Mycotoxins

Mycotoxins can occur in both tropical areas and temperate regions of the world. Major food commodities affected include cereals, nuts, oil seeds and fruit. Mycotoxin production is foremost a food safety issue, although the occurrence of moulds can also lead to damage ranging from rancidity, odour, flavour changes, loss of nutrients and germ layer destruction resulting in quality reduction of commodities.

Mycotoxins are produced by one or more very specific fungal or mould species. In some cases one species can form more than one mycotoxin. It is important to remember that the presence of a toxin-producing mould does not automatically imply the presence of the associated toxin as many factors influence the production of mycotoxins. Mycotoxins are often produced when the mould is under stress, for example, when the temperature, water activity or amount of oxygen becomes less favourable. In general, the minimum water activity for growth is lower than the minimum for mycotoxin production. Conversely, the absence of any visible mould does not guarantee that no toxins are present as the mould may have already died out while leaving the toxin intact.

Mycotoxin-producing moulds are generally divided into field and storage moulds. Field mould primarily occur pre-harvest in the field and storage mould post-harvest during storage. Any crop that is stored for more than a few days is a target for mould growth and mycotoxin formation.

Moulds tend to develop in isolated pockets in stored commodities. This results in a very uneven distribution of the mould and any associated mycotoxin within a consignment. Correct sampling procedures to ensure a truly representative sample of the whole consignment is therefore vital. Most mycotoxins are toxic in very low concentrations, requiring sensitive and reliable methods for their detection. Failure to achieve satisfactory sampling and analysis performance can lead to unacceptable consignments being accepted or satisfactory loads being unnecessarily rejected.

Most mycotoxins are chemically stable and tend to survive storage and processing even when cooked to quite high temperatures as reached during baking bread or producing breakfast cereals. The difficulty of removing a mycotoxin once produced means that the best method of control is prevention.

Mould growth in the field can be limited by amongst other planting resistant cultivars, correct planting density, weed control and control of insect and pest damage. Other control methods include harvesting at the correct time, rapid drying of the grain, avoiding rewetting and controlling insects during storage to reduce the risk of mould growth. Milling will also reduce the level of contamination by removal of the outer layers of affected kernels. This milling fraction will by comparison contain much higher levels of contamination and most probably cannot be used for animal feed. [(1)]

In a BIOMIN survey conducted from January to December 2013, 4 218 samples different grain and grain products were collected worldwide and analysed for the presence of mycotoxins. Aflatoxin (Afla) was present in 30%, Zearalenone (ZEN) in 37%, Deoxynivalenol (DON) in 59%, Fumonisin (FUM) in 55% and Ochratoxin A (OTA) in 23% of these samples. Of the samples from South Africa, 10% tested positive for DON, 92% for FUM and 3% for OTA. No samples tested positive for Afla or ZEN. The most frequent occurring mycotoxins were the field mould produced mycotoxins such as DON, FUM and ZEN. Other findings included the observations that more than half of all the worldwide samples analysed for the survey contained DON and FUM and that more than one myctoxin was detected in half of the samples.

Constant monitoring and continued research on the preventation and mitigation of mycotoxin contamination are necessary. Application of good agricultural practices and storage conditions as well as effective mycotoxin risk management programs are essential elements in preventing the negative effects of mycotoxins. [(2)]

SAGL implements a multi-mycotoxin screening method using UPLC-MS/MS. With this technique simultaneous quantification and confirmation of Aflatoxin G_1; B_1; G_2; B_2, Fumonisin B_1; B_2; B_3, Deoxynivalenol, 15-ADON, HT-2 Toxin, T-2 Toxin, Zearalenone and Ochratoxin A are possible in one run.

Forty samples (representing different regions as well as different classes and grades) were randomly selected for mycotoxin analyses. Only one of these forty samples selected, tested positive for mycotoxin residues, deoxynivalenol (DON) to be specific with a level of 151 µg/kg.

This level is well below the maximum level prescribed internationally.

The **European Union** specifies the following maximum levels for mycotoxins on cereals and specifically wheat:

Aflatoxins
- All cereals and all produts derived from cereals, including processed cereal products, with the exception of maize, rice, processed cereal-based foods for infants and young children and dietary foods for special medical purposes intended specifically for infants, $B_1 \leq 2.0$ µg/kg.
- All cereals and all products derived from cereals, including processed cereal products, with the exception of maize, rice, processed cereal-based foods for infants and young children and dietary foods for special medical purposes intended specifically for infants, sum of $B_1 + B_2 + G_1 + G_2 \leq 4.0$ µg/kg.

Ochratoxin A
- Unprocessed cereals, ≤ 5.0 µg/kg.
- All products derived from unprocessed cereals, including processed cereal products and cereals intended for direct human consumption, ≤ 3.0 µg/kg.

Deoxynivalenol
- Unprocessed cereals other than durum wheat, oats and maize, ≤ 1250 µg/kg.
- Cereals intended for direct human consumption, cereal flour, bran and germ as end product marketed for direct human consumption, with the certain exceptions (see full regulation) ≤ 750 µg/kg.
- Bread (including small bakery wares), pastries, biscuits, cereal snacks and breakfast cereals, ≤ 500 µg/kg.

Zearalenone
- Unprocessed cereals other than maize ≤ 100 µg/kg.
- Cereals intended for direct human consumption, cereal flour, bran and germ as end product marketed for direct human consumption and the germ with the certain exceptions (see full regulation) ≤ 75 µg/kg.
- Bread (including small bakery wares), pastries, biscuits, cereal snacks and breakfast cereals, excluding maize-snacks and maize-based breakfast cereals, ≤ 50 µg/kg. [3]

T-2 and HT-2 toxin
- Unprocessed cereal – wheat, rye and other cereal, indicative level 100 µg/kg.
- Cereal grains for direct human consumption – cereals other than oats and maize, indicative level 50 µg/kg.
- Cereal products for human consumption – cereal milling products other than oat and maiz, indicative level 50 µg/kg.
- Cereal products for human consumption – breakfast cereals including formed cereal flakes, indicative level 75 µg/kg.
- Cereal products for human consumption – bread (including small bakery wares), pastries, biscuits, cereal snacks, pasta, indicative level 25 µg/kg.
- Cereal products for human consumption – cereal-based foods for infants and young children, indicative level 15 µg/kg. [4]

In the **USA**, the Food and Drug Administration (FDA) actions levels for **Aflatoxin** for all commodities intended for human consumption is 20 µg/kg (excluding Aflatoxin M1 in milk where the maximum level is 0.5 µg/kg). Advisory maximum levels for **DON** in finished wheat products intended for human consumption is 1 000 µg/kg. [5]

References:
1) Fact sheets available from the European Mycotoxin Awareness Network website. www.mycotoxins.org.
2) BIOMIN Mycotoxin Survey 2013. www.biomin.net.
3) COMMISSION REGULATION (EC) No 1881/226 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs.
4) COMMISSION RECOMMENDATION of 27 March 2013 on the presence of T-2 and HT-2 toxin in cereals and cereal products.
5) FDA Mycotoxin Regulatory Guidance, A Guide for Grain Elevators, Feed Manufacturers, Grain Processors and Exporters, August 2011.