



Effect-of-dietary-supplementation of tomato powder on growth performance and immunological status of broilers under aflatoxicosis

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Abstract

Objective: Due to chicken meat is an important source of nutrients, the purpose of the study are to show the efficacy of Tomato powder in alleviating the deleterious effects of aflatoxin in broilers and on Growth Performance and Immunological.

Methods: One hundred straight-run broiler chicks Ross 308 (one day -old) were used in the present work. In control condition, birds were randomly divided into 5 equal groups, 20 birds for each group as following for 35 days: (G1)20 chicks Basal diet control negative, (G2) 20 chicks Basal diet + aflatoxin (30 ppb) control positiv, (G3) 20 chicks Treated group aflatoxin (30 ppb) + mycofix 3 plus, (G4) 20 chicks Treated group aflatoxin (30 ppb) +Tomato powder %1, (G5) 20 chicks Basal diet +Tomato powder %1.

Results: The immunological results showed a significant increase ($P<0.05$) in the levels of antibodies against Newcastle Disease and Infectious Bursal Disease for the fourth group (AF&TP) compared with the second group (AF), which showed a significant decrease ($P<0.05$) in the same parameters. The results of the body weight in day 7,14,21 and 28 showed a significant increase ($P<0.05$) in the fourth group (AF&TP) compared to the second group (AF) for the same results.

Conclusion: Tomato powder 1% can be used as a feed supplement in broilers from 1 to 35 days of age to enhance their immune response and body performance. In addition, dietary Tomato powder can replace (Mycofix®).

Keywords: tomato powder, aflatoxins, immunity, body performance, broilers

Introduction

Aflatoxicosis poisoning that occurs from ingesting aflatoxins, is characterized in broiler chickens by decreased feed intake and growth rate, poor feed utilization, and mortality. The productive deterioration is also associated with changes in biochemical and hematological parameters, liver and kidney abnormalities, and impaired immunity, its able to enhance susceptibility to infectious diseases. Thus, aflatoxicosis causes severe economic losses in the poultry industry. Furthermore, the transmission of AF and its metabolites from feed to animal edible tissues and products, such as liver and eggs becomes particularly important as apotential hazard for human health [1]. In addition, dietary exposure to AF is associated with immune dysfunction of chickens, making the broilers more susceptible to infectious diseases [2]. It has been reported that AF could induce apoptosis in immune organs, and cause significant decrease in the production of immunoglobulin [3].

Tomato (*Solanum lycopersicon L*) is one of the world's major vegetable with a worldwide production of 126 million tons in 2005 [4]. Carotenoids are natural yellow, orange, and red pigments found in fruits and vegetables and have a wide range of proposed biologic functions including antioxidant and anticarcinogen properties and immune protection [5]. Tomato components like lycopene (LYC), phenolic, flavonoids, vitamins C and E are mainly responsible for the antioxidant capacity of raw tomatoes and processed tomato products [6]. Tomato powder is high in lycopene is a natural food-derived pigment belonging to carotenoids used in food processing, and is mainly enriched in fruits and vegetables with a red color, such as tomatoes [7]. LYC can be used as a

bioactive plant food material with many vital activities, including antioxidant capacity, and has therapeutic potential against diseases [8].

Chicken meat is an important source of nutrients for human consumption. Its more superior to red meat due to several other reasons, including its health benefits, as it contains less fat and cholesterol, easy to handle portions and less religious barriers, few fast-growing commercial broiler strains play the vital role in producing the required amount of chicken meat to the world population [9]. Broiler feed it exposed to various contaminants during the process of production, transportation and storage. Moisture is the most important factor favoring the growth of fungus during these stages [10]. Emphasis is put on importance of chicken meat consumption for maintaining body weight due to the intake of dietary protein. Chicken meat is often a part of the diet aimed to reduce body weight, because of its high protein and low-fat content [11, 12].

Materials and Method

Animals of the Study

One day old broiler chicks (Ross 308) were purchased from a local hatchery in Karbala (Barakat of Imam Hussein), the chicks were raised according to routine management practice. Basal diet and water were supplied *ad libitum* to meet National Research Council NRC, (1994).

