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Mycotoxins

Technical Bulletin

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The term mycotoxin is derived from the Greek word “Mykes” meaning mold and the Latin word “Toxicum” meaning toxic. Mycotoxins are toxic compounds produced from various *Genera* of microfungi affecting most grain crops, some fruits, vegetables and herbs, and some nuts and legumes. Molds producing mycotoxins include *Aspergillus*, *Pencillium*, *Fusarium*, and *Alternaria*. These molds are capable of producing Aflatoxins, *Fusarium* toxins, *Trichothecenes*, *Patulins*, *Ochratoxins* and *Zearalenone*. Many of the mycotoxins have adverse effects on humans and animals that consume mold infected foods.

Aflatoxins, produced mainly by *Aspergillus*, are considered carcinogenic and primarily affect the liver. This fungus infects many of our food crops such as nuts, grains and culinary herbs. Of primary economic concern are infestations that occur in corn and peanuts. Four related compounds are produced, i.e. aflatoxins B1, B2, G1, and G2. Aflatoxin (M1) can also be found in milk, and milk products. This occurs when ingested aflatoxin B1 from contaminated feed is metabolized into M1. Another mycotoxin family produced by *Aspergillus*, as well as by *Pencillium*, are the *Ochratoxins*. *Ochratoxin A* is primarily considered to be a nephrotoxin, but has also been shown to affect the liver. After ingestion of infected food, *ochratoxin* can persist in tissue for many years.

Fusarium fungi are capable of producing a wide variety of related mycotoxins-known as *Trichothecenes*. T-2 toxins, *nivalenol* and *deoxynivalenol* are *trichothecenes*. *Fusarium* fungus is widespread, infecting crops worldwide. The most widespread toxin produced is *Deoxynivalenol*, also known as DON or vomitoxin. Swine are probably the most sensitive to this mycotoxin. The toxin can cause intestinal disorders and emesis. *Fusarium* fungi are also capable of producing other mycotoxins, primarily by infecting maize crops, namely *Fumonisin*s and *Zearalenone*. *Zearalenone* can be produced by the same *fusarium* fungi which produce *Deoxynivalenol*. The toxin is known to affect the reproductive system causing hyperoestrogenism in female pigs. *Fumonisin*s are considered to be hepatotoxic.

ASSAY PRINCIPAL AND APPLICABILITY

The mycotoxins are extracted using a suitable solvent combination. Extracts are then filtered, followed by a clean-up step. A variety of different column packings are used for clean-up, depending on the mycotoxin to be purified and the matrix involved. The purified mycotoxin is then, in most cases, derivitized to enhance detection response. The sample is then injected onto a high pressure liquid chromatograph (HPLC) and detected using fluorescence or UV/Vis absorption. The fluorescence or absorptive response of the mycotoxins in the sample is compared to that of a standard of known concentration.

Reporting Units – Specific mycotoxin/matrix dependant, see levels in grains.

Information Required - The specific mycotoxin and matrix to be analyzed.

Sampling- Measurements: 1 pound = approximately 14,000 kernels of wheat; 1 part per million = 1 kernel from 71 pounds of wheat; 1 part per billion = 1 kernel from 71,000 pounds of wheat. Therefore correct sampling is critical for accurate results.

HPLC (quantitative)

Detection Limit – Matrix dependent, below are typical levels in grains

Aflatoxins (B1)	500 picograms/gram (ppt)
Ochratoxin (B1)	300 picograms/gram (ppt)
Deoxynivalenol	100 nanograms/gram (ppb)
Fumonsins (FB1)	250 nanograms/gram (ppb)

ELISA (Enzyme Linked Immunoassay)

Detection Limit – Matrix dependent, below are typical levels in grains

Aflatoxins (all)	5 nanograms/gram (ppb)
Ochratoxin (all)	10 nanaograms/gram (ppb)

ADDITIONAL INFORMATION

Aflatoxins are the only mycotoxin with regulatory set levels at this time. The limit is 20 parts per billion total aflatoxins in foods for human consumption.

Guidelines for the other mycotoxins are:

- Deoxynivalenol 1.0 parts per million (ug/gm)
- Ochratoxin 10.0 parts per billion (ng/gm), (may be lowered).
- Fumonisin 2.0 parts per million (ug/gm), (may be lowered).
- Zearalenone 10.0 parts per million (ug/gm)

A mycotoxin infestation is normally quite sporadic. There are, in a given field, “hot spots”. Hot spots are localized fungal infestations capable of producing mycotoxins. These would include the fungi capable of producing Deoxynivalenol, Zearalenone and Aflatoxins. Fumonisin and Ochratoxin are, in general, evenly distributed throughout a field. In general higher water activities and higher relative humidities favor the fungi capable of producing the various mycotoxins. Some mycotoxins favor warmer temperatures, while others favor cooler temperatures. All are opportunistic and favor damage from drought, insects and storms. Mycotoxins are relatively stable and may survive most processing operations.

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