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INFLUENCE OF TOMATO WASTE POWDER ON GROWTH PERFORMANCE AND GUT HEALTH IN BROILERS DIET EXPOSED TO AFLATOXINS

M.A.M. Mousa *, Amal, A. Bayoumi, Abeer, R. Khosht; I.H. Salim, A.E. Shamseldeen, A.S. Arafa, M.A. El-deeb, H.M.A. EL-Komy and Samia, M. Mobarez

Animal Production Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.

****Corresponding author: m_mousa67@yahoo.com***

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SUMMARY

In the current study, growth performance, intestinal morphology, and digestive enzymes activity for broilers challenged with aflatoxins (AF) were examined to determine the preventive efficacy of food supplementation with tomato waste powder (TWP). A total of 300 Ross (308) broiler chicks one-day old were randomly distributed in five treatments and six replicates (ten birds per replicate); feed and water were provided ad libitum throughout the 35 days experiment. Treatments were as follows: (T1) A basal diet containing neither AF nor TWP (positive Control) and (T2) a basal diet containing 100 µg/kg AFB1 (negative control). The other three treatment groups were supplemented with TWP at 2.5, 5.0 and 7.5 g/kg plus the 100 µg/kg AF. The results showed that AFB1 decreased growth parameters, diminished the intestinal villus height (VH) and crypt depth ratio (VCR) while raising the crypt depth (CD), decreased ($p<0.05$) intestinal amylase and lipase activity and increased pathogenic bacteria compared to the control group. On the other hand, dietary TWP supplemented diets alleviated the adverse effects of AF on growth and gut parameters. Dietary TWP supplementation (5.0 and 7.5 g/kg) resulted in significantly improved ($p<0.05$) growth performance, intestinal amylase and lipase activity with AFB1 contaminated diet. Additionally, decreased the pathogenic bacteria. These findings suggested that TWP is a promising feed supplement in the broiler industry.

Keywords: *Aflatoxin, broilers, growth, gut health, tomato waste powder*

INTRODUCTION

Strong mycotoxin known as aflatoxins are produced by Aspergillus species, such as *Aspergillus flavus*, *Aspergillus paracticus*, *Aspergillus nomius*, and others, as secondary metabolites. Aflatoxins have mutagenic, carcinogenic, teratogenic, and immunosuppressive properties that make them hazardous to both human and animal health. Aflatoxin-induced delays in animal growth and decreased meat output also result in significant financial losses (Khetmalis *et al.*, 2018). Naturally occurring aflatoxins are B1, B2, G1, and G2. According to El-Nekeety *et al.* (2017), aflatoxin B1 (AFB1) is the most prevalent type in feed and is also the most physiologically active, generating oxidative stress, cytotoxicity, and genotoxicity. Aflatoxins removal from feedstuff continues one of the primary problems in animal production; this may be due to the heat stability of aflatoxin or due to other physical conditions that restrict the use of these types of inactivation (Neeff *et al.*, 2018).

There are currently no workable, economically viable ways to detoxify AF contaminated grains with AF on a significant scale. Numerous studies have been carried out to combat AF using biological, chemical, nutritional, or physical methods (Murthy and Devegowda, 2004). The poultry industry employs a variety of techniques, including grain testing, use of mold inhibitors, fermentation, microbial inactivation, physical separation, thermal inactivation, irradiation, ammoniation, and ozone degradation, to shield birds from the harmful effects of AF.

Regretfully, according to Sehu *et al.* (2004), the majority of the techniques are hazardous, ineffectual, or unworkable. It has been demonstrated that many of the agents used to treat AF affect the absorption of minerals, hinder the body's ability to absorb nutrients, and have no binding action against multiple mycotoxins of practical importance (Girish and Devegowda, 2004). At the present time, there does not seem to be any method of preventing or ameliorating the disease other than evading conditions conductive to the formation of aflatoxins in feed stuffs and avoiding feed with performed aflatoxins. Because of the nature of the feed distribution method in the poultry industry, to avoid this complication.

