological actions, including anti-inflammatory (cortisol–like), antiviral, antibacterial, antifungal, anti-Trichomonas, antineoplastic and anti-allergic activities. The plant reinforces the body’s ability to withstand attack from virtually any kind of pathogen. However, if one is looking for a broad spectrum tonic to protect, maintain health, and heal injuries, there is no herb better than liquorice root. Utsumoitya et al. (1999) indicated that modern research on liquorice reports effects which are adrenal enhancing, analgesic, anti-inflammatory, antioxidant, anti tumor, antiviral, fungicide, immune protecting, liver protecting and liver detoxifying. However, by functioning as anti–fungal agent, this herb destroys or prevents the growth of fungi.

Liver seemed to be the target organ in aflatoxicosis. Hepatic hypertrophy following toxin administration appeared to be caused primarily by increased fat content in the organ (Reddy et al., 1982). Mashalhy et al. (1986) reported that aflatoxin feeding at 50 µg/kg diets resulted in a significant decline in body and liver weights, rate of liver protein and RNA synthesis, and muscle RNA synthesis. Brown and Abrams (1965) observed that a severe decline in plasma proteins on feeding aflatoxin B1 to chickens and ducklings was due to the suppression of liver protein synthesis as a consequence of mitochondrial injury and the lowered rate of ATP synthesis. Huff et al. (1986) also noted that aflatoxin treatment significantly (P<0.05) decreased body weight and weight gain; increased the relative weight of the spleen, liver, proventriculus, gizzard, heart, and kidney; and induced hepatic hyperlipemia. Reddy et al. (1982) found that with the increase of the level of aflatoxin, liver, kidney, spleen, gizzard and pancreas showed an increase in weight with respective threshold doses of 0.50, 0.75, 1.50 and 4.0 ppm, while bursa of fabricius regressed at 1.25 ppm. Smith and Hamilton (1970) demonstrated that graded doses of aflatoxin (1.25, 2.5, 5.0 and 10.0 ppm) incorporated into the feed of broiler chickens resulted in a decreased growth rate, an enlarged liver, spleen, and pancreas and a regressed bursa of fabricius. However, analysis of the liver showed that lipids accounted for 60% of the dry weight increase (Smith and Hamilton, 1970).

The finding that liquorice extract can suppress the detrimental effects of aflatoxin on liver may be explained by the active component in liquorice root which help prevent and treat chronic hepatitis (liver inflammation). In one study, a Japanese patients with hepatitis C those received intravenous treatment with glycyrrhizin for an average of 10 years were significantly less likely to develop liver cancer and cirrhosis (progressive liver failure; Vanrossum et al., 1999). In a second study of 57 patients with hepatitis C, glycyrrhizin (in dose ranging from 80 to 240 mg / day) significantly improved liver function after only one month. These effects diminished after glycyrrhizin treatment discontinued (Arase et al., 1997). Fujioka et al. (2003) reported that liquorice both protects the liver and promotes healing in this vital organ. The herb’s anti – inflammatory properties help calm hepatitis – associated liver inflammation. Liquorice also fights the virus and toxins commonly responsible for hepatitis, and supplies valuable antioxidant compounds that help maintain the overall health of liver and certain vital organs. However, glycyrrhizin may prevent liver and other vital organs such as heart, spleen, and kidney from being damaged by oxidants. Too many oxidants can harm healthy cells and cause inflammation. Liquorice root nutritionally supports the respiratory and gastrointestinal systems, liver, heart and spleen (Vaya et al., 1997).

Conclusion

It was concluded from this study that dietary liquorice extract particularly at the level of 450 mg/kg of diet can ameliorate the severity of aflatoxicosis in broiler chickens and may be helpful in the control and prevention of this economically important disease.
REFERENCES


