Managing mycotoxins – controlling the hidden threat that impacts bottom line

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The prevalence of mycotoxin contamination in poultry feedstuffs is now well documented. Three types (genera) of fungi are the major producers of mycotoxins: fusarium, pencillium and aspergillus. Within each type of fungus, particular species may be mycotoxigenic, or mycotoxin-producing.

Animal toxicity

While hundreds of mycotoxins have been identified from a very large number of fungi, about 20-30 mycotoxins have been associated with potential animal toxicity. In this report, mycotoxins of relevance to the poultry industry including aflatoxins, cyclopiazonic acid (CPA), ochratoxins, and fusarium toxins such as deoxynivalenol (DON), trichothecenes and zearalenone are presented.

Also presented, are the impacts of both single and multiple mycotoxin contamination on productive performance (losses in growth or FCR) and descriptions of the symptoms displayed by affected flocks (increased mortality and poor disease resistance), as well as the value of in-feed mycotoxin binders.

Mycotoxin contamination occurs in standing crops, at harvest, during storage, in the feed mill and in finished feed in all types of climates. Surveys from several regions have demonstrated the widespread nature of fungal contamination and the presence of toxins.

Data from Belgium (2009), where common feed materials were tested, showed that 35% were positive for zearalenone (>25 ppb) and 72% were positive for DON (>100 ppb).

Lesions of the beak and mouth due to trichothecenes.

Wheat and barley had the highest levels of risk. Asian surveys from 2006 and 2007 found multiple mycotoxin contamination in feed.

Table 1 shows the results from a survey in Spain (2008) where feedstuffs tested positive (in terms of clinical significance) for zearalenone, DON and T-2 toxins (> 25ppb).

From these surveys it can clearly be seen that the risk of exposure to mycotoxins exists across climatic regions.

This needs to be negated if productive performance is to be maintained and improved. But what impact do these toxins really have on poultry production?

Multiple symptoms

The main problem with mycotoxicosis in animals is that they cause multiple symptoms that can be difficult to quantify and diagnose.

General indicators of mycotoxicosis include poor performance, organ damage and compromised immunity.

Any losses in FCR can be attributed to these impacts, leading to increased costs of production and, in some countries, penalties relating to poor welfare or disease.

Specific toxins from certain fungi are likely to lead to specific, as well as generalised, symptoms (for example beak lesions) that are related to a specific toxin, but in general, multiple symptoms are the norm.

Table 1. Positive samples found in a Spanish survey (2008).

Mycotoxin	No. samples	Positive (%)	Average (ppb)
Zearalenone	798	95	253
DON	876	78	143
T-2	804	68	89

Aflatoxins

Aflatoxins are found in feed materials grown in warm and humid climates and mainly affect the liver, resulting in fatty livers, hepatocyte degeneration, necrosis, and altered liver function.

The resulting decline in liver protein synthesis causes growth suppression in poultry and can interfere with the activity of vitamin D, leading to rickets.

Reduced calcium deposition in bone is seen with aflatoxicosis (as reduced tibial ash), and ingestion of as little as 1ppm reduces circulating P and calcium levels. Iron and copper metabolism can also be negatively impacted.

Aflatoxins may reduce bile salt production, disrupting fat digestion and uptake of fat soluble nutrients, including vitamins, antioxidants and pigments. Pale meat or yolk colour is a marketing problem for certain markets. Aflatoxin affects the robustness of blood vessels, which leads to increased bruising and more downgrades at slaughter.

These effects in combination lead to poor feed intake, reduced growth and poorer FCR.

The toxin cyclopiazonic acid (CPA) is associated more with problems in turkeys and layers, but may also reduce leg strength in poultry by changing the Ca profile of bone, leading to increased culls and downgrades.

Ochratoxins are generated in badly stored feedstuffs and are typically found in all feedstuff-producing countries; with ochratoxin A being the most widespread.

The main impact in poultry is kidney damage (nephrotoxicity), which is manifested as pale and enlarged kidneys.

In cases of acute exposure, renal failure increases mortality in growing flocks. For young broiler chicks, ochratoxin A is much more toxic than aflatoxin, and has been implicated in significant field outbreaks of mycotoxicosis.

Bone strength may be compromised, as Raju and Devegowda (2000) found reduced tibial bone ash in broilers fed 2mg/kg ochratoxin in feed.

