How to Cite:
Jahil, A. A.-H., Kadhim, L. I., Abid, A. R., & Hamza, A. M. (2022). Efficacy of Tomato powder meal in modulating the oxidative stress induced by aflatoxin exposures in broilers. *International Journal of Health Sciences*, *6*(S6), 7993–7999.
https://doi.org/10.53730/ijhs.v6nS6.12193

Efficacy of Tomato powder meal in modulating the oxidative stress induced by aflatoxin exposures in broilers

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Abstract---Objective: Due to the importance of poultry production, the purpose of the study are to show the efficacy of Tomatopowderin alleviating the deleterious effects of aflatoxin in broilers and modulating the oxidative stress. Methods:One hundred one-day-old fattening chicks (Ross 308) were used in the present work which lasted for 35 days and aflatoxin administration lasted for 28 days. In the control condition, birds were randomly distributed into 5 groups, 20 birds for each group as following for 35 days: (G1)20 chicksfed basal diet control negative(CON),(G2) 20 chicksfed basal diet + aflatoxin (30 ppb) (AF) control positiv,(G3) 20 chickstreated withaflatoxin (30 ppb) + mycofix 3 plus(AF+M),(G4) 20 chickstreated withaflatoxin (30 ppb) +Tomato powder %1(AF+TP),(G5) 20 chicksfed basal diet +Tomato powder %1(TB). Results:A significant increased ($P<0.05$) in the concentration of (Gpx) and (SOD) in the fourth group (AF&TP) compared to the second group (AF) In addition, the results showed a significant decreased ($P<0.05$) in the concentration (MDA) in the fourth group (AF&TP) compared to the second group (AF)at day 28. While at day 35 showed a significant increased ($P<0.05$) in the concentration of (Gpx) in the fourth group (AF&TP) compared to the second group (AF). Conclusion: Tomato powder (1%) can be used as a feed supplement in broiler chickens from 1 to 35 days of age to enhance their antioxidant status.

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2022.
Manuscript submitted: 9 April 2022, Manuscript revised: 18 June 2022, Accepted for publication: 27 July 2022

Keywords---tomato powder, aflatoxins, antioxidant status, broiler.

Introduction

Aflatoxins are one of the most widespread pollutants in poultry feed in both developing and developed countries (1,2).At present, many aflatoxins have been identified, among which Aflatoxin (AF) is the most toxic for chicken and has been classified as a Class I carcinogen by the International Agency for Research on Cancer (3,4). AF is often found in corn and peanut, which is the major energy sources for the poultry feed, and the permitted level of AF is very low in poultry feed, and thus poultry feed is at a high risk of contamination with AF (5). It has been reported that the most vulnerable body organ of chicken to AF is the liver (4). AF can induce unbalanced lipid metabolism, inhibit the activity of antioxidant enzymes, and increase pro-inflammatory cytokines and hepatocyte apoptosis levels (4,5,6). In addition, dietary exposure to AF is associated with immune dysfunction of chickens, making the broilers more susceptible to infectious diseases (7). It has been reported that AF could induce apoptosis in immune organs, and cause significant decrease in the production of immunoglobulin (5).

Tomato is a well-studied species belonging to the family Solanaceae. Its consumption, as well as production, is increasing because of its antioxidant and anti-cancerous properties (8). 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 (9). 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 (10).LYC can be used as a bioactive plant food material with many vital activities, including antioxidant capacity, and has therapeutic potential against diseases (11).Antioxidants is a molecules that inhibits the oxidation of other molecules. Oxidation is a chemical reaction that can produce free radicals. Antioxidants can be categorized in to enzymatic and nonenzymatic (12). The enzymatic antioxidant include catalase (CAT),superoxide dismutase (SOD), glutathione reductase (GSH-r) and glutathione peroxidase (GPx). The enzymatic antioxidant act as scavengers for free radicals from both intracellular and extracellular origin and there for preventing lipid peroxidation of plasma membrane, whereas the nonenzymatic antioxidant Carotenoids, together with vitamins C and E and phenolic compound are the major antioxidants of plant-derived foods. can be used to moderate the negative side effects of environmental origin stress(13,14).