Throughout the world, tomatoes are among the most widely grown crops. After tomatoes are processed into commercial products such paste, ketchup, puree, soup, salsa sauce, and tomato juice, tomato waste powder (TWP) is the by-product (Hosseini-Vashan *et al.*, 2016). The TWP is made up of leftover green tomatoes, skins, and seeds, and contains about 81% water (Lira *et al.*, 2011). The disposal of this by-product by the factories causes an added cost for the firm, and improper disposal leads to environmental pollution as it quickly degrades due to its high water content (Faryabidoust *et al.*, 2013). Antioxidant components found in TWP include flavonoids, phenolic compounds, β-carotene, α-tocopherol, and lycopene (Kalogeropoulos *et al.*, 2012). For broiler chickens, TWP has been shown to have growth-stimulating (Yitbarek, 2013), immune-enhancing (Selim, Youssef, *et al.*, 2013), antioxidant (Sahin *et al.*, 2016), antibacterial (Selim, Youssef, *et al.*, 2013), and anti-lipidemic (Hosseini-Vashan *et al.*, 2016) properties. Therefore, in an effort to develop a workable method for AF detoxification, the aim of the current study was to examine the toxic effects of AF (100 µg/kg) on growth performance of broiler chickens and to investigate the preventive efficacy of tomato powder as a feed additive to suppress or counteract the severity of aflatoxicosis on broiler chickens.

MATERIALS AND METHODS

Aflatoxin production:

The aflatoxin was generated from *Aspergillus flavus* strain and was obtained from the Animal Health Research Institute, Dokki, Giza, Egypt by fermentation of rice using the technique of Shotwell *et al.* (1966). The rice that had fermented successfully was then dried, ground into a fine powder, and autoclaved to kill the fungus. Aflatoxin levels in rice powder were determined using the HPLC method in the Central Lab of the Faculty of Veterinary Medicine at Assiut University. The rice powder contained 2.8% AFB2 and 97.19% AFB1 aflatoxin. Crushed rice was added to the basal diet to offer (100 ppb) according to Abdel-Sattar *et al.* (2019).

Experimental birds, diets, and husbandry:

The purpose of this study was to ascertain whether adding tomato waste powder to the diet may mitigate the negative effects of aflatoxin on the growth and gut health characteristics of broilers. A total of 300 broiler chicks (ROSS 308), 1 day old, were obtained from commercial hatchery. The chicks were raised on the floor in thirty pens, weighed, and then randomly allocated to five groups, each with six replicate pens holding ten chicks each. The treatment diets were as follows: (T1) Basal diet (control), (T2) Basal diet + 100 µg/kg AF contaminated diet, (T3) Basal diet + 100µg/kg AF + 2.5 g/kg TWP, (T4) Basal diet + 100 µg/kg AF + 5.0 g/kg TWP, and (T5) Basal diet + 100 µg/kg AF +7.5 g/kg TWP. The standard environmental and hygienic requirements were met when raising chicks in litter. From the first to the third day of the trial, the lighting system ran continuously for 24 hours. From that point on, it ran for 23 hours. For the first three days, the temperature was controlled at 33 ± 1◦C. After that, it was lowered by 3◦C per week until it reached 24◦C at the conclusion of the trial period. Throughout the experiment, the humidity was kept at roughly 60%. Feed and water were given ad libitum. At the appropriate dates, all birds received vaccinations against Newcastle disease and IBD disease. Corn-soybean-based diets were formulated according to NRC (1994) to meet the nutrient requirements from 1 to 21 days (starter) and 22–35 days (grower) experimental periods for broilers (Table 1). The basal diet contained 10 µg of AFB1/kg of diet, as determined by the techniques described above.

