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Research Article

INVESTIGATION OF MANY MYCOTIC TOXINS IN FISH, POULTRY AND RUMINANT FEEDS

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Abstract

Fungus toxins consider one of the most common factors that have a serious impact on animal production. The current study aimed to demonstrate many mycotic toxins in animal feeds. About 500 – 1000 grams of 90 samples have got from poultry, fish, and ruminant feeds at animal farms from different parts of Baquba city in Diyala province, Iraq. All these 90 samples were sent to the laboratory of the College of Veterinary Medicine - University of Diyala from the 1st October 2021 to the 1st November 2021, and these samples were analyzed days after collection. The results recorded significantly lower $P < 0.05$ of mycotic toxins in ruminant feeds compared with poultry and fish feeds. Also, this study showed increased levels of both Penicilic acid and Afla, with a significant difference of $P < 0.05$ in ruminant feeds compared with other fungus toxins. The levels of Zearalenone and deoxynivalenol were significantly $P < 0.05$ greater in fish feed than in poultry and ruminant feeds. The current study recorded a serious remarkable difference of $P < 0.05$ among levels of mycotic toxins in fish and poultry and Penicilic acid toxin was higher compared with other toxins. In conclusion, the mycotic toxins may be high risk in fish and poultry feeds than in ruminant feeds.

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1. Introduction

The contamination by several types of mycotic toxins considers one of the most common dangerous impacts on the public health of humans and animals. Moreover, these mycotic toxins may cause severe economic losses (Mishra and Sopori, 2012). Mycotoxins are low molecular weight secondary metabolites produced by certain strains of filamentous fungi such as *Penicillium*, *Fusarium*, and *Aspergillus* which invade large numbers of crops in the field and may grow on most types of foods during storage under favorable conditions of humidity and temperature. They are regularly implicated in toxic syndromes in both humans and animals (Stasiewicz *et al.*, 2017). Principally, the feeds of most ruminate consist of soybean products, maize, oil cake, groundnuts, fishmeal, and brewers' grains, most of these feeds are exposed and suitable for aflatoxins contamination (Pitt *et al.*, 2012). Contamination by Mycotoxins may have happened sporadically during different seasons of the year and geographically (Pestka, 2011). The major toxins of fungus grades originated from the genera *Aspergillus*, *Fusarium*, and *Penicillium* and involved the aflatoxins, trichothecenes, ochratoxin A, and fumonisins (Danicke *et al.*, 2011).

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Aflatoxin considers the main common source of food contamination over the world and contaminates their subsidiary products originating from these main feedstuffs (Caloni and Cortinovis, 2011). Anyway, contamination of the milk of dairy animal farms and their products with aflatoxin causes serious problems for public human health in the world (Lopez *et al.*, 2003). Aflatoxins (AFs) are harmful minor metabolites secreted by *Aspergillus flavus* and other serotypes include *A. parasiticus, A. pseudotamarii*, and *A. nomius* (Pankaj *et al.*, 2017; Frisvad *et al.*, 2019; Loi, *et al.*, 2020), and considered as carcinogens impact of human public health (Kumar *et al.*, 2017). Aflatoxins consider organic mixtures and have minor molecular weight, and are created typically from fungal mycelia and assembled in sclerotia and conidia. The contamination by aflatoxins huge range of year growth, such as corn, rice, oilseeds, and nuts (Lizárraga Paulín *et al.*, 2013). Aflatoxins contamination in cereals could happen before and after harvest steps (Iimura *et al.*, 2017).

Aflatoxin contamination considers serious trouble in tropical and sub-tropical areas, in which the environmental status is extremely suitable for fungus growth and AF creation. Anyway, recently, also Mediterranean region had suffered from huge aflatoxin contamination due to weather variations, increasing temperatures, also continuous droughts (Moretti *et al.*, 2019; Loi *et al.*, 2020). Limitation humidity, temperature degree, and moisture consider the most common effective ways strategies to control spoilage and AF fungus creation during the storage process and shipping of variable commodities (Neme and Mohammed, 2017).

