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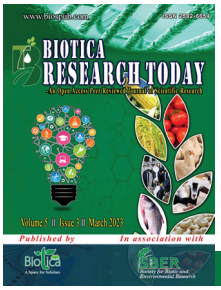

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The Hidden Dangers of Mycotoxins in Poultry Feed and How to Mitigate Their Effects

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Abstract

Mycotoxins are secondary metabolites produced by a variety of toxigenic fungi that can cause many harmful effects on the animal body. Toxic syndromes, such as mycotoxicosis in animals and poultry, are seriously threatened by ubiquitous occurrence, heat stability, and lipophilic character. The economy of the poultry sector in India has been severely impacted by widespread mycotoxin exposure or contamination of various agricultural products. The economic losses are mostly caused by the decreased growth rate, feed conversion efficiency, carcass production, carcass quality, and increased susceptibility to various diseases among the affected birds, which is brought on by their immunosuppressive effects. Mycotoxins can be decontaminated by using several physical and chemical techniques that reduce the toxin burden in crop/ feed.

Keywords: Decontamination, Mycotoxicosis, Mycotoxin, Poultry

Introduction

Mycotoxins are secondary metabolites synthesized by a variety of toxigenic fungi, primarily those from the genera *Aspergillus*, *Fusarium*, *Penicillium*, and *Claviceps*. Different fungi can produce the same mycotoxin & the same fungus can produce different mycotoxins. The ideal conditions for toxin generation are very individual to each fungus and only occur under precise parameters of moisture, temperature, compatibility of the substrate, and suitable oxygen tension. Toxic syndromes, such as mycotoxicosis in animals and poultry, are seriously threatened by ubiquitous occurrence, heat stability, and lipophilic character. Fungus invades crops in the field and may grow on foods during storage under favourable conditions of temperature and humidity (Patil *et al*., 2014). Crops may be more susceptible to fungal infection if the seed coat has been damaged by insects, mechanical harvesting, severe frost, or other causes. Insects may also serve as carriers of fungal spores. Before the grains are harvested, field fungi like *Fusarium*, *Helminthosporium*, and *Cladosporium* infect them and need more water activity to grow. Aspergillus and Penicillium are two examples of the storage fungus that attack grains during drying and storage after harvest.

Types of Mycotoxicosis

1) Aflatoxicosis

A then-unknown illness called Turkey "X" Disease, which killed over 1,00,000 turkeys (*Meleagris gallopavo*) and other fowl in England in 1960, led to the discovery of the acute toxicity of dietary aflatoxin. Aflatoxins are toxic compounds produced by some strains of *Aspergillus flavus, Aspergillus parasiticus*, and a number of other *Aspergillus* species during growth on natural substrates including growing crops and stored food. Dietary exposure to aflatoxins can have severe toxic and carcinogenic effects on poultry. Aflatoxin B1 (AFB1), B2 (AFB2), Aflatoxin G1 (AFG1), and Aflatoxin G2 (AFG2) are the four principal aflatoxins, and they are named based on their blue or green UV fluorescence. The most mutagenic, hepatotoxic, and widespread of them is AFB1 on a global

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scale. Chickens (*Gallus gallus*) are more resistant to acute aflatoxicosis than other poultry species, except during embryonic development. The order of sensitivity is ducks > turkeys > Japanese quail (*Coturnix japonica*) > chickens. Aflatoxin causes liver damage and nervous system symptoms like ataxia and convulsions in cases of acute poisoning. Death could happen suddenly. While in chronic situations, immunosuppression leads to lower daily weight gain, poor food conversion efficiency, and increased susceptibility to recurring infections. The presence of hepatomegaly with necrosis and bile duct hyperplasia may be noticed, depending on the level of intoxication (Monson *et al*., 2015).

2) Ochratoxicosis

Ochratoxins are one of the most lethal mycotoxins. Several *Aspergillus* and *Penicillium* species, particularly toxigenic strains of *Aspergillus ochraceus*, *A. alutaceus* and *Penicillium verrucosum* produce ochratoxins. The four ochratoxins A, B, C, and D have all been identified, with ochratoxin A being the most prevalent and dangerous of the four. This toxin is mostly nephrotoxic and in poultry along with nephropathy it also causes anaemia, decreased skeletal integrity, impaired coagulation of blood, impaired phagocytosis, and lowered development rate (Patil *et al*., 2014).