Preparation of tomato powder:

The tomato waste was obtained from commercial workstations (Egyptian International Co. For Food Products. The First Industrial zone, New Borg El Arab, Egypt). It was spread out on a plastic sheet and exposed to sunlight to dry. According to Yitbarek (2013), waste particle size is decreased by pounding with a stick and hand crushing. Nutrient content of tomato waste samples was analyzed in accordance with AOAC (2006). Tomato waste contains crude protein (13.27%), crude fiber (31.20 %), ether extract (4.52%), and calcium (0.52%). While, analysis of tomato waste powder content of active components by HPLC according to (Pataro *et al.*, 2018) were carotenoid total 185.55 µg/g, and estimated lycopene 146 µg/g.

Table (1): Composition and calculated analysis of the experimental starter and grower diets.

Ingredient	Starter (%)	Grower (%)
Maize	55.10	59.20
Soybean meal	38.6	33.25
Soybean oil	2.38	3.90
Limestone	1.17	1.05
Dicalcium phosphate	2.05	1.83
Premix*	0.25	0.25
Salt	0.25	0.25
DL-methionine	0.16	0.17
L-lysine	0.04	0.10
Total	100	100
Analyzed and calculated composition (NRC, 1994)		
Crude protein %	23	20
Metabolizable energy (Kcal/kg	3094	3142
Methionine %	0.80	0.58
Calcium %	1.00	0.90
Available phosphorous %	0.49	0.45
Lysine %	1.25	1.11

** Composition (per 3 kg): vitamin A 12000000 IU, vitamin D3 2500000 IU, vitamin E 10000 mg, vitamin K3 2000 mg, vitamin B1 1000 mg, vitamin B2 5000 mg, vitamin B6 1500 mg, vitamin B12 10 mg, niacin 30000 mg, biotin 50 mg, folic acid 1000 mg, pantothenic acid 10000 mg, manganese 60000 mg, zinc 50000 mg, iron 30000 mg, copper 4000 mg, iodine 300 mg, selenium 100 mg, and cobalt 100 mg.*

Collect samples and measurements:

Broiler weight and feed intake (FI) were recorded weekly to calculate average body weight gain (BWG), daily weight gain (DWG), average daily feed intake (DFI) and feed conversion ratio (FCR). Daily mortality data were gathered to modify the feed conversion ratio (FCR). At the end of the experiment, 6 chicks per treatment were slaughtered and the duodenum, and ileum were separated. A small intestine tissue sample was collected (about 2 cm from the mid duodenum, and ileum) and then stored in a 10% formaldehyde solution for further analysis. The gastrointestinal tract (ileum) was collected in a plastic tube to measure digestive enzyme activity, and all samples were stored at −40°C until analysis.

Intestinal morphology:

The fixed small intestine samples (duodenum, and ileum) were soaked through a graded level of ethanol and xylene, inserted in paraffin, the sections were sectioned at 5 µm with a microtome. The sections were deparafinizied with xylene and rehydrated throughout progressively dilutions of ethanol and stained with hematoxylin and eosin (H&E). A light microscope (Nikon YS100) connected to a computer was used to measure the villus height (VH), crypt depth (CD), and ratio (VCR) on each segment.

Intestinal enzyme activity assay:

Trypsin, amylase, and lipase activity in the ileum of the birds (1 bird per replication) was measured at the end of the experiment. The ileum of the chick was dissected, and the ileal contents were aseptically collected in sterile specimen vials with screw caps. The activities of digestive enzymes were measured using the method of Najafi *et al.*, (2005, 2006).

Microbiological analysis:

Approximately 10 g of samples (six samples per treatment) were taken from the chick’s caecum at the conclusion of the experiment and put into a 250 ml Erlenmeyer flask together with 90 ml of 0.1%

peptone in saline solution (0.85% NaCl) and thoroughly mixed. Using the techniques of Reda *et al.* (2020b) and Reda *et al.* (2020a), total negative bacteria, Salmonella, and E. coli were all measured.

