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Mycotoxins: A Threat to Animal & Human Health

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Mycotoxins are generally defined as metabolites of fungi which evoke pathological changes in man and animal, and which result in illness and economic losses.

The term “mycotoxins” is reserved for the toxic chemical products produced by fungi that readily colonize crops. The worldwide contamination of foods and feeds with mycotoxins is a significant problem. Some fungi are capable of producing more than one mycotoxin and some mycotoxins are produced by more than one fungal species. It is well-established that not all fungi are toxigenic and not all secondary metabolites from fungi are toxic. Aflatoxins, Ochratoxins, Trichothecenes, Zearalenone, Fumonisins and Ergot alkaloids are the mycotoxins of extreme agro-economic importance (Table 1).

TABLE 1 The major classes of mycotoxins, the common food products that may be contaminated with mycotoxins, and the animals that are most affected.

Mycotoxin	Products	Notable Animals Affected	Clinical Effects
Aflatoxins	Maize, peanuts, dairy products, tree nuts	Pigs, dogs cats, cattle, sheep, human	Liver damage, intestinal bleeding, cancer
Ochratoxins	Cereal grains, coffee, grapes	Pigs, humans	Kidney and liver damage, cancer
Trichothecenes	Wheat, barley, oats, maize	Pigs, dairy cattle, poultry, horses, humans	Feed refusal, diarrhoea, vomiting, skin disorders, reduced growth
Zearalenone	Maize, hay	Pigs, dairy cattle	Enlargement of uterus, abortion, malformation of testicle and ovaries
Fumonisins	Maize, silage	Horses, pigs, humans	Pulmonary edema, leukoencephalomalacia, esophageal cancer, neural tube defects, liver damage, reduced growth
Ergot alkaloids	Rye, sorghum, pasture grasses	Cattle, sheep, humans	Hallucinations, gangrene, loss of limbs, hastening of birth

Currently more than 300 mycotoxins are known, and scientific attention is focused mainly on those that have proven to be carcinogenic or toxic.

Human exposure to mycotoxins results from the consumption of plant-derived foods that are contaminated with toxins, the carry-over of mycotoxins and their metabolites in animal products, such as meat and eggs, or exposure to air and dust containing toxins (Figure 1).

Figure 1: Maize cobs infected with *Aspergillus flavus*, Oranges infected with *Aspergillus* (Agrilinks Ag Team, 2015), Lesions in the oral mucosa are caused by T-2 toxin (Murugesan, 2015)

The main difficulty in assessing the risk of mycotoxins to human and animal health is the variety of factors affecting the production or presence of mycotoxins in food and feed. Mere isolation and confirmation of mycotoxigenic fungal species in food and feed does not indicate the presence of mycotoxins.

Market restrictions, non-marketable products and post-harvest costs are some of the economic losses associated with mycotoxin contamination. Loss of animal productivity as a result of mycotoxin-contaminated feed also leads to economic losses (Ncube and Flett, 2012).

Regulatory agencies such as the European Commission have formulated guidelines for the maximum level of mycotoxins in food and feed. For example, the maximum level for fumonisins in human food is 2 mg/kg and for aflatoxins it is 0.02 mg/kg (Ncube and Flett, 2012).

A survey by the Agricultural Research Council (GCI) was conducted to determine the levels of fumonisins and aflatoxins in maize produced by subsistence farmers. Results indicated that most areas in Northern KwaZulu-Natal had high fumonisins (>2 mg/kg) and aflatoxin levels (>0.02 mg/kg) (Ncube and Flett, 2012). The high incidence of mycotoxin contamination of human food in subsistence farming systems indicates the need for awareness programmes.

Most developed countries will not allow the import of commodities containing amounts of mycotoxins above the specified limits, and therefore this has implications for trade between nations. The prevention of fungal infection of commodities is by far the most effective method of avoiding problems.

Good agricultural practices have been shown to reduce the effect of mycotoxin contamination in the field.

1. Early harvesting: reduces fungal infection of crops in the field before harvest and consequent contamination of harvested produce. It has been

reported that early harvesting and threshing of ground nuts results in lower aflatoxin levels.

2. Proper drying: quick drying of agricultural products to low moisture levels results in less favourable conditions for fungal growth and insect infestation. Maintaining low moisture levels during storage and transportation is critical to prevent infection by mycotoxic fungi.
3. Sanitation: cleaning of storage units before loading new produce has proven to reduce aflatoxin levels.
4. Storage: maintaining a good storage facility with low levels of moisture is essential.
5. Insect management: the level of insect damage influences the degree of mycotoxin contamination. Proper management of insect pests through appropriate control measures limits mycotoxin contamination.

Use of biological control agents to suppress growth of fumonisin-producing fungi has been reported. Fungal strains of *Trichoderma* have also been shown to control the pathogenic fungi.

The appropriate use of chemicals during the production phase helps in reducing the fungal infection or insect infestation of crops and consequently results in a reduction of mycotoxin contamination.

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