The Experimental Design

One hundred straight-run broiler chicks Ross 308 (one day -old) were used in the present work. In control condition, birds were randomly divided into 5 groups, 20 birds for each group as following:

1. Group (G1) 20 chicks Basal diet control negative
2. Group (G2) 20 chicks Basal diet + aflatoxin (30 ppb) control positive
3. Group (G3) 20 chicks Treated group aflatoxin (30 ppb) + mycofix 3 plus
4. Group (G4) 20 chicks Treated group aflatoxin (30 ppb) +Tomato powder %1
5. Group (G5) 20 chicks Basal diet +Tomato powder %1

Preparation of tomato powder

Fresh, mature, and ripe tomatoes (*Lycopersicon esculentum*) were purchased from local market (50 KG). The tomatoes were cut into slices [13]. Tomato slices were distributed uniformly as a thin layer onto the stainless-steel trays and dried under direct sunlight [14].

Blood sample collection

At day 4, 28 and 35th of age, blood samples were collected from 5 chickens in each group from the jugular vein in a test tube with anticoagulant (EDTA) the serum was separated by

centrifugation for 10 minutes at 3000 rpm and stored in a deep freeze (-20) until analysis to determine immunological tests.

Statistical Analysis

The data was analyzed with SPSS (16.0 for Windows) by using a one-way analysis of variance (ANOVA). Differences between means were determined using Tukey's test in which the significance level was designated at (P<0.05).

Results

Effect of Tomato powder in the alleviating the deleterious effect of aflatoxin on the body weight (gm) of broilers

A significant (P<0.05) decrease was noticed in the body weight in the (AF) group in the ages of 7,14,21 and 28 days in comparison with the other treated groups table (1-1). In addition, had no statistically significant (P>0.05) between all groups in age 1 and 35 day.

Table 1: Effect of Tomato powder in the alleviating the deleterious effect of aflatoxin on the body weight (gm) of broilers (Mean ± SD)

| Ages Groups | Day 1 | Day 7 | Day 14 | Day 21 | Day 28 | Day 35 |
|-----------------|--------------|----------------|----------------|----------------|------------------|------------------|
| Group 1 (CON) | 50.1 ± 2.4 A | 173.0 ± 15.7 A | 538.5 ± 51.7A | 1140.3 ± 93.6A | 1643.1 ± 139.0A | 2093.7 ± 366.8 A |
| Group 2 (AF) | 52.2 ± 4.1A | 152.5 ± 24.7B | 487.0 ± 59.8B | 917.7 ± 100.9B | 1435.4 ± 173.0B | 1907.7 ± 130.5A |
| Group 3 (AF+M) | 52.8 ± 3.6A | 166.8 ± 7.2AB | 517.0 ± 35.4AB | 979.5 ± 110.7B | 1506.3 ± 114.5AB | 1982.1 ± 187.4A |
| Group 4 (AF+TP) | 47.7 ± 3.2A | 170.9 ± 18.8A | 532.2 ± 47.0A | 1095.2 ± 95.4A | 1593.0 ± 190.3A | 2053.8 ± 194.8A |
| Group 5 (TP) | 49.2 ± 3.6A | 177.4 ± 20.0A | 551.6 ± 43.7A | 1165.0 ± 45.9A | 1657.7 ± 132.1A | 2203.8 ± 151.6A |

Different letters in the same column represent a significant different at (P<0.05)

Effect of Tomato powder in the alleviating the deleterious effect of aflatoxin on the body weight gain (gm) of broilers

Table (1-2) statistically showed there were a significant increases (P<0.05) in body weight gain of broilers in the group (AF&TP) in Age 28 days and in the group (TP) in

Ages 7,21 days in comparison with the second group (AF), While second group (AF) showed decrease significantly (P<0.05) in body weight gain of broilers in ages 7,21 and 28 days compared with other treated groups. Also noticed in the same table no significant different at (P>0.05) in ages 14 and 35.

Table 2: Effect of Tomato powder in the alleviating the deleterious effect of aflatoxin on the body weight gain (gm) of broilers. (Mean ± SD)

| Ages Groups | 1 st Week | 2 nd Week | 3 rd Week | 4 th Week | 5 th Week |
|-----------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Group 1 (CON) | 120.0 ± 16.6 AB | 365.5 ± 50.5 A | 601.8 ± 96.9 A | 502.8 ± 60.2 AB | 450.6 ± 108.2 A |
| Group 2 (AF) | 101.0 ± 29.6 B | 332.0 ± 59.6 A | 478.1 ± 62.9 B | 429.2 ± 77.7 B | 605.6 ± 157.6 A |
| Group 3 (AF+M) | 114.2 ± 9.1 AB | 347.0 ± 32.8 A | 434.3 ± 97.7 B | 557.7 ± 85.9 AB | 461.6 ± 100.0 A |
| Group 4 (AF+TP) | 118.5 ± 19.8 AB | 350.3 ± 70.6 A | 528.0 ± 83.8 AB | 619.5 ± 100.0 A | 537.6 ± 129.0 A |
| Group 5 (TP) | 129.0 ± 20.7 A | 377.6 ± 45.0 A | 605.9 ± 66.2 A | 497.5 ± 94.7 AB | 543.3 ± 109.3 A |