Materials and Method

Animals of the Study

Straight-run one day old chicks Ross 308 were purchased from a local hatchery in Karbala, the chicks were raised according to routine management practice. Basal diet of broiler chicks 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:

- Group (G1) 20 chicks fedbasal diet control negative
- Group (G2) 20 chicks fedbasal diet + aflatoxin (30 ppb) control positive
- Group (G3) 20 chickstreated withaflatoxin (30 ppb) + mycofix 3 plus
- Group (G4) 20 chickstreated withaflatoxin (30 ppb) +Tomato powder %1
- Group (G5) 20 chicks fedbasal diet +Tomato powder %1

Preparation of tomato powder

Fresh, mature, and ripe tomatoes (*Lycopersiconesculentum*) were purchased from local market(50 KG). The tomatoes were cut into slices (15).Tomato slices were distributed uniformly as a thin layer onto the stainless steel trays and dried under direct sunlight (16).

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 without anticoagulant (plane tube) 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 onsome antioxidant status of broilers at 28 day

A significant decreased ($P<0.05$) was noticed in the concentration of glutathione peroxidase (Gpx) and Superoxide dismutase (SOD) in the (AF) group compared with the other groups table (1-1). In addition, in the same table the results showed a significant increase ($P<0.05$) in concentration of malondialdyhyde (MDA) in the second group (AF) compared with other treated groups.

Table 1-1
Effect of Tomato powder in the alleviating the deleterious effect of aflatoxin onsome antioxidant status of broilers at 28 day(Mean ± SD)

Parameters Group	SOD U/mL	GPX mmole/mL	MDA nmole/mL
Group 1(CON)	68.2±0.8 A	20.1± 0.8 A	1.1±0.01 B
Group 2(AF)	55.1±1.8 B	14.6±1.1 B	2.1±0.6 A
Group3(AF+M)	65.5±1.1 A	19.7± 0.9 A	1.0±0.02 B
Group 4(AF+TP)	66.8±2.7 A	19.8±0.4 A	1.3±0.4B
Group 5(TP)	67.7±1.4 A	19.3±0.7 A	1.2±0.2B

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 onsome antioxidant status of broilers at 35 day

A significant decreased (P<0.05) was noticed in the concentration of glutathione peroxidase (Gpx) in the (AF) group compared with the other groups table (1-2).At the same time there was no significant different at (P>0.05) in (SOD) and (MDA) between all groups.

Table 1-2
Effect of Tomato powder in the alleviating the deleterious effect of aflatoxin onsome antioxidant status of broilers at 35 day(Mean ± SD)

Parameters Group	SOD U/mL	GPX mmole/mL	MDA nmole/mL
Group 1(CON)	74.19±6.52 A	20.1±1.0 A	1.08±0.01 A
Group 2(AF)	66.21±3.20 A	15.2±0.9 B	1.09±0.02 A
Group 3(AF+M)	68.42±7.40 A	20.3±0.7 A	1.09±0.02 A
Group 4(AF+TP)	67.64±4.26 A	20.1±0.6 A	1.08±0.01 A
Group 5(TP)	65.87±6.46 A	19.1±0.9 A	1.11±0.01 A

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

Discussion

Antioxidant status

The present study revealed that there was significant increase in (MDA) level in table (1-1) and significant decrease in (Gpx and SOD) enzymes in the same table in group (AF) that broilers exposed to contaminated diet with aflatoxin and these results were matched with previous studies (17). The present findings were also in agreement with (18) in aflatoxin induced broiler chicks. In animals, oxidative stress may occur as a consequence of nutrition, including the contamination of feed with fungal toxins (19). Aflatoxin induced lethally injured hepatocytes in an

unmanageable disorder, which results in mitochondrial dysfunction, enzyme inhibition and denaturation of structural proteins. the increase in hepatic MDA level may be attributed to the fact that AF is metabolized by the cellular cytochrome P450 enzyme system (20),this leads to lipid peroxidation and cellular injury and (21) also might be due to significant reduction in the activities of enzymatic antioxidants like Gpx in level which is also observed in present study.The SOD and GPx as the key enzymes of antioxidant system can scavenge free radicals generated from oxidant stress, reduce oxidative damage and maintain cell structure (22).Antioxidants may protect cells from the damage caused by free radicals. Antioxidant nutrients and enzyme defenses are fundamental protectors against all forms of stress (23).

showed that serum MDA levels were significantly lowered after lycopene treatment. Additionally, (24) reported that tomatoes antioxidants might contribute to the protection against peroxidation. Diminishing MDA levels in this study also might have been attributed to lycopene which protects cells against oxidative stress. Similar observations have been made by (25) who attributed the ability of lycopene in quenching free radical anions and increasing the number of conjugated double-bonds. It was found that TP supplementation elevated the values of SOD, GPx, which are important enzymes associated with the high antioxidant activity, subsequently, decreasing oxidative stress properties like antioxidant, antiviral, inflammatory and immunomodulatory. These findings agreed with those of (26,27).

