Mycotoxins – an everlasting problem in poultry nutrition

Mycotoxins are toxic substances produced by naturally occurring metabolic processes in fungi. Mycotoxins can invade the seeds before the actual harvest whilst the crop is still on the field, or alternatively, mould growth can occur during storage at the feed mill or on the farm. As a result, high numbers of mycotoxins could already be present in the ingredients before they are received in feed mills or farms.

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Maize field devastated by drought in the summer of 2015.

Mould can also grow during feed processing especially when the temperature and humidity in the feed is increased during mixing. Finally, mould growth and mycotoxin production can also occur at the farm level from improperly cleaned silos, transport systems and feeders.

The production of mycotoxins is enhanced by factors such as the moisture of the substrate (10-20%), the relative humidity (≥70%), the temperature (0-50°C, depending on the fungus species) and the availability of oxygen.

The most important role of feed mills is to keep the levels of mycotoxins as low as possible, while multi-mycotoxin contamination should be also avoided. Most of the mycotoxins occur concurrently and a commodity usually contains more than one mycotoxin at the same time.

Uncertain mycotoxin situation in 2015 led Nutriad to conduct several surveys in different European countries (UK and Ireland, Poland, Spain). Each survey was conducted on 60-70 samples of wheat or maize. The Spanish Nutriad Mycotoxin Survey covers 60 locally produced maize samples from across Spain.

Insight into contamination

More than 400 analysis were conducted to test for the occurrence of the seven mycotoxins most frequently found in agricultural commodities intended for animal feed production.

The survey provided an insight into the incidences of aflatoxins (Afla), zearalenone (ZEN), deoxynivalenol (DON), T-2 toxin, fumonisin B1 (FB1), fumonisins B2 (FB2) and ochratoxin A (OTA) across all regions of Spain.

The 60 samples were collected either directly from the farms or from animal feed production sites immediately after the harvest.

The results from the survey showed that 55% of the maize samples were contaminated with DON and 11% with AfB1.

Only 1.6% of the samples contained T-2 toxin. The majority of wheat samples were contaminated with FB1 (90%) and FB2 (80%).

Most of the recovered mycotoxins were in concentrations regarded as medium (›LOD but below EU recommendation levels), while the highest concentration of DON and FB1 found reached 6500µg/kg and 11500µg/kg respectively.

Interestingly, 31.6% of the samples contained zearalenone, a mycotoxin which affects reproductive performance in breeding animals. Its maximum concentration reached 990µg/kg, a significant level.

As expected, only a few samples were contaminated with OTA, a known typical storage mycotoxin. One sample of maize exceeded the maximum EU permitted concentration of aflatoxin B1 (20.2µg/kg) (Commission Regulation (EU) No 574/2011).

Mycotoxin concentrations such as those found during the Spanish maize survey 2015 may cause various toxic effects or mycotoxicosis in poultry.

Symptoms caused by mycotoxin contamination depend not only on the level and type of mycotoxin, but also on several factors such as animal species, sex, environment, nutritional and health status and other toxic entities. However, mycotoxin contamination is not transmissible between animals and contaminated feed is the likely cause.

Diagnosis of mycotoxicosis is often very difficult because the effects of mycotoxins in animals are diverse, varying from specific to unspecific symptoms like immune suppression, diarrhoea, haemorrhages or reduced performance.

Prevention is always better than treatment

The best practical way to control mycotoxin levels is to use rapid test kit systems for the analysis of mycotoxins in raw ingredients, which are not yet placed in silos.

Different rapid test kit systems are validated for different mycotoxins and

Continued on page 41

Continued from page 39
commodities and offer a very quick and effective way of raw material screening before they enter the feed mill.

Once the levels are known, every feed mill can estimate the quality of its raw ingredients in terms of mycotoxin contamination and can effectively and more precisely (dosage adjustment) apply mycotoxin deactivator during feed production.

Another strategy of mycotoxin risk management is to test for the presence of mycotoxins in finished feeds. This method has some advantages and disadvantages.

The most important advantage is that as every raw ingredient can bring its own mycotoxins into the finished feed and by only testing some raw ingredients by rapid test kits, some important raw ingredients whose inclusion is not high (5-10%) and which can still cause significant contamination of finished feed can be missed.

	AfB1	DON	ZEN	FB1	FB2	T2-toxin	OTA
Number of tests	60	60	60	60	60	60	60
% of positive	11	55	31.6	90	80	1.6	3.3
Average of positive (µg/kg)	18.3	823.4	104.7	1,840.37	495.70	8.04	1.7
Maximum (µg/kg)	20.2	6,500	990	11,500	5,280	8.04	1.93

Table 1. Mycotoxin contamination of maize harvested in 2015 in Spain.

Since the 1960s, many analytical methods have been developed for the testing of mycotoxins in human food and animal feeds due to the concern of toxicity for human health.

Among them, the methods of thin-layer-chromatography (TLC), enzyme-linked immunosorbent assay (ELISA) and immunosensor-based methods have been widely used for rapid screening, while high-performance liquid chromatography (HPLC) with fluorescence detection (FD) and mass spectrometry detection (MS) have been used as confirmatory and reference. An accredited laboratory service is required for this step.

The most important disadvantage is that analysis of finished feed takes quite a long time such that the tested feed is likely to have been fed to the animals by the time the results from the analysis are known.

Storage mycotoxin contamination (ochratoxins, aflatoxins) can be prevented by keeping temperature and moisture content in silos low, whilst grain is regularly aerated. In case perfect storage conditions cannot be guaranteed, the use of a mould inhibitor is highly recommended.

Conclusion

The last but very effective step in mycotoxin management is the application of a mycotoxin deactivator. These products work strictly in vivo and will not counteract or mask mycotoxin in stored feed or raw ingredients.

It is highly recommended to apply an effective mycotoxin deactivator which offers an opportunity to significantly improve animal health, performance, productivity and profit impaired by mycotoxins.

Depending on the target performance different mycotoxins can be more or less problematic. Therefore, using different products for different animal groups is becoming a rational trend. ■

References are available from the author on request