Ochratoxin A (OTA) considers the common essential and deleterious fungus toxin (Santos *et al.*, 2009). Ochratoxin A (OTA) was isolated and characterized chemically in 1965, OTA was discovered in South Africa in corn meals as a toxic metabolite of *Aspergillus ochraceus* that was intentionally inoculated with this fungus (Van der Merwe *et al*, 1965). Also, many studies have recorded that Ochratoxin has an embryotoxic impact, and also can be hepatotoxic, neurotoxic nephrotoxic, teratogenic, carcinogenic, and immunotoxic, in several types and sex-related differences species (Malir *et al*, 2013). Penicillic acid considers B-unsaturated, 5-membered lactone, and usual fungus toxins created by *Penicillium* and *Aspergillus* types (Sekiguchi *et al.*, 1987). Penicillic acid is recorded that patulin is a tetraketide fungal toxin, the biosynthetic pathway for which was found in various blocked mutants, cell extracts, and immobilized cells. Moreover, the biosynthetic way for penicillic acid, which is also a tetraketide, persists ambiguous (Sekiguchi *et al.*, 1987).

Deoxynivalenol (DON) considers also essential toxin produced by fungus that commonly responsible of contamination of several types of harvested cereal - food and feed worldwide. At the molecular level, Deoxynivalenol disorder slandered cell role by inhibiting proteins synthesis processes by binding to the ribosomes and by activating critical cellular kinases involved in signal transduction related to proliferation, differentiation, and apoptosis, The presence of DON in human foods raises serious issues of safety. (Pestka and Smolinski, 2005; Abdual-Shahid *et al.*, 2013). Zearalenone (ZON) considers the peripheral metabolic of Fusarium species. Contrasting with other fungal toxins, ZON is practical without impact toxic of mammals after acute ingestion (Abdual-Shahid *et al.*, 2013). However, Zearalenone is extremely action in other pathways, because it is similar to a key hormone created by a woman's ovaries, 17β- estradiol, and as an event, may be harmful to the endocrine system of human beings (Dombroski, 2012). There are a few studies about the isolation of these mycotoxins in the feed of poultry fish and cattle, so the aim of the current study is to determine many fungus toxins in animals fed in Diyalaprovince.

2. Materials and Methods

This study was carried out in the laboratory of the College of Veterinary Medicine, University of Diyalafrom the 1st of October 2021 to 1stNovember 2021.

Specimen collection

Our study materials involved 90 representative animals feed specimens that got directly at animals' herds from several areas of Baquba province during a one-month period included farms of poultry, ruminant and fish. The samples (each about 500 mg/kg) were analyzed at one week after collection. The technique of study based on Sreenivasa *et al.* (2009) was depend for extraction and clean of fungal toxins. Investigation of two mycotoxins for samples was achieved by High Performance Liquid Chromatography (HPLC). Statistical analysis was applied by SPSS and Analysis of Variance (ANOVA) and used the Least significant difference to detect the significant differences among means of groups. In addition, the significant difference statements were based on the possibility (P≤0.05).

3. Results and Discussion

Mycotoxins are fungal metabolic results that can pollute animal feeds and human foods. To explore the frequency of mycotoxins in fish, ruminant, and poultry feed in Diyala Governorate, Iraq, 90 examples of feed (n =90) were gathered from 90 animals ranches 30 homesteads of fish, 30 ranches of ruminant, and 30 homesteads of poultry. The tests were examined to quantitatively decide the presence of five mycotoxins which more distribution, specifically aflatoxin, Penicilic corrosive, ochratoxin, deoxynivalenol, and zearalenone, utilizing specific packs for everybody. The results of our study recorded significantly lower $P \leq 0.05$ of mycotic toxins in ruminant feeds compared with poultry and fish feeds (Table - 1). Also, this study showed increased levels of both Penicilic acid and Afla with significant differences $P \leq 0.05$ in ruminant feeds compared with other fungus toxins. The levels of Zaralenone and deoxynivalenol were significantly $P \leq 0.05$ higher in fish feed than in poultry and ruminant feeds. The current study showed a serious significant difference $P \leq 0.05$ between levels of mycotic toxins in fish and poultry and Penicilic acid toxin was higher compared with others toxins.