Different letters in the same column represent a significant different at (P<0.05)

Effect of Tomato powder in the alleviating the deleterious effect of aflatoxin on the feed intake (gm) of broilers

Table 3: Effect of Tomato powder in the alleviating the deleterious effect of aflatoxin on the feed intake (gm) of broilers

| Ages Groups | 1 st Week | 2 nd Week | 3 rd Week | 4 th Week | 5 th Week |
|-----------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Group 1 (CON) | 113 | 345 | 581 | 1057 | 1413 |
| Group 2 (AF) | 143 | 347 | 706 | 1031 | 1473 |
| Group 3 (AF+M) | 109 | 383 | 710 | 1242 | 1588 |
| Group 4 (AF+TP) | 146 | 421 | 729 | 1250 | 1600 |
| Group 5 (TP) | 138 | 358 | 658 | 1144 | 1486 |

Effect of Tomato powder in the alleviating the deleterious effect of aflatoxin on the feed conversion rate (FCR) of broilers

Table 4: Effect of Tomato powder in the alleviating the deleterious effect of aflatoxin on the feed conversion rate (FCR) of broilers

| Ages Groups | 1 st Week | 2 st Week | 3 st Week | 4 th Week | 5 st Week |
|-----------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Group 1 (CON) | 1.17 | 1.17 | 1.28 | 2.10 | 3.13 |
| Group 2 (AF) | 2.39 | 1.74 | 2.39 | 3.08 | 3.09 |
| Group 3 (AF+M) | 1.36 | 1.57 | 2.33 | 2.38 | 3.68 |
| Group 4 (AF+TP) | 1.63 | 1.60 | 2.04 | 2.01 | 2.97 |
| Group 5 (TP) | 1.42 | 1.26 | 1.44 | 2.30 | 2.73 |

Effect of Tomato powder on Newcastle disease (ND) antibody titer of broilers

Table (1-5) showed these were significant increase (P<0.05) in the (AF&TP) group in ND titer of broilers at age 28 and 35 days with significant decrease (P<0.05) in the second group (AF) in ND titer of broilers at age 28 and 35 days with the other treated groups. Also noticed in the same table no significant different at (P>0.05) in ND titer between all groups at age 4 days of chicks.

Table 5: the effect of Tomato powder on Newcastle disease (ND) antibody titer of broilers (Mean ± SD)

| Ages Groups | ND at 4 days | ND at 28 days | ND at 35 days |
|-----------------|------------------|------------------|------------------|
| Group 1 (CON) | 9301.0 ± 386.0 A | 3842.6 ± 331.6 A | 4203.6 ± 306.6 A |
| Group 2 (AF) | 9160.0 ± 454.6 A | 1702.2 ± 323.6 B | 2006.0 ± 87.5 B |
| Group 3 (AF+M) | 9310.0 ± 487.8 A | 3369.2 ± 281.2 A | 4018.2 ± 498.7 A |
| Group 4 (AF+TP) | 9134.4 ± 443.6 A | 3409.0 ± 378.3 A | 4214.0 ± 477.9 A |
| Group 5 (TP) | 9290.0 ± 410.5 A | 3788.4 ± 395.4 A | 4109.0 ± 202.9 A |

Different letters in the same column represent a significant different at (P<0.05)

Effect of Tomato powder on Infectious Bursal disease (IBD) antibody titer of broilers

Table (1-6) showed these were significant increase (P<0.05) in the (AF&TP) group in IBD titer of broilers at age 28 and 35 days with significant decrease (P<0.05) in the second group (AF) in IBD titer of broilers at age 28 and 35 days with the other treated groups. Also noticed in the same table no significant different at (P>0.05) in IBD titer between all groups at age 4 days of chicks.