Statistical analysis:

The trial was operated using a completely random design. Duncan's multiple range tests (Duncan,1955) were employed to evaluate the differences in means (P< 0.05) and were used in conjunction with The General Linear Model (GLM) approach of SAS (2003).

RESULTS

Growth performance:

Data from Table 2 showed the impacts of dietary treatments on broiler growth performance. Broilers exposed to AF diet had decreased (p<0.05) FBW, BWG, DWG and DFI and recorded worst FCR during the experimental trial compared to the control group. Broilers fed AF contaminated diet + 5.0g TWP and those fed AF contaminated diet + 7.5g TWP significantly improved (p<0.05) the growth parameters in 1–35 days compared to AF- group.

Table (2): Effect of TWP on growth performance of broiler fed with AF contaminated diets during the whole experimental period.

Items	Treatments					SEM	p-value
	T1	T2	T3	T4	T5		
IBW,g	40.8	41.0	40.8	40.5	41.0	1.08	0.658
FBW,g	2105^{a}	1900^{b}	1950^{ab}	2080^{a}	2090^{a}	14.55	0.002
BWG,g	2064.2^{a}	1859.0^{c}	1909.2^{b}	2039.5^{ab}	2049^{a}	12.25	0.004
DWG,g	60.14^{a}	54.28^{b}	55.71^{b}	59.43^{a}	59.71^{a}	2.68	0.025
DFI,g	104.95^{a}	101.28^{b}	102.57^{ab}	103.85^{a}	104.00^{a}	3.67	0.001
FCR (F/G)	1.745^{b}	1.865^{a}	1.841^{a}	1.747^{b}	1.741^{b}	0.095	0.001
Mortality %	0^{d}	8.33^{a}	3.33^{b}	1.66^{c}	0^{d}	0.006	0.003

a,b,c values with different superscripts in rows were significantly different (P>0.05). SEM =Standard Error of the mean; T1: Basal diet (B); T2: B + AF (100µg/kg); T3: B + AF (100µg/kg) + TP (2.5 g/kg); T4: B +AF (100µg/kg) + TP (5.0 g/kg); T5: B + AF (100µg/kg) + TP (7.5 g/kg); IBW= initial body weight; FBW= final body weight; BWG= body weight gain; DWG= daily weight gain; DFI= daily feed intake; FCR= feed conversion ratio.

Intestinal morphology:

Data from Table 3 showed the impacts of dietary treatments on intestinal morphology. In contrast, AF considerably reduced the villus height and villus height / crypt depth ratio, while crypt depth significantly increased (P<0.05) in comparison to the control group, according to data on duodenum and ileum morphology. However, TWP addition reduced crypte depth regardless of dosage, and at 35 days, AF + 5.0g TWP and AF + 7.5g TWP increased villus height and villus height / crypte depth ratio in comparison to AF basal diet without TWP (Table 3).

Digestive enzyme activities:

Data from Table 4 showed the impacts of dietary treatments on digestive enzyme activities. The ileum enzyme activity data showed that, at 35 days, AF considerably (P<0.05) reduced the amylase and lipase activity in comparison to the control. On the other hand, compared to the AF group, the dietary TWP supplementation (AF + 5.0g TWP and AF + 7.5g TWP) considerably (P<0.05) boosted the activity of lipase and amylase (Table 4).

Microbiological analysis:

Table 5 showed the impacts of dietary inclusion of tomato powder on ileal bacterial counts of aflatoxin-contaminated broiler chicks at day 35 of age. Aflatoxin significantly (P<0.05) elevated the ileal counts of Salmonella, E. Coli, and Total Negative Bacteria at 35 days of age. When compared to an unsupplemented diet, the dietary supplementation of tomato powder led to decreased levels of E. Coli, Salmonella, and total negative bacteria at day 35 of age. It is interesting to note that in birds polluted with 100 µg aflatoxin, the counted of E. Coli and Salmonella at day 35 of age was suppressed by dietary tomato powder supplementation at the amount of 7.5 g/kg.