Conclusion

Based on the current research findings, the conclusions are as follows.Tomato powder (1%) can be used as a feed supplement in broiler chickens from 1 to 35 days of age to enhance their antioxidant status. In addition, dietary TP can replace (Mycofix®).

Acknowledgments

We gratefully acknowledge Research Council of (Karbala University- College of Veterinary Medicine) for support.

References

1. Agarwal, A., and Prabhakaram, S.A. (2005). Mechanism, Mesurment and prevention of oxidative stressin male reproductive physiology. Ind. J. Exp. Biol., 43,963-974.
2. Alshatwi, A. A., Al Obaaid, M. A., Al Sedairy, S. A., Al-Assaf, A. H., Zhang, J. J., & Lei, K. Y. (2010). Tomato powder is more protective than lycopene supplement against lipid peroxidation in rats. Nutrition Research, 30(1), 66-73.
3. Arslan, D., &Özcan, M. M. (2011). Drying of tomato slices: changes in drying kinetics, mineral contents, antioxidant activity and color parameters Secado de rodajas de tomate: cambiosencinéticos del secado, contenidoenminerales, actividadantioxidante y parámetros de color. CyTA-Journal of Food, 9(3), 229-236.

4. Balladin, D. A., & Headley, O. (1999). Evaluation of solar dried thyme (Thymus vulgaris Linne) herbs. Renewable Energy, 17(4), 523-531.
5. Beutner, S., Bloedorn, B., Frixel, S., Hernández Blanco, I., Hoffmann, T., Martin, H. D., Mayer, B., Noack, P., Ruck, C., Schmidt, M &Schülke, I. (2001). Quantitative assessment of antioxidant properties of natural colorants and phytochemicals: carotenoids, flavonoids, phenols and indigoids. The role of β- carotene in antioxidant functions. Journal of the Science of Food and Agriculture, 81(6), 559-568.
6. Chen, X., Horn, N., & Applegate, T. J. (2014). Efficiency of hydrated sodium calcium aluminosilicate to ameliorate the adverse effects of graded levels of aflatoxin B1 in broiler chicks. Poultry Science, 93(8), 2037-2047.
7. Elwan, H. A., Elnesr, S. S., Mohany, M., & Al-Rejaie, S. S. (2019). The effects of dietary tomato powder (Solanum lycopersicum L.) supplementation on the haematological, immunological, serum biochemical and antioxidant parameters of growing rabbits. Journal of Animal Physiology and Animal Nutrition, 103(2), 534- 546.
8. Elwan, H., Xie, C., Miao, L. P., Dong, X., Zou, X. T., Mohany, M., ... &Elnesr, S. S. (2021). Methionine alleviates aflatoxinb1-induced broiler chicks embryotoxicity through inhibition of caspase-dependent apoptosis and enhancement of cellular antioxidant status. Poultry Science, 100(8), 101103.
9. Fouad, A. M., Ruan, D., El-Senousey, H. K., Chen, W., Jiang, S., & Zheng, C. (2019). Harmful effects and control strategies of aflatoxin b1 produced by Aspergillus flavus and Aspergillus parasiticus strains on poultry. Toxins, 11(3), 176.
10. Frankič, T., Salobir, J., &Rezar, V. (2008). The effect of vitamin E supplementation on reduction of lymphocyte DNA damage induced by T-2 toxin and deoxynivalenol in weaned pigs. Animal Feed Science and Technology, 141(3-4), 274- 286.
11. Garg, M. C., & Bansal, D. D. (2000). Protective antioxidant effect of vitamins C and E in streptozotocin induced diabetic rats. Indian journal of experimental biology, 38(2), 101.
12. Genaro-Mattos, T. C., Maurício, A. Q., Rettori, D., Alonso, A., & Hermes-Lima, M. (2015). Antioxidant activity of caffeic acid against iron-in- duced free radical generation-A chemical approach. PLoS ONE, 10, e0129963.
13. Gowda, N. K., Ledoux, D. R., Rottinghaus, G. E., Bermudez, A. J., & Chen, Y. C. (2009). Antioxidant efficacy of curcuminoids from turmeric (Curcuma longa L.) powder in broiler chickens fed diets containing aflatoxin B1. British Journal of Nutrition, 102(11), 1629-1634.
14. Grabowska, M., Wawrzyniak, D., Rolle, K., Chomczyński, P., Oziewicz, S., Jurga, S., &Barciszewski, J. (2019). Let food be your medicine: nutraceutical properties of lycopene. Food & function, 10(6), 3090-3102.
15. Heber, D., & Lu, Q. Y. (2002). Overview of mechanisms of action of lycopene. Experimental biology and medicine, 227(10), 920-923.
16. KheirEldin, A. A., Motawi, T. M., &Sadik, N. A. (2008). Effect of some natural antioxidants on aflatoxin B1-induced hepatic toxicity.
17. Li, S., Liu, R., Wei, G., Guo, G., Yu, H., Zhang, Y., ... & Zhang, X. (2021). Curcumin protects against Aflatoxin B1-induced liver injury in broilers via the modulation of long non-coding RNA expression. *Ecotoxicology and Environmental Safety*, *208*, 111725.