Table 6: the effect of Tomato powder on Infectious Bursal disease (IBD) antibody titer of broilers (Mean ± SD)

| Ages Groups | IBD at 4 days | IBD at 28 days | IBD at 35 days |
|-----------------|-------------------|-------------------|--------------------|
| Group 1 (CON) | 14986.8 ± 256.9 A | 11724.2 ± 581.1 A | 14940.2 ± 642.1 A |
| Group 2 (AF) | 14954.2 ± 93.7 A | 4431.6 ± 407.6 B | 11821.0 ± 912.7 B |
| Group 3 (AF+M) | 14886.4 ± 339.8 A | 10978.4 ± 673.1 A | 14319.20 ± 1188.2A |
| Group 4 (AF+TP) | 15367.6 ± 459.5 A | 11146.4 ± 368.3 A | 14522.2 ± 1219.2 A |
| Group 5 (TP) | 14983.6 ± 221.7 A | 11865.6 ± 202.7 A | 16036.2 ± 548.3 A |

Different letters in the same column represent a significant different at (P<0.05)

Discussion

Body performance

Results of the present study reflected that dietary aflatoxin adversely affected the body mass as well as performance of the broilers. Similar findings were also noticed earlier by [15, 16] of broilers and [17] in white albino rats induced with mycotoxin. AF significantly decreases BW gain, feed intake and impairs feed conversion rate [18, 1].

The present findings were in accordance with the similar reports like significant decrease in body mass, decline in feed intake and poor FCR in mycotoxin induced birds by [19]. The adverse effects of AF on body mass, feed intake and FCR have been related with a decrease in the protein synthesis, energy utilization and reduced pancreatic digestive enzyme productions [20] which results in a deterioration of the digestive and metabolic efficiency of the birds. In the present study, decrease in body weight might be due reduced feed consumption and feed conversion, Additionally reduced weight gain in induced birds due to depressed appetite and impaired nutrient utilization [21].

That the use of plant rich polyphenols seem to be a promising strategy for improving products quality. In dietary manipulations, antioxidants are introduced into the

muscle via the animal feed. Various authors have reported that inclusion of natural antioxidants in animal diets not only slows down oxidation, but also greatly improves meat quality when compared to diets with no antioxidants [22].

Tomato contains other carotenoids, including phytoene, phytofluene, and the provitamin A carotenoid β-carotene, which may have a synergistic effect with lycopene, it improved the performance, namely live weight gain and feed conversion was in agreement with results of [23].

Immunity Parameters

The (ND and IBD) antibody titer level showed significant decrease in table (1-5 and 1-6) in second group (AF) that broilers exposed to contaminated diet with aflatoxin. This might be associated with that aflatoxins works as an inhibitor of protein synthesis and as resulted, destroy cells and tissues with a high protein turnover such as that found in the liver, immune system or gut epithelium, which is most susceptible to the toxic effects of AF. In this way, exposure to AF has been demonstrated to suppress the immune response in poultry [24]. Furthermore AF can inhibits the development of the thymus gland or effect the relative weight of the bursa of Fabricius, which may result

in serious deficiencies in both cellular and antibody responsiveness of the chicken immune system^[25]. Inhibition of macrophage functions, T lymphocyte activity or cytokine expression by AF results in vaccine failure or pathogen persistence, as exemplified in many studies by reduced immunoglobulin production^[26].

Recent epidemiological data indicates a high correlation between outbreaks of Newcastle disease and AF contamination of broiler rations^[26]. A variety of factors such as vaccination failure, infection by immune suppressive diseases, and abuse of antibiotics can induce immunodeficiency^[27].

Table (1-5 and 1-6) revealed significant increase in (ND & IBD) antibody titer level in forth group that broilers fed on (T & AF) compared with AF group. Herbs that are rich in flavonoids extend the activity of vitamin C, act as antioxidants, and may therefore enhance immune functions^[28]. This is in agreement with the previous ports of improving antibody response caused by herbal depravities^[27, 29]. In poultry production, it is more effective to use immune stimulators to improve immunity and decrease susceptibility to infectious disease^[30]. Lycopene mediates cell growth regulation, immune response, and modulation of phase I and II detoxifying enzymes and gene transcription^[31]. Effect of lycopene in immune system modulation is not as simple as absorption and execution and it could be a result from a complicated network consisted of simultaneous activation of various immunomodulatory pathways^[32]. Changes in lymphocyte concentration could be an indicator of activation of cell-mediated or humoral immune response and thus, lycopene was proposed to be able to influence immune response and the production of antigen-specific antibodies^[33].

Conclusion

Based on the current research findings, the conclusions are the tomato powder 1% can be used as a feed supplement in broiler chickens from 1 to 35 days of age to enhance their immune response. In addition TP enhance body performance.

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