Table (3): Effect of TWP on intestinal morphology of broiler fed with AF contaminated diets at 35 days.

Items	Treatments					SEM	p-value
	T1	T2	T3	T4	T5		
Duodenum							
VH (µm)	1425a	1255c	1276bc	1320b	1400ab	12.05	0.002
CD (µm)	141	146	137	141	139	1.635	0.068
VH/CD (µm/µm)	10.12a	8.60c	9.31b	9.36b	10.07a	0.225	0.004
Ileum							
VH (µm)	662a	628c	633bc	640b	660a	8.62	0.001
CD (µm)	80.8	86	84	82.4	81.5	1.58	0.064
VH/CD (µm/µm)	8.19a	7.30b	7.54b	7.77ab	8.09a	0.138	0.001

a,b,c values with different superscripts in rows were significantly different (P>0.05). SEM =Standard Error of the mean; T1: Basal diet (B); T2: B + AF (100µg/kg); T3: B + AF (100µg/kg) + TP (2.5 g/kg); T4: B +AF (100µg/kg) + TP (5.0 g/kg); T5: B + AF (100µg/kg) + TP (7.5 g/kg); VH= villus height; CD= Crypt depth

Table (4): Effect of TWP on ileum digestive enzyme activity of broiler fed with AF contaminated diets at 35 days.

Items	Treatments					SEM	p-value
	T1	T2	T3	T4	T5		
Ileum digestive enzyme activity							
Trypsin (U/gprot)	1.96a	1.49c	1.60b	1.75ab	1.88a	0.09	0.002
Amylase (U/gprot)	212.8a	171.9c	189.5bc	191.0b	200.6ab	5.85	0.001
Lipase (U/gprot)	4.25a	3.26c	3.42b	3.76ab	4.05a	0.184	0.001

a,b,c values with different superscripts in rows were significantly different (P>0.05). SEM =Standard Error of the mean; T1: Basal diet (B); T2: B + AF (100µg/kg); T3: B + AF (100µg/kg) + TP (2.5 g/kg); T4: B +AF (100µg/kg) + TP (5.0 g/kg); T5: B + AF (100µg/kg) + TP (7.5 g/kg).

Table (5): Effect of TWP on ileal microbial count (log10 cfu/g digesta) of broiler fed with AF contaminated diets at 35 days.

Items	Treatments					SEM	p-value
	T1	T2	T3	T4	T5		
Ileal microbial count (log10 cfu/g digesta)							
Escherichia coli	3.60c	4.89a	4.20b	3.85bc	3.76c	0.88	0.001
Salmonella	2.06c	3.36a	3.10ab	2.68b	2.28c	0.85	0.004
Total negative bacteria	3.96c	4.90a	4.25ab	4.10b	3.85c	0.154	0.005

a,b,c with different superscripts in rows were significantly different (P>0.05). SEM =Standard Error of the mean; T1: Basal diet (B); T2: B + AF (100µg/kg); T3: B + AF (100µg/kg) + TP (2.5 g/kg); T4: B +AF (100µg/kg) + TP (5.0 g/kg); T5: B + AF (100µg/kg) + TP (7.5 g/kg).

DISCUSSION

Growth performance:

Globally, poultry is a significant food product, with broilers being the most readily available and significant source of protein. It has become more difficult to prevent harmful contamination of broiler feed in the modern period, and prolonged ingestion of AFB1-contaminated feed has been shown to have negative effects on the growth and performance of broilers. Throughout the whole experimental period in this investigation, AF (100 µg/kg) significantly decreased the FBW, BWG, DWG and DFI and the worst FCR. Previous research (Bintvihok and Kositcharoenkul, 2006; Fan *et al.*, 2013) had shown similar results, indicating that AFB1 (50–100 µg/kg) could considerably reduce the body weight gain and FCR of broilers, resulting in economic losses. Another study in ducks fed diets contaminated with 20 µg/kg of AFB1 had a significantly decreased body weight and inferior FCR (Han *et al.*, 2008). Aflatoxin challenge-induced suppression of body weight may be related to multiple different mechanisms. According to Eaton and Gallagher (1994), aflatoxicosis first decreases protein synthesis by interfering with the enzymes and substrates needed for the initiation, transcription, and translation phases. Second, as Tables 3 and 4 demonstrate, aflatoxins diminish the surface area of villi and resultant absorptive surface area, which lowers nutrient absorption (Awad *et al.*, 2008). Third, aflatoxins lower body weight via lowering average feed intake. Our findings concur with those of Wang *et al.* (2009), Quist *et al.* (2000), Danicke *et al.* (2003), and Denli *et al.* (2009). In contrast to our results, Politis *et al.* (2005) and Awad *et al.* (2006) found that the growth performance of broiler chicks was not significantly affected by mycotoxin challenge.

One approach that appears to hold promise for enhancing product quality is the utilization of polyphenols found in plants. Antioxidants enter the muscle through the animal feed during dietary modifications. According to some authors, adding natural antioxidants to an animal's diet dramatically enhances the quality of the meat while also slowing down oxidation in comparison to diets devoid of antioxidants (Brenes *et al.*, 2016).

Other carotenoids included in tomatoes include phytoene, phytofluene, and the provitamin A carotenoid β-carotene. These carotenoids may have a synergistic effect with lycopene to improve performance, as evidenced by improvements in live weight growth and feed conversion that were consistent with the findings of (Rao and Agarwal, 1999). According to Youssef *et al.* (2013), broiler BW rose when fed 5 and 10 g/kg tomato puree. In a similar vein, Yitbarek (2013) found that feeding broiler chicks 50 g/kg tomato powder increased their BW and FCR. Tomato waste increased feed intake in chickens aged 1 to 7, 8 to 14, and 29 to 36 days, according to research by Lira *et al.* (2010). According to a number of studies by various authors, adding lycopene to chicken diets boosted body weight (Englmaierová *et al.*, 2011), feed intake (Lira *et al.*, 2010), and may even be able to lessen the negative effects of stress on performance (Sahin *et al.*, 2016). Furthermore, even in stress conditions, lycopene supplementation in quail meals improved the body weight and FCR (Sahin *et al.*, 2006). In the current investigation, we found that adding varying amounts of tomato powder (2.5, 5.0, and 7.5g/kg) to the contaminated meals with AF ameliorated the growth suppression induced by AFB1, as shown by noticeably higher body weight, feed intake, and superior FCR. Therefore, adding TWP to the broiler diet can counteract the harmful effects of AFB1 on growth performance.

Intestinal morphology:

The intestine works as feed digestion, absorption function, which also works as essential fighter against all pathogenic bacteria and toxic materials found in the intestinal lumen. The intestinal villus and crypt system act an essential role in nutrients absorption and animal growth (Hernandez *et al.*, 2006). These functions provide the conditional environment that forms the gut health status markers. Shorter villus heights and deeper crypt depths have been proposed to be associated with poorer nutrient absorption, higher intestinal tract production of water and electrolytes, and impaired animal growth and performance (Li *et al.*, 2015). In the current investigation, we discovered that broilers in the AFB1-treated group had significantly lower villus height and villus height/crypt depth in the duodenum, and ileum of the small intestine as compared to the control group.

These results were consistent with earlier research conducted by Zhang *et al.* (2014), who discovered that 0.3 mg/kg AFB1 reduced the height of the jejunum villus and the villus height/crypt depth ratio as well as damaged the intestinal barrier cells of 21-day-old broiler chickens. Furthermore, Wan *et al.* (2013) discovered that adding 100 µg/kg AFB1 to ducklings' diet reduced the height of the gut villus and the ratio of villus height to crypt depth. One explanation could be that AFB1 caused damage to the structure of the broiler intestine, which decreased the surface area available for absorbing nutrients. The aforementioned findings showed that dietary AFB1 caused toxic lesions and suppressed intestinal morphological development, which reduced the function of the broiler intestine.