Table – 1: The levels of Mycotic toxins in fish, poultry and ruminant feeds (µg/kg)

Type	Ochra µg/kg	Afla	Penicilic acid	deoxynivalenol	Zaralenone
Fish	7.94 ± 0.02[b] C	19.15 ± 0.09[b] B	48.67 ± 0.21[b] A	1.69 ±0.03[a] E	2.05 ±0.02[a] D
Poultry	7.49 ± 0.16[b] C	17.56 ±0.15[b] B	50.77 ± 0.17[b] A	1.04 ±0.03[b] E	1.79 ±0.05[b] D
Ruminant	1.82 ±0.78[a] B	5.53 ± 2.27[a] AB	8.97 ±4.23[a] A	0.24 ± 0.10[c] B	0.45 ±0.12[c] B

All the tested samples contained ochratoxin at concentrations range between 1.04 and 7.96 µg/kg and averaging (7.94 ± 0.02 and 7.49 ± 0.16) µg/kg in the feed of fish and poultry with significant differences P<0.05 compared with feed of ruminants (1.82 ± 0.78 µg/kg) (Figure - 1).

Mycotoxins are poisonous secondary metabolites of low molecular weight that are produced mainly from certain fungal strains of *Aspergillus*, *Fusarium*, and *Penicillium* (Kosicki *et al.*, 2016; Pinotti *et al.*, 2016; Misihairabgwi *et al.*, 2019). Under favorable conditions of moist and elevated temperatures, they can colonize the field crops, during the harvesting period, storage, and feeding of animals until products are consumed by humans (Wild *et al.*, 2015; Misihairabgwi *et al.*, 2019). Generally, mycotoxin production will vary with crop type, geographical location, seasonal variations, humidity, temperature, hygienic status, storage conditions and overall farming practices employed (Marroquín-Cardona *et al.*, 2014).