This may be due to poor protein, enzyme, and Ca and P serum concentrations caused by the toxin. Other research has implicated ochratoxin with problems in layer performance.

Trichothecenes

Trichothecenes are a diverse range of toxins commonly found on cereals used in poultry diets. These toxins are irritants associated with oral lesions, poor feed intake, dermatitis and intestinal irritation, which affects the activity of the gut and, hence, growth.

Poultry are most sensitive to T-2 toxin and DAS trichothecenes, which are strong immuno-suppressive agents, as they have a direct impact on immune and lymphatic tissues and the production of immune cells.

Fusarium contamination is ubiquitous in cereals, and produces multiple mycotoxins.

Daley et al., (2005) showed that feeding contaminated grain to growing broilers significantly decreased productive performance ($P<0.01$) and organ (liver and bursa) weights ($P<0.05$). However, the inclusion of the commercial binder Mycosorb at 0.2% in the diet reversed this (see Table 2).

Using 21 day old turkeys fed naturally contaminated diets containing

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Fusarium, Girish et al., 2008 reported significantly poorer weight gains between days 28-42 (P=0.02) and days 42-63 (P=0.01), and significantly reduced immune parameters.

As a response, bursal weights were highest (P=0.03) in the treatment group.

These effects were mitigated by inclusion of the adsorbent Mycosorb in the contaminated diet.

Parameter	Uncontaminated control	Fusarium	Fusarium + Mycosorb	P value mycotoxin
Body weight (kg)	0.784[a]	0.680[b]	0.728	<0.01
Feed intake (kg)	1.024[a]	0.963[b]	0.993	<0.01
FCR	1.31[b]	1.42[a]	1.36	<0.01
Bursal weight (g)	5.05[b]	6.07[a]	6.00	0.05
Liver weight (g)	37.0[b]	48.0[a]	41.5	<0.01

Table 2. Effect of feeding naturally contaminated fusarium grain on 1-24 day broiler performance and organ weight (Daley et al., 2005).

Egg production

Laying hens fed fusarium contaminated feed have reduced feed intakes and poorer FCR. Trials have shown that egg production was significantly reduced (P=0.0002) from 95 to 81% after four weeks of receiving the contaminated feed, and remained significantly lower until week eight, coupled with lower egg mass.

Breeder flocks are affected by fusarium, which causes decreased shell thickness and increased early embryo mortality. Research using broiler breeder pullets infected with coccidiosis and exposed to fusarium, highlighted problems in gut functionality and poor villous structure and density in the major site of absorption – the duodenum.

Lastly, the fusarium fusarochromanone (FCH) toxin is known to cause bone abnormalities in growing broilers, leading to increased tibial dyschondroplasia in flocks where dietary levels exceed 20mg/kg.

This is an important economic consideration in terms of culls and downgrades.

Controlling mycotoxins

Even though there are several pieces of legislation and guidance documents aiming to control mycotoxins, it is very difficult to ensure that poultry feed is free from contamination.

This is partly due to the fact that in storage, mycotoxins may occur in particular 'hot' spots in the bulk stored material and they usually occur in a non-uniform distribution.

As a result obtaining a representative sample for analysis is very difficult. Sampling of bulk material therefore involves taking numerous samples throughout the material, at various locations and depths, according to a specified protocol.

The individual (or incremental) samples are composited and this composite (or aggregate) sample is mixed by grinding and blending followed by sub-sampling to obtain a sample for analysis.

The minimum sample size required to be representative overall, depends on the size of the lot to be sampled, the homogeneity and the size of the individual particles or components contained in it.

Even with strict controls in place, the Food and Agriculture Organization (FAO) estimates that 25% of the world's food crops, overall, are affected by mycotoxins.

Having considered how each class of mycotoxins can cause general or specific problems, it is important to remember that most feedstuffs carry multiple fungal contaminants.

Toxins act in synergy, exacerbate the symptoms in the animal, and contribute significantly to performance losses and/or increased costs of production.

Difficult to diagnose

Multiple contamination makes diagnosing mycotoxicosis even more difficult. The only way to ensure that the risk to flocks is minimised is to routinely employ a proven, broad spectrum mycotoxin binder to the feed. Research has shown that the application of Mycosorb ameliorates the negative effects of a broad range of toxins. Even when feeds appear to be free of contamination, benefits have still been observed in improved performance when Mycosorb has been used, highlighting the truly hidden danger of mycotoxins to poultry performance. ■

References are available from the author upon request