Mycotoxins in turkey feed: understanding the risk and the challenges

Mycotoxins are metabolic products produced by fungi which can be toxic to humans and animals. Mycotoxin-producing fungi damage crops either in the field or during storage, causing economic loss due to spoilage.

Moreover, many of the mycotoxins impair health and cause disease and death in humans or animals which consume the food or feed products containing the damaged crops.

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Currently there are more than 400 known mycotoxins, but the knowledge is limited by analytical technology and there could be many more. Those of most concern can be divided into six major categories: aflatoxins, tricothecenes, fumonisins, zearalenone, ochratoxins and ergot alkaloids. Table 1 shows some of the major mycotoxins and their effect on the tissues, and the fungi producing them.

The fungi can be divided into field fungi, which produce mycotoxins in crops before harvest, and storage fungi, which produce mycotoxins mainly after harvest. Fusarium fungi are considered to be field fungi and aspergillus and penicillium fungi are classified as storage types.

However there are exceptions where, during hot or dry conditions, aspergillus and penicillium species also affect crops during the growing season and fusarium species might also continue to produce mycotoxins during storage.

Fungal growth and mycotoxin production is affected by various conditions:

- Adequate moisture content.
- Suitable temperature.
- Sufficient oxygen.
- Physical damage of the grains.
- Presence of fungal spores.

Stress factors such as drought, poor fertilisation, high crop densities, weed competition, insect or mechanical damage at harvest, and storage conditions can affect the plant or grain's natural defences and help to promote the development of the fungal infection and lead to mycotoxin production.

Major mycotoxin producing fungi	Major mycotoxins produced	Important effects in poultry	Raw material affected
A. flavus A. parasiticus	Aflatoxins – B1, B2, G1, G2	Fatty liver, decreased bodyweight gain and impaired feed utilisation, immunosuppression	Wheat, maize, barley, sorghum, soya
A. ochraceus P. verrucosum P. viridicatum P. citrium	Ochratoxins – A Citrinin	Renal dysfunction, blood and meat spots in eggs, decreased bodyweight gain and impaired feed utilisation, immunosuppression	Barley, oats, wheat, rye
F. verticilloides F. moniliforme F. graminearium F. pseudograminearium F. culmorum F. poae	Type A Trichothecenes: T-2 toxin, HT-2 toxin, diacetoxyscirpenol Type B Trichothecenes: Nivalenol, Deoxynivalenol, Fusarenon-X, Fumonisins Zearalenone	Tongue lesions, oral/dermal toxicity, gizzard lesions, decreased bodyweight gain and impaired feed utilisation, immunosuppression	Barley, oats, wheat, rye Barley, oats, sorghum, soya, maize, wheat

Table 1. The major mycotoxins and their effects.

The occurrence of mycotoxins shows a geographical pattern; aspergillus species meet optimal conditions in tropical or subtropical regions, whereas fusarium and penicillin species are adapted to the moderate climates of North America, Europe and Asia. But worldwide trading of feedstuffs means the problems can be seen anywhere.

Mycotoxins may be present in feedstuffs despite a negative analytical result. Mycotoxins are not homogenously dispersed in feedstuffs but usually occur in hot-spots. This makes sampling difficult and the mycotoxins may stay undetected despite adequate sampling.

Mycotoxins may also be masked from analytical detection by small molecules (glycosides, glucuronides, fatty acid esters and proteins) attached to the toxin which give a false negative result in a test. However the attached molecule can be removed during digestion, releasing the mycotoxin to affect the animal.

Different species of animals show varying susceptibility to mycotoxins. Poultry are highly susceptible to T-2 toxins and moderately sensitive to aflatoxins and ochratoxins. However within poultry species chickens are less sensitive to aflatoxins than turkeys and geese, but in most cases the younger the birds, the more susceptible they are.

The effects of mycotoxins on poultry have usually been studied by adding graded levels of one of the toxins to the feed. However in field conditions there may be several mycotoxins present in a feedingstuff at the same time because plants may have been affected by more than one fungus.

The combination of multiple mycotoxins in the feed can cause more adverse affects than a single mycotoxin due to additive or synergistic interactions. For instance aflatoxin acts synergistically with T-2 toxin and other Fusarium toxins to generate a more severe response in the animal than would be anticipated based on the levels of each.

Once a mycotoxin is present in a feedstuff it cannot be easily removed. Apart from high temperature ammoniating there are few chemical treatments that can destroy a mycotoxin. So the approach used to minimise the effects of mycotoxins is to try and mop up the mycotoxin by binding it to an inert substrate or to try and deactivate it.

The absorption technique uses compounds that bind to the toxin during the digestive process in the gut resulting in a reduction of the toxin's ability to be absorbed into the bloodstream. Effective binding depends on the chemical structure of the mycotoxins and only a few toxins can be deactivated in this way. Aflatoxins, fumonisin and ergot alkaloids can be bound effectively but zearalenones and tricothecenes can not.

Biological detoxification or biotransformation uses enzymes to deactivate the mycotoxin directly during the digestive process. As specific enzymes are needed for each mycotoxin the successful application of this technique will depend on the use of the correct product to achieve control of the toxins present.

Several mycotoxin binders are available to be added to poultry feeds with varying claims of efficacy, but to gain the most cost-effective response it is necessary to understand the challenge in the feed by analysing the mycotoxin levels in the feedingstuffs and then selecting the correct binder with the right activities to act against the challenge identified.

The manufacturers of these products should be able to advise on the suitability of their products and the levels that should be used. ■