The main causes of lycopene's (LYC) positive benefits are its anticarcinogenic and anticancer qualities as a carotenoid. According to recent research, LYC is crucial in preventing cancer of the gastrointestinal system. According to Yucel *et al.* (2016), LYC helped protect rats' intestinal damage from methotrexate. According to a study by Itoh *et al.* (2004) found that LYC possessed a significant radio protective effect on villus and crypts in the small intestine of abdominally radiated (15 Gray unit) mice. The results of the current study demonstrated that adding varying amounts of dietary tomato waste, which is rich in lycopene, significantly increased the villus height and villus height/crypt depth ratio of the small intestine of broiler chickens. This reduced the toxicity caused by AFB1 and enhanced the small intestine's histological structure.

Digestive enzyme activities:

The animal's physiological functions and daily activities are significantly impacted by the intestinal enzyme activities (Cho *et al.*, 2012). It is generally accepted that the AFB1 application results in reduced activity of digestive enzymes and malabsorption syndrome with respect to macronutrients (Devegowda and Murthy, 2005). Numerous studies have shown that AFB1 negatively impacted the poultry industry's production performance (Zaghini *et al.*, 2005). The current investigation revealed that the diet contaminated with AFB1 decreased the levels of intestinal digestive enzymes, such as trypsin, amylase, and lipase. The possible reason might be ascribed to the damage of the intestinal structure caused by the AFB1 diet. AFB1 induced disturbance of digestive enzyme activity and nutrient transporters may lead to intestinal disorders, resulting in the alteration of nutrient digestion, absorption function, and reduced growth performance of broilers. According to Matur *et al.* (2010), giving 0.1 mg/kg AFB1 to female Ross breeder hens resulted in a decrease in lipase enzyme activity in the duodenum. Animal life activities and physiological processes are significantly impacted by the actions of intestinal enzymes (Di Cerbo *et al.*, 2013; Cho *et al.*, 2012).

When lycopene was added to the feed of broiler chickens, Sarker *et al.* (2021) observed a considerable improvement in the activity of lipase and amylase when compared to the other group. According to the current study, the inclusion of varying amounts of dietary tomato powder in an AFB1-contaminated meal enhanced the activity of lipase and amylase in the broiler chicks' small intestine. Dietary tomato powder, which contains lycopene, may have enhanced intestinal shape and integrity, which could account for the elevated enzyme activity.

Microbiological analysis:

In addition to managing food intake and nutrient absorption, energy balance, immunological homeostasis, biological antagonistic relationships, and neurofunctional modulation, the intestinal microbiota affects animal health by keeping viruses and toxins out of the body (De Vadder & Mithieux, 2018; Rooks & Garrett, 2016). Taking into consideration the functional ramifications, researchers tried to discover ways to balance or optimize the microflora on intestinal lines so that it reaches normal or active levels and maintains the body's health.

Table 5 shows that ileal populations of Salmonella, E. coli, and total negative bacteria were elevated following exposure to aflatoxins. Our findings concur with those of Jahanian *et al.* (2016) and Placha *et al.* (2009), who found that mycotoxins raise the susceptibility to outbreaks of Ileal bacterial populations, in addition to AFB1 has a toxic effect on the intestinal microecology of birds, causing diarrhea, indigestibility of feed, distension of the abdomen, soreness, and discomfort on the abdomen.

