Impact of mycotoxins on efficiency and profitability of poultry operations

Mycotoxins are an increasingly recognised worldwide problem, with a moderate to high economic impact in poultry production. Climate change, advances in agriculture practices and soil use are expected to change the occurrence and prevalence patterns of mycotoxins throughout Europe.

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Mycotoxins are often found in feed ingredients as secondary metabolites produced by moulds during their life span. Under field conditions, biological effects of co-occurring mycotoxins are more likely to appear than a single mycotoxicosis, as many mycotoxigenic fungi grow and produce their toxic metabolites under similar conditions. In addition, compound animal feeds are comprised of several grain sources, which may be contaminated by different mycotoxins and are potentially imported from regions other than Europe.

Mycotoxins can be synergistic, additive or cause dissimilar pathologies according to the specific toxin structure, leading to difficulties in diagnosis due to the multiple symptoms shown in affected birds.

While the European Commission has set maximum levels or guidance values for the individual mycotoxins, an additional comprehensive database on the hazards associated with each mycotoxin has been carried out by Alltech via an ultra performance liquid chromatography coupled to tandem mass spectrometry (UPLC-MS/MS) technique to evaluate the risk of up to 37 mycotoxins and their co-occurrence in the 2015 crop in Europe to provide an earlier detection of the risk of the 2015 crop in poultry diets.

European 2015 crop

In 2015, large areas of Europe have been negatively impacted by high temperatures and dry conditions, hitting summer crops during their most critical grain-filling stage.

In southern Spain, the already weak development of summer crops has been further impacted by very high temperatures. In Italy, grain yield expectations were further reduced due to the latest heat wave at the beginning of August.

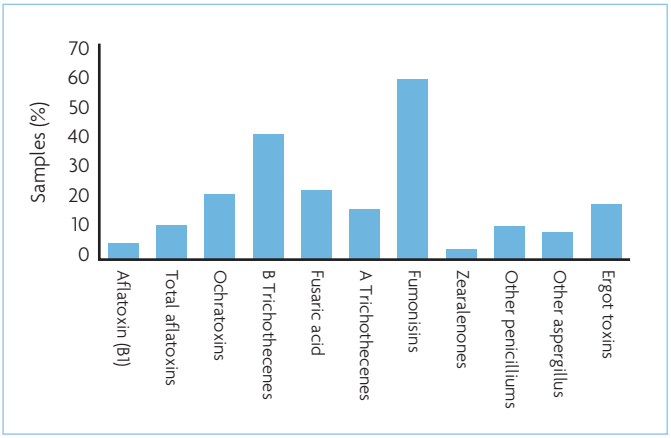
Record temperatures and critically low soil moisture levels led to grave situations in eastern France and southern Germany as well as Poland, which have been affected by the hot and dry conditions.

The combined effect of persistently high temperatures since mid-August and the absence of relevant precipitation also impacted the grain formation of maize in the Czech Republic, northern Austria, Slovakia, Hungary, Romania and Bulgaria.

The winter cereals yield has improved toward the end of the growing season thanks to favourable weather conditions in northern parts of Europe.

Rain pre-harvest has led to a partial recovery of crop conditions in the affected countries, while in Eastern Europe abundant rainfall has delayed harvest of cereals and the potential increase of storage-driven challenges due to high humidity in grains after harvest.

Fig. 1. Occurrence of mycotoxin groups (n = 174).



Mycotoxin management

As a fundamental part of Alltech's diagnostic and remediation strategy, the objective of the Alltech Mycotoxin Management Program is to develop a database to evaluate 2015 European grains and other complex feed matrices for multiple mycotoxins, using UPLC-MS/MS methodology developed at Alltech's global research headquarters in Lexington, Kentucky, USA.

The methodological advances using UPLC-MS/MS can account for mycotoxin group presence simultaneously in a more selective and sensitive way with a higher degree of accuracy and repeatability.

