Quantitative and Qualitative Assessment of Aflatoxins Residues in Home and Industrial Broilers ChickenLivers

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Abstract:

Aflatoxins are a group of toxins mostly produced by Aspergillus flavus and Aspergillus parasiticus, two moulds that thrive in warm, humid climates on different crops which are used in manufacture of chicken rations. People can be exposed to aflatoxins which have a carcinogenic, mutagenic, teratogenic, immunosuppressive, and other adverse effects by consuming chicken livers from poultry that ate Aflatoxin contaminated feed. The result revealed that the mean residual values of 100 liver sample; home chicken broiler livers (n=50) were 27.61± 6.60 (µg/kg) for AFB1; 0.92± 0.35 (µg/kg) AFB2; 0.10± 0.05 for AFG1 and 44.30 ± 14.50 (µg/kg) for AFG2. While in industrial chicken liver sample (n=50) were5.44 ± 0.87 (µg/kg) for B1; 0.61 ± 0.14 (µg/kg) for AFB2 and 7.10±1.10 (µg/kg) for AFG2. The prevalence of the mean ±SE of the total AFLs/ µg/kg residues in home and industrial rearing chicken broiler liver samples were 72.47± 0.12 µg/kg and 12.54 µg/kg and 12.78 ± 0.008 µg/kg respectively. The detected total aflatoxins were exceed the MLs (15-20ppb) in home rearing chicken livers samples, while lied with the limits in industrial rearing liver samples. Monitoring of aflatoxin residues must be implemented and control programs in all broiler meat products.

Key words: Aflatoxin, chicken liver, home rearing, Industrial rearing, human risk

Introduction

Aflatoxins are chemicals that are among the most prominent types of mycotoxins that affect poultry. These toxins are secreted by some mould species. The danger of aflatoxin lies in the fact that they infect birds without any symptoms appearing. That is why it is called the silent killer and It is thought to be the most potent naturally occurring liver carcinogen to play a part in up to 28% of liver cancer cases globally ***(Liu and Felicia, 2010)*** Broiler chicken livers is uniquely rich nutrition profile

makes it a worthy addition to any nourishing diet. Due to high content of oxygenating iron, low in calories, Folate, Biotin that perform a multitude of functions, rich in protein, B vitamins, ultra-high vitamin A, rich in selenium and vitamin C and vitality of internal organs ***(Bordoni and Danesi (2017).*** Aflatoxins discovered began shortly after an outbreak of an unknown etiologic disease in turkeys in 1960.The illness was dubbed Turkey "X" disease, and it was later linked to a tainted groundnut meal imported from Brazil ***(Blount, 1961).*** From there, a thorough investigation revealed that a mould species known as *Aspergillus flavus* and *Aspergillus parasiticus* were build up a secondary metabolites referred after that to Aflatoxins which were the real cause of Hepatotoxicity, ***(Liu and Felicia, 2010;Molaghi et al., 2017; WHO, 2018, and Alam et al., 2020).***Chicken meat are distinguished by their flavour, affordability, and ability to offer an exceptional, well-balanced source of animal proteins for people of all ages ***(kralik et al., 2017).*** It's known that mycotoxins not only cause problems for the animal feed industry but also threaten the human's safety. The adverse health effects of mycotoxins are range from acute poisoning to long-term effects such as immune deficiency and cancer ***(Bryden, 2012*** *and* ***WHO, 2018).*** Due to their toxicity, the majority of political authorities limit the amounts of AFs that can be used in human and animal food. The permissible levels of AFs in human and animal foods depend on the perceived danger and the governing bodies' purview ***(Gupta, 2018)***.

In Egypt, the poultry industry is exceedingly based on the imported ingredients for feed formulation, in this way, the defilement with fungi are exceptionally tall either amid the stages of generation or amid transportation period or may happen amid capacity stages within the markets ***(Lizárraga-Paulínet al., 2011*** *and* ***Bryden, 2012).*** Aflatoxins are considered the most important form of mycotoxins, most dangerous for their serious pathogenic effects and economic losses caused by the destruction of polluted crops; ***(Agag, 2004 and Kumar et al., 2020).*** The greatest accumulation of Aflatoxins was observed in organs which responsible for biotransformation, such as the liver and kidney ***(Del et al., 2005).*** According to the type of chicken broiler rearing, age and ration performed in addition to degree of mould contamination aflatoxin residues were dependant ***(Hussain et al., 2010*** *and* ***Shareef, 2010)***. Therefore, this study was carried out to assess the prevalence and the content of aflatoxin residues in rearing chicken broiler liver samples which collected from both home rearing and industrial rearing broilers which having different age;

feeding and rearing systems located in Alsharqia governorate.