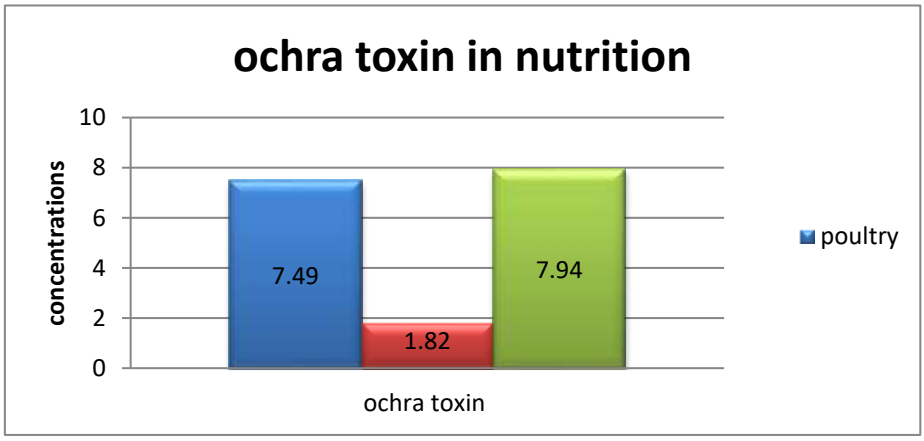

Figure - 1: Ochra levels in poultry, fish and ruminant feeds

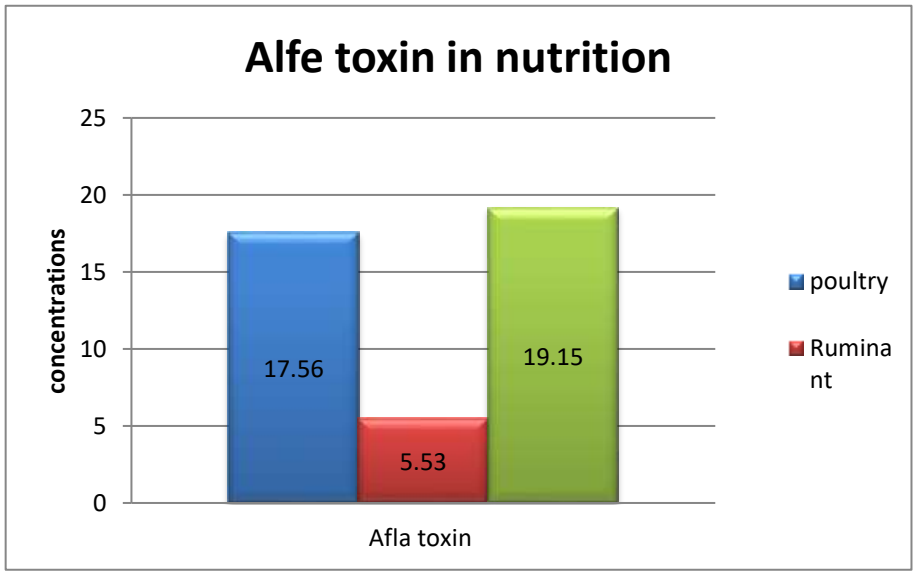

Figure - 2: Alfe levels in poultry, fish and ruminant feeds

The results referred that the samples contained Afla toxin at concentrations ranging between 3.26 and 19.24 µg/kg and averaging (19.15 ± 0.09 and 17.56 ± 0.15) µg/kg in the feed of fish and poultry with significant differences $P < 0.05$ compared with a feed of ruminants (5.53 ± 2.27 µg/kg) (Figure - 1). Apart from irreversible health concerns to life forms, the economy and international trades are being in peril due to poor quality of crops, impaired animal productivity, and increased contaminated products in the market (Iheshiulor *et al.*, 2011). The Maize contamination rates with aflatoxin have increased due to climatic changes and global warming (Batellani *et al.*, 2016). However, the possibility of forage contamination by aflatoxin is high when conditions are suitable for the growth of fungi as the vast majority of the sample tested positive for this mycotoxin (Rahim *et al.*, 2020). Many of groups of mycotoxins have been identified, which are common in cereal crops are known to have economic impacts and health implications, specifically the aflatoxins, ochratoxin, zearalenone, deoxynivalenol, and Penicilic acid. Even though mycotoxins are considered one of the major dangerous feed and food contaminants globally, certain groups of mycotoxins seem to be more ubiquitous in some geographic regions than others (Lawlor and Lynch, 2005).

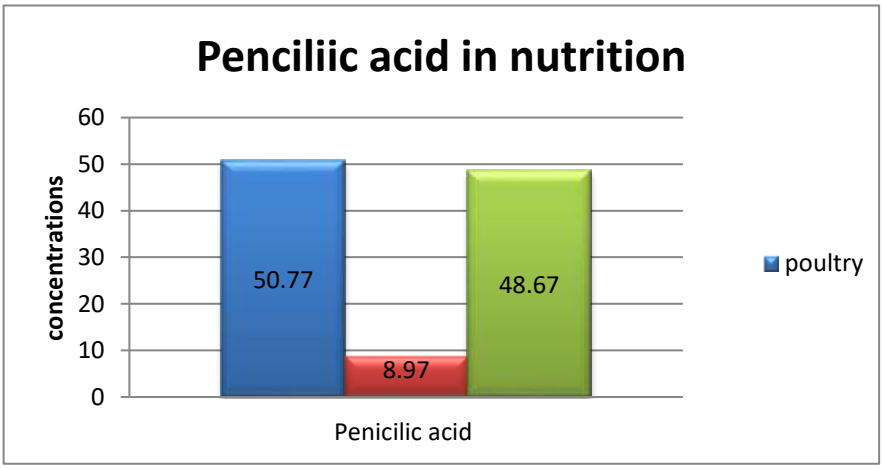

Figure - 3: Pencilly acid levels in poultry, fish and ruminant feeds

Dioxinevalinol (DON) and ochratoxin have been reported to cause the economic losses, disease, and even death in both animals and humans. The risks of feed contamination with mycotoxin have been reported to be so high that adequate control and good storage are difficult to achieve (Okoth *et al.*, 2018; Nakavuma*et al.*, 2020; Kemboi*et al.*, 2020).