18. Liang, X., Ma, C., Yan, X., Liu, X., & Liu, F. (2019). Advances in research on bioactivity, metabolism, stability and delivery systems of lycopene. Trends in Food Science & Technology, 93, 185-196.
19. Nández-Ramírez, J. O., Merino-Guzmán, R., Téllez-Isaías, G., VázquezDurán, A., & Méndez-Albores, A. (2021). Mitigation of AFB1-related toxic damage to the intestinal epithelium in broiler chickens consumed a yeast cell wall fraction. Frontiers in veterinary science, 793.
20. Nojoku, P.C. (1986). Effect of dietary ascorbic acid supplementation on the performance of broiler chichen in tropical, environmwnt. Anim. Feed Sci Technol., 6:17-24.
21. Ojha, R., Prasad, R., Manzoor, N., & Khan, L. A. (2010). Vitamin C modulates oxidative stress related enzyme activities in Candida albicans. Turk J Biochem, 35(1), 35-40.
22. Primatanti, P. A., & Jawi, I. M. (2019). Anthocyanin as neuroprotector for methamphetamine-induced neurotoxicity. International Journal of Health & Medical Sciences, 3(1), 11-16. https://doi.org/10.31295/ijhms.v3n1.101
23. Rai, G. K., Parveen, A., Jamwal, G., Basu, U., Kumar, R. R., Rai, P. K., ... &Sakran, M. I. (2021). Leaf Proteome Response to Drought Stress and Antioxidant Potential in Tomato (Solanum lycopersicum L.). Atmosphere, 12(8), 1021.
24. Rosa, C. A. R., Miazzo, R., Magnoli, C., Salvano, M., Chiacchiera, S. M., Ferrero, S., ... &Dalcero, A. (2001). Evaluation of the efficacy of bentonite from the south of Argentina to ameliorate the toxic effects of aflatoxin in broilers. Poultry Science, 80(2), 139-144.
25. Rushing, B. R., &Selim, M. I. (2019). Aflatoxin B1: A review on metabolism, toxicity, occurrence in food, occupational exposure, and detoxification methods. Food and chemical toxicology, 124, 81-100.
26. Sharma, V; Sharma, C; Pracheta, R. P; & Sharma, S. (2011). Protective potential of Curcuma longa and Curcumin on aflatoxin B1 induced hepatotoxicity in Swiss Albino Mice. Asian Journal Pharmacology Health Science, 1: 116-122.
27. Shivachandra, S. B., Sah, R. L., Singh, S. D., Kataria, J. M., &Manimaran, K. (2003). Immunosuppression in broiler chicks fed aflatoxin and inoculated with fowl adenovirus serotype-4 (FAV-4) associated with hydropericardium syndrome. Veterinary research communications, 27(1), 39-51.
28. tresser, D. M., Bailey, G. S., & Williams, D. E. (1994). Indole-3-carbinol and betanaphthoflavone induction of aflatoxin B1 metabolism and cytochromes P-450 associated with bioactivation and detoxication of aflatoxin B1 in the rat. Drug metabolism and disposition, 22(3), 383-391.
29. Widana, I.K., Sumetri, N.W., Sutapa, I.K., Suryasa, W. (2021). Anthropometric measures for better cardiovascular and musculoskeletal health. *Computer Applications in Engineering Education*, *29*(3), 550–561. https://doi.org/10.1002/cae.22202