



Mycotoxins in Animal Feed: Implications for Livestock Health and Food Safety

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Abstract

Mycotoxins are toxic compounds produced by certain fungi that contaminate crops and stored agricultural products, posing significant risks to livestock health and food safety. Important mycotoxins include aflatoxins, fumonisins, ochratoxin A and zearalenone, which can affect animal growth, immunity, organ function and reproductive performance. Aflatoxins are of particular concern in dairy production because aflatoxin B1 consumed through contaminated feed can be converted into aflatoxin M1 and excreted in milk. This transfer creates a potential food-safety hazard, as conventional milk processing, including pasteurisation, does not reliably eliminate aflatoxin M1. Indian studies have demonstrated contamination in dairy-animal feed and milk samples, highlighting the importance of surveillance while recognising that findings from individual studies do not represent current national prevalence. Moisture management, appropriate drying, hygienic storage, representative sampling and laboratory testing are essential for risk reduction. Suspected contaminated feed should be managed according to veterinary, laboratory and regulatory guidance. An integrated One Health approach involving farmers, veterinarians, feed manufacturers, laboratories and food-safety authorities can strengthen prevention and protect animal health, consumer safety and the sustainability of livestock production.

Keywords- Mycotoxins; Aflatoxins; Aflatoxin B1; Aflatoxin M1; Animal feed contamination; Dairy safety; Milk quality; Feed storage; Food safety; One Health

Imagine visiting a dairy farm after the monsoon. Feed is stored in a shed where moisture has seeped into a few bags. The cattle appear healthy, and the feed looks ordinary. Yet, hidden within it may be substances capable of affecting animal health and contaminating the milk that eventually reaches consumers.

These substances are called **mycotoxins**. They are invisible chemical hazards that can move through the food chain, linking crop production, livestock health and human food safety.

The danger is not always obvious. Not every mould produces toxins, and feed that looks clean is not necessarily safe. Understanding mycotoxins is therefore essential for farmers, veterinarians, feed manufacturers and everyone involved in keeping our food supply safe.

What are mycotoxins?

Mycotoxins are toxic compounds produced by certain fungi that grow on crops and stored agricultural products. Contamination may occur before harvest or during storage, particularly when temperature, moisture and other conditions favour fungal growth. Several mycotoxins are important in animal production:

Mycotoxin	Main producing fungi	Commodities commonly affected
Aflatoxins	<i>Aspergillus flavus</i> , <i>A. parasiticus</i>	Maize, groundnut, cottonseed
Fumonisin	<i>Fusarium verticillioides</i> and related species	Maize
Ochratoxin A	<i>Aspergillus</i> and	Cereals and stored grains

	<i>Penicillium</i> species	
Zearalenone	Certain <i>Fusarium</i> species	Maize and other cereals

Different mycotoxins affect animals in different ways. Some primarily damage the liver or kidneys, while others can interfere with immunity, growth or reproduction. Zearalenone, for example, has oestrogen-like activity and can disrupt reproductive function in susceptible animals.

The consequences depend on the toxin involved, its concentration, the amount consumed, the duration of exposure and the species of animal. Contamination can also involve more than one mycotoxin, making its effects harder to predict.

Aflatoxin: from the feed trough to the milk can

Among the mycotoxins of concern in dairy production, aflatoxins deserve particular attention because contamination can extend beyond the animal feed itself.

When a cow consumes feed contaminated with aflatoxin B1 (AFB1), the toxin is processed in the liver. Some is converted into reactive compounds that can damage cellular DNA and contribute to liver cancer risk, while another portion is transformed into aflatoxin M1 (AFM1) and excreted in milk.

This transfer from feed to milk is known as *carry-over*. Its extent varies according to the amount of toxin consumed, milk yield and the animal's physiological condition.

The implications are important because milk is widely consumed by children and other vulnerable groups. Ordinary milk processing, including pasteurisation, does not reliably eliminate AFM1. Preventing contamination at the feed stage is therefore more effective than relying on processing to remove the hazard

later.

Regulatory limits also differ between jurisdictions. For example, the European Union's maximum level for AFM1 in milk is 0.05 micrograms per kilogram ($\mu\text{g/kg}$), compared with the Codex Alimentarius maximum level of 0.5 $\mu\text{g/kg}$. A sample may consequently comply with one standard while exceeding another jurisdiction's limit. These limits are regulatory benchmarks, not guarantees that exposure carries zero risk.

What do Indian studies tell us?

Indian studies show why this issue deserves attention, although their findings must be interpreted within the limits of the samples investigated. In a 2021 study from Punjab, researchers tested 189 samples of dairy-animal concentrate feed using ELISA screening, with high-performance liquid chromatography (HPLC) for confirmation. They detected aflatoxins in 59% of the samples. About 44% exceeded the US Food and Drug Administration's tolerance limit for total aflatoxins, while 58% exceeded the European legal limit for AFB1. The study also found that AFB1 concentrations were significantly higher during the rainy season (41.6 $\mu\text{g/kg}$) and winter (35.9 $\mu\text{g/kg}$) than during summer (25.5 $\mu\text{g/kg}$). The authors' theoretical extrapolation of toxin carry-over suggested that milk produced from such feed could exceed the European limit in 50–100% of cases, depending on the season [3]. These figures describe the feed samples examined in that study, not the prevalence of contamination across all livestock feed in India. Nevertheless, they demonstrate why local feed testing and seasonal monitoring can be valuable.