Broilers exposed to 100 µg aflatoxin showed reduced bacterial counts when given 7.5g of tomato powder as a dietary supplement. It has been shown in numerous research that the bioactive elements found in by-product exhibit antibacterial action through the presence of their hydroxyl group. According to Bessam and Mehdadi (2014), hydroxyl can attach to bacterial membrane proteins and cause essential cell components to seep out. Tomato waste' high phenolic content had an antagonistic effect on the bacterial load in the diet. The antibacterial activity of tomato peel extract is attributed to polyphenols, which may be due to interactions between polyphenols and a variety of cell membrane locations (Bouarab-Chibane *et al.*, 2019).

CONCLUSION

In conclusion, adding 100 µg/kg AFB1 to the broiler diet has various detrimental consequences that are shown in the form of decreased growth parameters, altered intestine morphological condition, decreased digestive enzyme activity and increased pathogenic bacteria in the broiler. In broiler chickens challenged with AFB1, dietary supplementation at levels (5.0, and 7.5 g/kg) of tomato waste powder showed positive impacts on growth performance, and gut health. The outcomes of this investigation also showed that adding tomato powder to broiler diets could be a viable strategy to counteract the negative impacts of AFB1 on broiler productivity.

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تأثير مسحوق مخلفات الطماطم على أداء النمو وصحة الأمعاء في علائق دجاج التسمين المعرضة للأفلاتوكسينات

محمد عبد العظيم موسى، امل عبد السلام بيومي، عبير ربيع خشت، إبراهيم حمدان سالم، احمد السيد شمس الدين، احمد صبري عرفه، ماجد عبد النبي الديب، حمدي محمد احمد الكومي، ساميه مصطفى مبارز

معهد بحوث الإنتاج الحيواني، مركز البحوث الزراعية، الدقي، الجيزة، مصر

في الدراسة الحالية، تم فحص أداء النمو، وتشكل الأمعاء، ونشاط إنزيمات الهضم لدجاج التسمين المعرض للأفلاتوكسين (AF) لتحديد الفعالية الوقائية لمسحوق مخلفات الطماطم (TWP) كمكمل غذائى. تم توزيع 300 كتكوت تسمين روس (308) بعمر يوم واحد عشوائياً في خمس معاملات وستة مكررات (عشرة طيور لكل مكرره)؛ تم توفير العلف والماء للأستهلاك الحر طوال التجربة التي استمرت 35 يومًا. كانت المعاملات على النحو التالي: (T1) نظام غذائي أساسي لا يحتوي على افلاتوكسين ولا مسحوق نفايات الطماطم (الكنترول الموجب) و (T2) نظام غذائي أساسي يحتوي على 100 ميكروجرام افلاتوكسين /كجم علف (كنترول سالب). تم استكمال المعاملات الثلاثة الأخرى بـ مسحوق مخلفات الطماطم عند 2.5 و5.0 و7.5 جم/كجم مع 100 ميكروجرام/كجم افلاتوكسين. أظهرت النتائج أن الأفلاتوكسين أدى إلى انخفاض قياسات النمو، وانخفاض ارتفاع الخملات المعوية ونسبة ارتفاع الخملات: عمق الخملات مع زيادة عمق الخملات، وانخفاض معنوي (P <0.05) في نشاط انزيمات الأميليز والليبيز وزيادة البكتيريا المسببة للأمراض، مقارنة بالمجموعة الضابطة. من ناحية أخرى، فإن الوجبات الغذائية المكملة بمسحوق مخلفات الطماطم خففت من التأثيرات الضارة للأفلاتوكسين على النمو وصحه الأمعاء. أدت مكملات مسحوق مخلفات الطماطم الغذائية (5.0 و7.5 جم / كجم) إلى تحسن ملحوظ في أداء النمو (P <0.05) وأنزيم الأميليز الهضمي والليبيز في النظام الغذائي الملوث بالأفلاتوكسين. بالإضافة إلى انخفاض البكتيريا المسببة للأمراض. تشير هذه النتائج إلى أن مسحوق مخلفات الطماطم هو مكمل علفي واعد في صناعة دجاج التسمين.