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 produce 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 so this requires 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)]

Results obtained with comprehensive mycotoxin surveys, such as the worldwide annual survey conducted by Biomin are useful to answer questions such as how severe is the mycotoxin contamination in different commodities, what is the situation worldwide and in different regions and which mycotoxins and concentration levels occurred. The Biomin survey report for 2014 covers 6 844 agricultural commodity samples from 64 countries. Samples of primary components used for animal feed including maize, wheat, soybean meal, dried distillers grains, silage, etc. were tested for Aflatoxins (Afla), Zearalenone (ZON), Deoxynivalenol (DON), T-2 toxin, Fumonisins (FUM) and Ochratoxin A (OTA).

Of the African samples tested, 78% tested positive for ZON, 69% for DON, 67% for FUM, 15% for Afla, 8% for OTA and 2% for T-2 toxin. Globally, DON poses the most frequent threat to livestock and were found in more than half of the samples tested, with 82% of the samples containing DON levels exceeding the risk thresholds for livestock. FUM and ZON are also causes for concern with 50% of the samples exceeding risk threshold levels. The average concentrations of DON and ZON nearly doubled compared to 2013. Altough the prevalence of several mycotoxins in wheat were not notably high, the average concentrations of Afla, ZON, DON and T-2 in wheat samples all exceeded risk threshold levels. The average of the positive results on 592 wheat samples was 860 µg/kg (ppb) with the highest level tested 28 864 µg/kg.

The Biomin report for the first time also highlighted the co-occurence of myctoxins. Of 814 samples tested, all contained multiple metabolites, ranging from a low of four metabolites to a high of 75 metabolites. [(2)]

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 is essential elements in preventing the negative effects of mycotoxins.

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 with certain exceptions (see full regulation), ≤ 3.0 µg/kg.

Deoxynivalenol
- Unprocessed cereals other than durum wheat, oats and maize, ≤ 1 250 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 maize, 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 M_1 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]

In **China** the maximum level for Aflatoxin B_1 in wheat is 5.0 µg/kg. The maximum level for DON in cereals and their product including wheat and wheatmeal is 1 000 µg/kg. Ochratoxin A in cereals and processed products of milled grains may not exceed 5.0 µg/kg and Zearalenone in wheat flour may not exceed 60 µg/kg. [6]

According to **Codex**, Ochratoxin A in raw wheat may not exceed 5 µg/kg and the proposed maximum level for DON is 2 mg/kg in raw wheat and 1 mg/kg in flour, semolina, meal and flakes derived from wheat. [7]

References:

1. Fact sheets available from the European Mycotoxin Awareness Network website. www.mycotoxins.org.
2. BIOMIN Mycotoxin Annual Report 2014. 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.
6. National Food Safety Standard, Maximum Levels of Mycotoxins in Foods, GB 2761-2011.
7. CODEX General Standard for contaminants and toxins in food and feed, CODEX STAN 193-1995, Revised in 1997, 2006, 2008, 2009, Amended 2009.