Materials and Methods

Standard Solutions:

The stock aflatoxin standard solutions were prepared according to the ***A O A C (2000).***

Extraction of Aflatoxins from the sample: ***A O A C (2000)***

One hundred (100) gram liver sample was homogenized. 10 ml of 20% citric acid was added and mixed well. 200mL of dichloromethane was added and held on the automatic shaker for 30 minutes. The mixture was filtered and the filtrate evaporated in vacuum. Add hexane and redetect the extracted material.

Clean-Up:

The procedure was carried out using Solid-Phase Extraction columns.

HPLC analysis

Analysis of Aflatoxins was done by Agilent HPLC apparatus, Faculty of Veterinary Medicine, Zagazig University

Results and Discussion

The results showed in Table (1) the minimum, maximum and mean values ± SE of Aflatoxins residual level (µg/kg) in the examined liver samples of home chicken broiler rearing livers were 1.2, 67.97 and 27.61± 6.60 (µg/kg) respectively for AFB1; ≤ 1.0, 3.30 and 0.92± 0.35 (µg/kg) respectively for AFB2; ≤ 1, 0.50 and 0.10± 0.05; respectively for AFG1 and 2.40, 150.2 and 44.30 ± 14.50 (µg/kg), respectively for AFG2. The obtained results were nearly similar to those reported by ***Nashwa et al. (2017)*** and ***Ibrahim et al. (2018)*** but lower than those reported by ***El-Nabarawy et al. (2021)***, while in industrial chicken broiler rearing livers (Table2) were 2.20, 9.50 and 5.44 ± 0.87 (µg/kg) respectively for AFB1; ≤ 1, 1.35 and 0.61 ± 0.14 (µg/kg) respectively for AFB2 and 2.70, 12.50 and 7.10±1.10 (µg/kg) for G2 respectively. The obtained results were nearly similar to those reported by ***Nashwa et al. (2017)*** and ***Abd El-Tawaab et al. (2019)*** and higher than those mentioned by ***Ebeed et al. (2015)*** and ***Sineque et al. (2017)*** and ***Gathumbi and Bebora (2000).***

The frequency percentages of Aflatoxins residues in examined liver samples as given in Table (3) were 15(36.6%) and15 (41.7%) for AFB1, 9(21.9%) and 6(16.6%) for AFB2, 2(4.9%) and Zero for AFG1 and 15(36.6%) and 15(41.7%) for AFG2 in examined liver samples of home and industrial rearing chicken broiler livers respectively. These results showed that AFs were arranged according to its prevalence in the examined samples as AFB1>AFG2>AFB2 > AFG1. The results obtained were lower to the result obtained by ***Sineque et al. (2017)*** in case of industrial samples while in home sample was higher. AFB1 were considered the most common and dangerous to the human liver because of their carcinogenic, mutagenic and teratogenic effects and

contaminated the chicken livers through the ration which performed to the reared chicken. The results were higher than those obtained by ***Ebeed et al. (2015)*** and arranged as AFB1>AFG1> AFG2 while AFB2 was not detected, while they were nearly similar to those reported by ***El-Desouky et al. (2014), Faten et al. (2016),*** and ***Nashwa et al. (2017).***