The mycotoxin levels found are then assessed to build the practical risk equivalent quantity (REQ) concentration to help diagnose the total risk that can impact animal performance impairment.

Impact of the European 2015 crop on poultry diets

Fumonisins, Type A Trichothecenes such as T2/HT-2 and Type B Trichothecenes such as deoxynivalenol, have been found to be the most prevalent mycotoxin groups in the European 2015 crops.

These mycotoxins can have a variety of impactful effects on poultry:

- **Gastrointestinal damage:** Reductions in cellular protein synthesis can cause lesions of the gastrointestinal tract, resulting in necrosis, gizzard erosion, haemorrhaging and malabsorption of nutrients. Reduced hepatic protein synthesis can decrease utilisation of dietary amino acids, resulting in increased uric acid synthesis as amino acids are oxidised for energy purposes. Visually, birds may have a lower feed intake or altered feed efficiency, as well as watery faeces with poorly digested feed particles.
- **Immune suppression:** This results in increased susceptibility to disease, lingering health problems in the flock and possible failure of vaccination programmes. Gastrointestinal pathogens, such as clostridium, may proliferate due to gut damage and decreased epithelial integrity. The suppressed immune system can no longer manage these pathogens and diseases;

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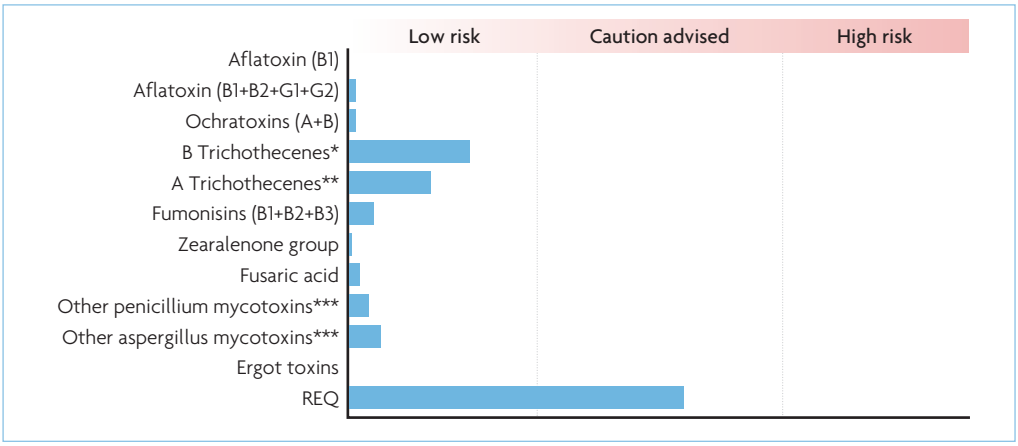

Fig. 2. Mycotoxin risk assessment for performance impairment on poultry broilers (2015 EU harvest).

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therefore, symptoms such as necrotic enteritis develop.

However, disease symptoms arising from immune-suppression are not symptoms of direct mycotoxin exposure. They are, however, indirectly caused by mycotoxins, and this confirms the difficulty in identifying mycotoxins as the causative agent of reduced flock health.

● **Brain neurochemistry:** Combinations of Fusarium mycotoxins are pharmacologically active. This means they have drug-like properties due to their effects on brain neurochemistry. The most reproducible effects observed are elevations in brain regional concentrations of serotonin. Such changes alter behaviour including reductions in feed intake, loss of muscle coordination and increased lethargy.

● **Reduced growth and breeding performance:** Mycotoxins can have an impact on reduced growth in the grower phase, which may be due to the above mentioned internal impacts such as lower feed intake, intestinal damages, elevations in blood uric acid and immune suppression. Type A Trichothecenes and Type B Trichothecenes, detected in the 2015 crops, can also lower egg production of layers and breeders. Breeders can also have significantly reduced hatchability rates due to reduced shell thickness and lower embryonic survival.