3) Fusarium Toxin

Three of the most important Fusarium toxins are fumonisin, deoxynivalenol (DON), and zearalenone. Other Fusarium toxins include T-2 toxin, nivalenol, diacetoxyscirpenol, and fusaproliferin. These toxins normally affect crops like maize, barley, rice, wheat, and soybean. The disease in maize caused by these fungi is called Fusarium kernel rot. Fumonisin damages the liver and kidneys in chickens, whereas deoxynivalenol impairs the immune system and reproduction, and causes estrogenism and vulvovaginitis. While fusaproliferin is to blame for the teratogenicity of poultry, T-2 toxin, nivalenol, and diacetoxiscirpenol induce immunosuppression and productivity losses.

4) Ergot Alkaloids

Ergotism is caused by the ingestion of grasses & cereals, particularly rye, infected with fungal species of the genus Claviceps, notably *Claviceps purpurea.* The most dominant alkaloids in grain ergot bodies are ergotamine, ergocristine, ergosine, ergocornine, and ergocryptine. Ergot toxicosis is manifested in three forms:

• *Convulsive*: convulsions, muscle spasms, and temporary paralysis. This condition is mostly associated with *Claviceps paspali*. Rigor mortis is never complete, living muscle flaccid.

• *Gangrenous*: this form results in lameness, and loss of extremities. This is due to impaired circulation and blood supply.

• *Other*: less severe forms include vomition, fever, and alteration of endocrine function.

Impact of Mycotoxin

The economy of the poultry sector in India has been severely impacted by widespread mycotoxin exposure or contamination of various agricultural products. The economic losses are mostly caused by the decreased growth rate, feed conversion efficiency, carcass production, carcass quality, and increased susceptibility to various diseases among the affected birds, which is brought on by their immunosuppressive effects (Katole *et al*., 2013). The consumption of multiple mycotoxins contaminated diet may induce hematological, biochemical, and liver physiological changes and growth depression.

The effects of decreased animal output, increased illness incidence due to immunological suppression, harm to critical organs, and interference with reproductive potential are far more significant than the effects of mycotoxin poisoning death. Consumption of low levels of mycotoxins through the feeds does not cause overt mycotoxicosis but often predisposes to various infectious diseases and especially to secondary bacterial infections or to a heavy progression of some often-encountered parasitic diseases.

Mycotoxin Decontamination Methods

The Physical Method of Decontamination involves:

• Density segregation is sorting and separating healthy from unhealthy kernels *via* the flotation of contaminated grains and oilseeds.

• Irradiation is done by using UV and gamma rays to destroy fungal spores. Normal sun exposure (UV) significantly lowers mycotoxin levels in infected grains.

• Processing of food which involves wet milling, malting, brewing, cooking, and dry and oil roasting are other methods to eliminate the mycotoxins, effectively. The OTA concentration is 85% decreased by autoclaving for five hours at 132 °C.

Chemical Detoxification Includes Methods like:

• *Ammonisation*: To eradicate the mycotoxin in contaminated food, treatment with aqueous and gaseous ammonia or ammonium hydroxide, with or without heat and pressure. It also inhibits mould growth.

• *Ozonisation*: Aflatoxin in maize and cottonseed meals, as well as deoxynivalenol and moniliformin, are all broken down by ozone.

• *Sodium hydroxide*: Several mycotoxins in the feed were detoxified by heating grain to 105 °C in the presence of 0.5% sodium hydroxide. Biological methods use microorganisms to degrade mycotoxins.

To date, several substances have been utilized to treat poultry mycotoxicosis, including activated carbons (charcoal), bentonites, clay, hydrated sodium calcium aluminium silicate, and zeolite. Antioxidant products like ascorbic acid (vitamin C), phenolic compounds, plant products, vitamin A, and Vitamin E can also reduce the effect of mycotoxins. They act as scavengers of superoxide anion, preventing mycotoxin-induced damage to cell membranes. Numerous food components have ameliorative properties against mycotoxicosis, like aspartame, crude protein, dietary lipids, L-methionine, and L-phenylalanine (Patial *et al*., 2012).

Conclusion

In conclusion, mycotoxins are a significant issue for food safety that needs to be addressed by both food producers

and consumers. The danger of negative health effects related to their ingestion can be decreased with the help of proper education, understanding of mycotoxin contamination, and prevention strategies.

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