The prevalence of the minimum, maximum and mean ±SE of the total AFLs/ µg/kg residues as given in Table (4) in home and industrial rearing chicken broiler liver samples were 71.91, 72.93 and 72.47± 0.12 µg/kg and 12.54 µg/kg ,13.15 µg/kg and 12.78 ± 0.008 µg/kg respectively. The obtained results in industrial rearing broiler liver samples were nearly agreed with those mentioned by ***Abd El-Tawaab et al. (2019), Abdalla et al. (2021),*** *and* ***Morshdy et al. (2021)*** but higher than those mentioned by ***Ebeed et al. (2015)*** and ***Nashwa et al., (2017).*** The obtained results in home rearing broiler livers samples were higher than those mentioned by ***Ebeed et al., (2015), Abd El-Tawaab et al. (2019), Abdalla et al. (2021),*** and ***Morshdy et al. (2021).*** The estimated total aflatoxins were exceeding the MLs (15-20ppb) in-home rearing chicken livers samples, while lied with the limits in industrial rearing liver samples, this was attributed to the type of ration performed, age of the chicken and addition of anti-aflatoxin additives. The accepted and none accepted liver samples according to MLs standards were illustrated, it is clear that all samples of livers collected from home rearing were rejected. On the contrary, all samples from industrial rearing were accepted because they were in line with the permissible limits for the presence of mycotoxins in general and Aflatoxins residues in particular in chicken livers in food stuff.

Table (1): Incidence of Aflatoxins residues (µg/kg) in examined samples of home rearing chicken broiler liver

	AFB1	AFB2	AFG1	AFG2
Min	1.2	≤ 1.0	≤ 1	2.40
Max	67.97	3.30	0.50	150.2
Mean ±SE	27.61 ±06.60	0.92 ±0.35	0.10 ±0.05	44.30 ±14.50

Table (2): Incidence of Aflatoxinsresidues (µg/kg) in examined samples of Industrial rearing chicken broiler liver

	AFB1	AFB2	AFG2
Min	2.20	≤ 1	2.70
Max	9.50	1.35	12.50
Mean ±SE	5.44±0.87	0.61±0.14	7.10±1.10

Table (3): Frequency % of AFs detection in Home and Industrial rearing chicken broiler liver samples

AFs	Home rearing broiler liver		Industrial rearing broiler liver	
	No	%	N0	%
AFB1	15	36.6	15	41.7
AFB2	9	21.9	6	16.6
AFG1	2	4.9	0	0.0
AFG2	15	36.6	15	41.7
Total	**41**	**100**	**36**	**100**

Table (4): Prevalence of total AFLs/ µg/kg in Home and Industrial rearing chicken broiler liver

	AFLs/ µg/kg /Home rearing broiler livers	AFLs/ µg/kg /Industrial rearing broiler livers
Min.	71.91	12.54
Max.	72.93	13.15
Mean ±SE	72.47± 0.12	12.78 ± 0.008

Table (5): Accepted and none accepted liver samples according to MLs* standards

AFLs in home rearing broiler livers*				AFLs in industrial rearing broiler livers			
Accepted		Non accepted		Accepted		Non accepted	
No	%	No	%	No	%	No	%
0	0	15	100	15	100	0	0

Permissible limit according to US department of Agriculture (USDA) and Food and Drug Administration (FDA) set a tolerance limit of 20 ppb for aflatoxins in view of their toxic effects on foods* *(Sarma et al., 2017).***

Conclusion and recommendations:

The Aflatoxin levels either single or total residue recorded in this study were higher than the allowed limits in home rearing liver samples, suggesting that the chicken liver from this sources represents a high risk to consumers and aflatoxin residue monitoring should be performed and control programs in all chicken broiler rearing meat products. The encouragement of national authorities was recommended to monitor and ensure that the levels of mycotoxins in chicken broilers livers should be low as possible and comply with the

national and international MLs, legislation.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

References

Abd El-Tawaab A.A., Fatma I. E., Mahmoud A. H. and Dina M. R. (2019): Mycotoxin residues in different chicken products by HPLC and their inactivation using Gamma radiation. Int.J. Pharm. Res. Allied Sci., 8(4):71-81.

Abdallah, K.M.E., Elhelaly, A.E., Hebishy, R.M.M., Darwish, W.S. and El-Sherbiny, H.M.M. (2021): Prevalence of different mould genera and total aflatoxin content in frozen chicken meat and giblets: a health risk assessment study. Food Research 5 (6): 66.

Agag B.(2004):Mycotoxins in foods and feeds. 1-Aflatoxins.Assiut human diseases. Clin. Toxicol. 17: 45–60, 1980.University Bulletin for Environmental Researches.;7(1):173-206.

