

Mycotoxins in Animal Feed: The Invisible Threat to Livestock Health

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Abstract

Mycotoxins are toxic secondary metabolites produced by several species of fungi that contaminate feed ingredients, grains, oilseeds, forages and compound feeds. They represent an important but often underestimated threat to livestock health, productivity and food safety. The major mycotoxins of concern in animal production include aflatoxins, ochratoxin A, fumonisins, deoxynivalenol, zearalenone and T-2 toxin. Contamination may occur before harvesting, during harvesting, processing or storage, particularly when temperature and moisture conditions favour fungal growth. Unlike many infectious agents, mycotoxins are generally invisible and may not produce noticeable changes in the smell or appearance of feed. Consumption of contaminated feed may result in reduced feed intake, poor growth, impaired feed efficiency, reproductive problems, liver and kidney damage, intestinal disturbances and immunosuppression. Poultry and swine are particularly sensitive to several mycotoxins, while ruminants can also be affected depending on the toxin, dose and physiological status of the animal. Importantly, multiple mycotoxins may occur simultaneously, potentially producing additive or synergistic effects. Effective management requires an integrated approach involving good agricultural practices, proper harvesting, drying and storage, regular feed testing, appropriate detoxification strategies and careful selection of mycotoxin-control products. Prevention is generally more effective than attempting to detoxify heavily contaminated feed after contamination has occurred. Mycotoxin management is therefore an important component of animal health, livestock productivity and the One Health approach

Feed is one of the most important inputs determining the health, productivity and profitability of livestock. However, feed ingredients can sometimes contain hidden contaminants that cannot be detected by routine visual inspection. Among these, mycotoxins are particularly important. Mycotoxins are naturally occurring toxic compounds produced mainly by Moulds belonging to genera such as *Aspergillus*, *Fusarium* and *Penicillium*. They can contaminate cereals, oilseeds, agricultural by-products, silage and compound feeds before harvest as well as during transportation and Storage. The problem is often referred to as an “invisible threat” because feed containing mycotoxins may look completely normal. The absence of visible mould does not necessarily

mean that the feed is free from Mycotoxins. The economic importance of mycotoxins became particularly evident during the historical outbreak of “Turkey X disease”, in which large numbers of turkey poulters died after consuming contaminated peanut meal. The causative toxin was subsequently identified as aflatoxin produced by *Aspergillus flavus*.

Mycotoxin Comes from-

A. Pre-harvest Contamination: Fungal infection in standing crops, drought stress, insect damage, high temperature and humidity, poor crop management, and plant diseases.

B. During Harvesting: Delayed harvesting, mechanical damage to grains, and harvesting under high-moisture conditions.

C. During Storage: High moisture content, poor ventilation, temperature fluctuations,



condensation, insect and rodent infestations, and prolonged storage.

D. During Feed Processing: Contamination may occur through the use of contaminated equipment, improper handling, or the introduction of contaminated ingredients during feed manufacturing.

E. Through Contaminated Raw Materials: Contaminated raw materials can introduce mycotoxins into complete feed. Therefore, mycotoxin management should begin at the crop production stage and continue throughout harvesting, storage, processing, and feeding.

Major Mycotoxins of Importance in Animal Feed

Mycotoxin	Major fungal source	Important target/effect
Aflatoxin (AFB ₁)	Aspergillus flavus, A. parasiticus	Liver toxicity and immunosuppression
Ochratoxin (OTA)	Aspergillus and Penicillium spp.	Kidney toxicity
Fumonisin (FB ₁)	Fusarium spp.	Liver, kidney, and neurological effects
Deoxynivalenol (DON)	Fusarium spp.	Feed refusal, intestinal damage, and immune effects
Zearalenone (ZEN)	Fusarium spp.	Reproductive and estrogenic effects
T-2 toxin	Fusarium spp.	Oral and gastrointestinal lesions, immunosuppression
Other trichothecenes	Mainly Fusarium spp.	Gastrointestinal and immune effects

Aflatoxin: The Major Concern

Among feed-associated mycotoxins, aflatoxin B₁ is particularly important because of

its potent hepatotoxic and carcinogenic properties. It is primarily produced by *Aspergillus flavus* and *Aspergillus parasiticus*. Warm temperatures and high humidity favour fungal growth and increase the risk of contamination under suitable conditions.

Effects of aflatoxin exposure include:

- Liver damage and impaired liver function.
- Reduced growth and feed efficiency.
- Immunosuppression and increased susceptibility to infections.
- Reduced reproductive performance.
- Decreased production.
- Increased mortality at high exposure levels.

Effects of Major Mycotoxins on Livestock

Dairy Cattle

Mycotoxin exposure in dairy cattle may result in reduced feed intake, decreased milk production, poor body condition, impaired immunity, liver dysfunction, reproductive disturbances, and increased susceptibility to disease.

Poultry

Poultry are particularly sensitive to several mycotoxins, depending on the toxin type, dose, and duration of exposure. Common effects include:

- Reduced feed intake and poor body weight gain.
- Poor feed conversion ratio.
- Reduced egg production and hatchability.
- Immunosuppression.
- Liver and kidney damage.
- Increased susceptibility to infectious diseases.

Mycotoxin exposure can significantly compromise poultry health, growth, and productivity.

Swine

The major effects of mycotoxin exposure in swine include feed refusal, vomiting, reduced growth, poor feed conversion, gastrointestinal disturbances,



reproductive problems, and immunosuppression.

Clinical Signs of Mycotoxicosis

Clinical signs depend on several factors, including:

- Type and concentration of mycotoxin.
- Duration of exposure.
- Animal species and age.
- Nutritional status.
- Presence of other diseases.
- Co-exposure to multiple mycotoxins.

General Signs: Reduced appetite, poor growth, weight loss, reduced production, poor feed efficiency, and weakness.

Digestive Signs: Diarrhoea, vomiting in susceptible species, feed refusal, and intestinal irritation.

Immune-Related Signs: Increased incidence of disease, poor vaccine response, and increased susceptibility to infections.

Reproductive Signs: Reduced conception rates, irregular reproductive performance, reduced fertility, and reproductive tract abnormalities.

Diagnosis of Mycotoxicosis

1. **Feed History:** Collect information on the feed source, batch number, storage duration, storage conditions, and feed ingredients.
2. **Clinical Examination:** Assess reduced production, poor growth, reproductive problems, and signs of liver or kidney dysfunction.
3. **Feed Sampling:** Representative sampling is essential because mycotoxins may be unevenly distributed throughout a feed batch.
4. **Laboratory Analysis:** Detection methods include enzyme-linked immunosorbent assay (ELISA), high-performance liquid chromatography (HPLC), liquid chromatography–tandem mass spectrometry (LC-MS/MS), and rapid test kits.

Role of Nutrition in Mycotoxin Management

Proper nutrition can improve an animal's resilience to stress associated with mycotoxin

exposure. Important nutritional considerations include:

- Adequate protein and energy supply.
- Balanced vitamins and minerals.
- Inclusion of antioxidant nutrients.
- Use of good-quality feed ingredients.
- Access to clean and sufficient drinking water.
- Maintenance of healthy gastrointestinal function.

Future Perspectives

Emerging approaches for improved mycotoxin management include:

- Rapid on-farm diagnostic kits.
- Multi-mycotoxin detection technologies.
- Biosensor-based detection systems.
- Artificial intelligence-based risk prediction.
- Climate-based forecasting of mycotoxin contamination.
- Biological and enzyme-based detoxification methods.
- Biocontrol using non-toxigenic fungal strains.
- Precision feed management.
- Improved feed storage and preservation technologies.

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