● **Impacts on poultry profitability:** The impact of mycotoxins on poultry can result in changes to growth and production levels; profitability may also be altered. Based on a meta-analysis of scientific literature conducted by Alltech, the link between mycotoxin risk and performance or profitability changes can be estimated.

Although the average mycotoxin risk level from 2015 European grains was lower for broilers, bird profitability can certainly still be impacted when mycotoxins are consumed chronically. Daily gain may be reduced by 3.5g per bird per day, resulting in a reduction of 0.1kg in carcase weight per bird.

Additionally, feed conversion rate (FCR) may increase by approximately 5% resulting in an extra 2.5 days to reach desired market weight.

With this loss in performance, the reduction in carcase profit per broilers is an estimated decrease of €0.17 per bird.

For layers, there can also be an impact on profitability due to changes in egg production. Over a 55 week production phase, layers may have reduced egg production by 3.5 eggs per hen.

Eggs may also be lighter in weight, on average by 0.3g per egg at the current mycotoxin risk level from the 2015 European crops.

The impact on egg production subsequently impacts profitability, resulting in an average loss of €0.38 per hen.

Based on the scientific literature and the current mycotoxin risk levels in grains, these predicted impacts on poultry clearly show that even lower levels of mycotoxins can impact performance and profitability when birds chronically consume contaminated grains.

Alltech's MIKO Program

To prevent further mycotoxin development, a systematic program, which is based on HACCP principles, called Alltech MIKO, has been developed by Alltech.

The objective of this program is to identify mycotoxin critical control points through the feed production chain, focusing on incoming raw materials, processing and storage to prevent negative effects of mycotoxins on bird health and performance.

The critical control points (CCPs) for mould growth and mycotoxin production are identified and appropriate preventative measures are put in place. Monitoring procedures for these control measures are designated for the specific farm situation, addressing appropriate corrective actions.

Conclusions

It can be concluded that poultry are sensitive to combinations of mycotoxins and the feeding of contaminated materials should be minimised.

The frequency of mycotoxin contamination of poultry feeds has become increasingly important in Europe due to the changes in the weather patterns pre-harvest and agricultural practices.

Additionally, the complex nature of contemporary poultry rations, including the increasing use of by-products such as distillers' dried grains, adds to the possibility of toxicological synergy between combinations of mycotoxins, increasing the severity of the response of poultry to contaminated feeds.

While the use of an appropriate mycotoxin adsorbent is likely the best preventive and remediation strategy available for minimising the adverse effects of mycotoxins in poultry feeds, Alltech has focused further on analytical methods and management strategies such as improved quality control of raw ingredients to minimise mycotoxin challenges in the poultry industry.

The Mycotoxin Management program has developed an integrated approach encompassing the most advanced analytical method in the industry (Alltech 37+ Program – UPLC-MS/MS), a comprehensive critical control point analyses (MIKO) and a broad spectrum remediation solution, Mycosorb A+. ■

Fig. 3. Percent of samples with risk equivalent quantity (REQ) at low, medium or high risk to layer/breeder performance.

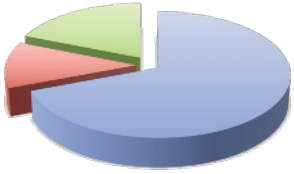

Fig. 4. Percent of samples with risk equivalent quantity (REQ) at low, medium or high risk to broiler performance.

Layer/breeder performance		
Low	20ppb	61.0%
Medium	40ppb	16.4%
High	80ppb	22.6%
Samples containing mycotoxins (%)	91.38	
Average REQ value of samples (ppb)	50.6	
Minimum REQ value measured (ppb)	0.1	
Maximum REQ value measured (ppb)	648.3	

Broiler performance		
Low	35ppb	69.2%
Medium	75ppb	11.9%
High	100ppb	18.9%
Samples containing mycotoxins (%)	91.38	
Average REQ value of samples (ppb)	52.4	
Minimum REQ value measured (ppb)	0.1	
Maximum REQ value measured (ppb)	683.9	