Alam S., Khan N.A., Muhammad A., Jan I., Hashmi M.S., Khan A., Khan M.O. (2020): Carryover of aflatoxinB1 from feed to Broilers tissues and its effect on chicken performance, by PSP 29 – Fresenius Environmental Bulletin No. 01: 214-221.

AOAC,(200): Association of Official Analytical Chemists. J Am Oil ChemSoc 54, 171–172.

Bordoni, A and Danesi F(2017): Poultry Quality Evaluation. Quality Attributes and Consumer Values. Chapter 11 - Poultry Meat Nutritive Value and Human Health.Woodhead Publishing Series in Food Science, Technology and Nutrition**.: 279-290**.

Blount, W. P.(1961): Turkey "X" disease. Turkeys, 9: 52-61.

Del B. M., Oliveira C. A. F, Albuquerque R., Guerra J. L., and Correa B. (2005): Immunology, health, and diseases effects of Prolonged Oral Administration of Aflatoxin B1 and Fumonisin B1 in Broiler Chickens, Poultry Science 84:1835–1840.

Bryden, W.L. (2012): Mycotoxin Contamination of the Feed Supply Chain: Implications for Animal Productivity and Feed Security. Animal Feed Science and Technology, 173, 134-158.

Ebeed A. S; Morshdy A.E., Mohamed A. M. Hussien and AbdElrhem E. and Ghorbal S.H.(2015): Aflatoxins Residues In Some Markted Poultry Products..http://www.damanhour.edu.eg/pdf.

El-DesoukyT.A., Mohamed S. R., Abou-Arab A. K., and SalimA. (2014): Occurrence of Aflatoxin B1 and M1 in Some Egyptian Chicken Organs and their Affected by Ozonated Water. Open Science Journal of Modern Physics. 1(4): 24-30.

El-Nabarawy A.M, I.Elshaimaa, ShaabanKh.A., Sawsan S.E.,

Batikh M.M. and Shakal M.(2020): Mycotoxin Contamination Levels in Broiler Feeds and Aflatoxin Residues in Broiler Tissues,. J. World Poult. Res., 10 (2S): 133-144.

Faten S. H., Mohammed M. M., Mahomud A. H., Wafaa M. H., and Fatma H. A. (2016): Aflatoxins residues in chicken and turkey tissues, BVMJ, 31(2):130-135.

Gathumbi J. K. and Bebora L.C. (2000): The occurrence of aflatoxin in poultry tissues collected in Nairobi, Kenya, Journal of Animal Health and production in Africa48(1):61-62

Hussain Z., Khan M.Z., Khan A., Javed I., Saleemi M.K., Mahmood S.and Asi M.R.(2010):. Residues of Aflatoxin B1 in Broiler Meat: Effect of Age and Dietary Aflatoxin B1 Levels. Food Chemistry and Toxicology, 48(12):3304-3307.

Ibrahim H.M., Hassan M. A. and Elsharkawy G. S. (2018): Aflatoxins B1 and B2 residues in Edible Offals BVMJ-35(2): 250-256.

Khan W.A., Khan M.Z., Khan A .and Hussain I. (2010): Pathological effects of aflatoxin and their amelioration by vitamin E in White Leghorn layers. Pak Vet J, 30(3): 155-162.

Kralik G, Kralik Z, Grčević M and Hanžek D· (2017): Quality of Chicken Meat (in Animal Husbandry and Nutrition bookan open access peer-reviewed edited volume.DOI10.5772/intechopen.69938.

KumarA, Thakur A, Patyal A, Thakur R, Himani Sharma H and ShakyaS(2020): Mitigating the Health Risks of Mycotoxins: Concerns and Solutions. International Journal of Livestock Research, 10 (11)1-14.

Lizárraga-Paulín, E.G.; Moreno-Martínez, E.; Miranda-Castro, S.P. (2011): Aflatoxins and their impact on human and animal health: An emerging problem. In Aflatoxins Biochemistry and Molecular Biology; Guevara-Gonzalez, R.G., Ed.; In Tech Press: Rijeka, Croatia: 255–282.