Zearalenone is a mycotoxin produced by several species of *Fusarium* such as *F. culmorum* and *F. graminearum*. In this study, zearalenone was detectable in the sample with an average concentration of 2.05 ± 0.02 µg kg^{-1}, and this zearalenone was present in most of the forage samples, which means that grain contamination is likely to occur if the right conditions for fungal growth are provided.

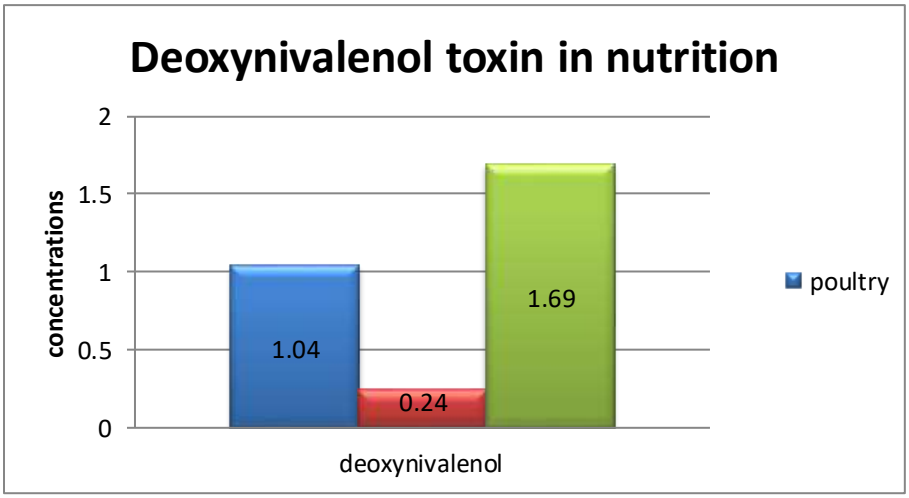

Figure - 4: Deoxynivalenol levels in poultry, fish and ruminant feeds

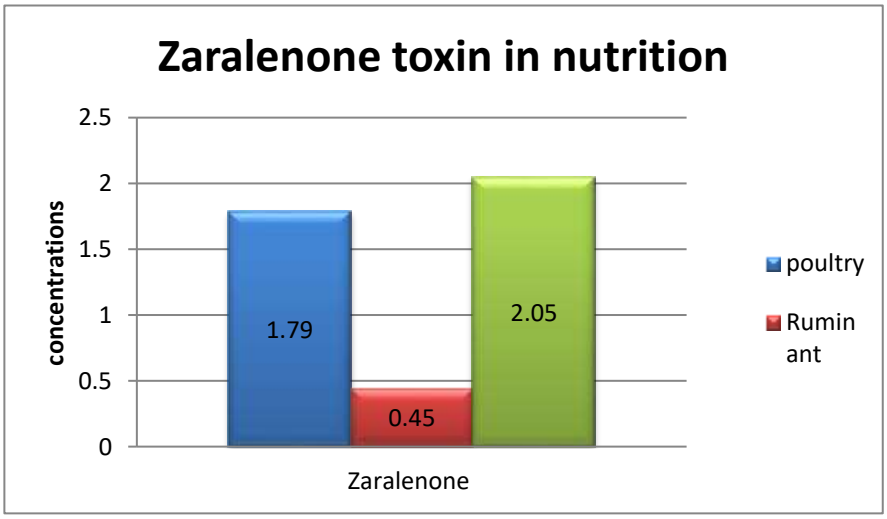

Figure - 5: Zaralenone levels in poultry, fish and ruminant feeds

4. Conclusion

The results of this study recorded higher ranges of mycotic toxins in fish feeds in compared with ruminant and poultry and fish feeds. There is a need to better understand the cumulative toxicological effects when several mycotoxins occur in animal feed, which may lead to new regulations on the maximum allowable concentrations of mycotoxins in feed. More efforts should be emphasized on monitoring, managing and controlling their levels starting from the field until their products reach the market. Understanding the physiological and environmental factors for mycotoxin biosynthesis, biology, and ecology of fungi and the overall interaction of the host plant is crucial for effective control of mycotoxin contamination. More research and investment need to be directed into developing and implementing surveillance programs, testing methods and rapid detection from the farm to industrial scale.

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