Evidence from the milk side tells a complementary story. In the interim report of its National Milk Quality and Safety Survey 2018, the Food Safety and Standards Authority

of India (FSSAI) reported that 368 of 6,432 milk samples—approximately 5.7%—contained AFM1 above the applicable permissible limit of 0.5 $\mu\text{g/kg}$ [4]. Most exceedances were relatively modest: approximately 3% of all samples were within twice the limit, 1.4% were two to five times above it, and 1.3% exceeded it by more than five times. Processed milk had a higher reported exceedance rate (8.6%) than raw milk (3.7%). The survey used rapid test kits for initial screening and LC-MS/MS to measure positive samples. Its authors concluded that the problem was concentrated in particular pockets and states rather than being uniformly distributed across the country [4].

This is a historical survey result, not an estimate of current contamination across India. However, it illustrates an important point: monitoring milk alone may identify a problem without revealing where it originated. Taken together, the two studies reinforce the same message: food safety cannot begin only at the dairy plant or retail outlet. It must also address what goes into the animal.

What contaminated feed does to animals

Mycotoxin exposure does not always produce obvious signs of illness. Depending on the toxin and level of exposure, affected animals may show reduced feed intake, slower growth, lower productivity, reproductive difficulties or impaired immune function. Some toxins can also damage organs such as the liver and kidneys.

In dairy animals, a decline in production or changes in health may have several possible causes. Mycotoxins should not be assumed to be responsible simply because an animal is underperforming. This is where veterinary expertise becomes important. A proper assessment considers the animal's clinical history, diet, management conditions and other

possible causes. When contamination is suspected, laboratory testing of representative feed samples can help establish whether mycotoxins are present. Recognising the problem early can reduce continued exposure and help farmers avoid unnecessary economic losses.

Why climate and storage matter

Mycotoxin contamination depends on the interaction of crop conditions, fungal growth, harvesting practice and storage. Warmth and moisture favour toxin-producing fungi, though the conditions differ between species and toxins. Drought stress can make some crops more susceptible to contamination, and wet weather at harvest or inadequate drying creates further risk. The Punjab study's seasonal pattern fits this picture.

Climate change may alter these risks through shifts in temperature, rainfall, drought frequency and humidity, but the effect is not uniform. The direction and size of the change depend on the crop, the region, the fungal species and local practice.

In India, feeding systems often rely on maize, oilseed cakes, crop residues, commercial concentrates and stored fodder, so prevention needs attention to both feed production and storage. Good practice cannot guarantee that every batch is toxin-free, but it reduces the conditions that encourage contamination.

Finding contamination: why sampling matters

Mycotoxin contamination is influenced by conditions throughout the crop and feed supply chain. Fungal growth may be encouraged by suitable temperatures, moisture and crop stress, while poor drying and storage can allow contamination to develop or worsen. The monsoon can create particular challenges where feed ingredients are stored in damp

conditions. Moisture entering bags, leaking roofs, inadequate ventilation and delayed drying may all increase the risk of fungal growth.

However, weather does not affect every mycotoxin in the same way, and contamination patterns vary with the crop, fungal species, region and storage practices. The Punjab study provides evidence of seasonal differences in the samples examined; it should not be interpreted as proof that the same pattern occurs throughout India or that climate change alone explains the problem.

For farmers, the practical lesson is straightforward: feed management must account for local weather and storage conditions, not merely the appearance of the feed.

What can farmers and veterinarians do?

Mycotoxins cannot always be prevented, but several practical measures can reduce the risk.

- **Control moisture:** Dry feed ingredients appropriately and store them in clean, dry, well-ventilated areas. Repair leaks and protect feed from rain and damp floors.
- **Inspect feed regularly:** Look for dampness, clumping, discolouration or mould. Remember that the absence of visible mould does not guarantee the absence of mycotoxins.
- **Test when risk is suspected:** Prioritise testing of high-risk ingredients, questionable batches and feed associated with unexplained animal-health or productivity problems.
- **Separate suspect feed:** Do not assume that mixing contaminated feed with clean material will make the resulting ration safe. Follow appropriate

veterinary, laboratory and regulatory advice for handling and disposal.

- **Use feed additives responsibly:** Certain mycotoxin binders or other authorised products may help reduce the effects of specific toxins under appropriate conditions. Their effectiveness varies, and they are not substitutes for preventing contamination or testing feed.

Feed safety is a shared responsibility. Farmers can improve storage and handling, veterinarians can investigate suspected exposure, laboratories can support surveillance, and feed manufacturers can strengthen quality-control procedures.

Why this is a One Health issue

Mycotoxins illustrate the interconnectedness of human, animal and environmental health. The chain can begin in the field, continue through harvested crops and stored feed, affect livestock, and ultimately compromise the safety of foods such as milk. Environmental conditions and agricultural practices influence the risk at every stage, making mycotoxin control a practical example of the One Health approach. Veterinary public health plays a vital role in this effort, as veterinarians help identify and manage hazards that can pass from animal feed into the human food chain. Collaboration among farmers, veterinarians, food-safety authorities, laboratories and agricultural experts is therefore essential for early detection, effective prevention and a safer food supply. Surveillance should therefore extend beyond finished food products to include feed ingredients, storage systems and the conditions under which animals are raised.

A safer food chain begins before the farm gate

Mycotoxins can be difficult to control because contamination is often invisible, unevenly distributed and not reliably eliminated by ordinary food processing. However, their risks can be reduced through proper feed storage, representative sampling, timely testing and coordinated action across the food chain. This does not mean that every bag of feed is dangerous or that every contaminated batch will cause illness; rather, it reminds us that appearance alone cannot guarantee safety. By the time a problem becomes evident in livestock or milk, exposure may already have occurred. So, when we think about safe milk, we must look beyond the dairy farm and collection centre to the crops, storage conditions and animal feed that come before them. **A safer food chain begins with safer feed.**

Further reading

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