Liu Y and **Felicia Wu(2010):** Global burden of aflatoxin-induced Hepatocellular carcinoma: a risk assessment. Environ Health Perspect. 118 (6) :818-24.

Molaghi M.A., Taher K.N. and Abd-AllatifF.H. (2019): Aflatoxins B1 and M1 residues in chicken's livers in Al Diwaniyah city/ QJVMS.17. (2) 6th (1st international) Scientific Conference 27-28 Sep. (P-ISSN 1818-5746/ E-ISSN 2313-4429.

Morshdy, A.E., Abdel Samie, A.A., Tharwat, A.E., Elshorbagy, I.M. and Hussein M.A. (2021): Prevalence of mould in chicken meat-cuts, giblets and products with immuno-affinity detection of aflatoxin residues. Food Research 5 (4) : 303 – 309.

Nashwa M. Z.; Khalid T., and Nahla, S.L. Elshater (2017): Fungal contamination and

estimation of total aflatoxins residues in meat and liver of turkey cuts using High Performance Liquid Chromatography Animal Health Research Journal 5(4A): 252-265.

Sarma,PU, Bhetaria,PJ , Devi, P and Varma A.(2017): Aflatoxins Implications on Health. Indian J. ClinBiochem. 32(2): 124–133

Shareef A. M. (2010): Moulds and mycotoxins in poultry feed from farms of potential mycotoxicosis Iraqi Journal of Veterinary Sciences, 24(1):17-25.

Sineque A.R., Macuamule .C.L.andAnjos. F.R.D. (2017): Aflatoxin B1 Contamination in Chicken Livers and Gizzards from Industrial and Small Abattoirs/Int. J. Environ. Res. Public Health 14, 951.

WHO (World Health Organization) (2018): Food Safety Digest: Aflatoxin, Biological contaminants, Food safety, Mycotoxins, Risk management. Food and Agricultural Organization of the united Nation.

الملخص العربي

التقييم الكمي والنوعي لمتبقيات الأفلاتوكسينات في كبد دجاج التسمين المنزلي والتجاري

الأفلاتوكسينات هي عائلة من السموم التي تنتج بشكل رئيسي من فطراسبرجيللاس فلافس و اسبرجيللاس بارازيتاكاس ، وهي وفيرة في البيئات الدافئة والرطبة على محاصيل مختلفة والتي تستخدم في تغذية الدجاج اللاحم. يمكن أن يتعرض الناس للأفلاتوكسينات التي لها تأثيرات مسرطنة ومثبطة للمناعة وغيرها من الآثار الضارة عن طريق تناول كبد الدجاج التي تأكل علفًا ملوثًا بالأفلاتوكسين. وقدأظهرت النتيجة أن متوسط القيم المتبقية لـ 100 عينة كبد ؛ كبد دجاج التسمين المنزلي (ن = 50) كان 27.61 ± 6.60 (ميكروغرام / كغ) لـ B1 ؛ 0.92 ± 0.35 (ميكروغرام / كغ) B2 ؛ 0.10 ± 0.05 لـ G1 و 44.30 ± 14.50 (ميكروغرام / كجم) لـ G2. بينما في عينة كبد الدجاج المربي علي نطاق تجاري (ن = 50) كانت 5.44 ± 0.87 (ميكروغرام / كغ) لـ B1 ؛ 0.61 ± 0.14 (ميكروغرام / كغ) لـ B2 و 7.10 ± 1.10 (ميكروغرام / كغ) لـ G2. كان معدل انتشار متوسط ± SE لمجموع AFLs / ميكروغرام / كغ في عينات كبد دجاج التسمين المنزلي والتجاري 72.47 ± 0.12 ميكروغرام / كغ و 12.54 ميكروغرام / كغ و 12.78 ± 0.008 ميكروغرام / كغ على التوالي. تجاوز مجموع الأفلاتوكسينات المكتشفة الحد الأقصى المسموح به (15-20 جزء في البليون) في عينات كبد الدجاج المنزلي ، بينما كانتفي الحدود المسموح بها في عينات كبد التربية التجارية. وقد خلص البحث الي ان هناك حاجة ضرورية لتنفيذ برامج مراقبة ومتابعه بقايا الأفلاتوكسين في جميع منتجات لحوم دجاج التسمين