Mycotoxins affect intestinal health and productivity in broiler breeders

*By **Han Zhanqiang**, Poultry Technical Manager, EWN China*

Poultry meat accounts for more than one-third of global meat production. With increasing demand levels, the industry faces several challenges. Among them is the continuous supply of day-old chicks, which is affected by various issues. Mitigation strategies should be taken to ensure the supply of good quality day-old chicks to production farms.

Fast-growing broilers versus fit breeders

The poultry industry is challenged by the broiler-breeder paradox: on the one hand, fast-growing broilers are desirable for meat production. On the other hand, the parents of these broilers have the same genetic traits, but in order to be fit for reproduction, their body weight should be controlled. Thus, feed restriction programs, considering breeder nutritional requirements, are necessary to achieve breed standards for weight, uniformity, body structure, and reproductive system development, determining the success of day-old chick production.

Mycotoxins affect breeder productivity

During the rearing period, gut health problems such as coccidiosis, necrotic enteritis, and dysbiosis affect flocks. Also during the laying period, breeder flocks are also susceptible to disturbances in gut health, especially during stressful periods, leading to reduced egg production and an increase in off-spec eggs. One measure to restrain these challenges is the strict quality control of the feed. In this context, contamination with mycotoxins is an important topic. However, due to the nature of fungal contamination and limitations of sampling procedures, mycotoxins may not be detected or may be present at levels considered low and not risky.

Existing studies on mycotoxins in breeders indicate that mycotoxins can cause varying degrees of reduction in egg production and hatchability and are also associated with increased embryonic mortality. Recent studies have shown that low levels of mycotoxins interact with other stressors and may lead to reduced productivity. These losses are often mistaken for normal breeder lot variation. However, they

cause economic losses far greater than normal flock-to-flock variability.

Mycotoxins impair the functionality of the gut

Low mycotoxin levels affect gut health. Individually and in combinations, mycotoxins such as DON, FUM, and T2 can impact gut functions such as digestion, absorption, permeability, immunity, and microbial balance. This is critical in feed-restricted flocks because it decreases body weight and uniformity, and in laying animals, egg production and egg quality can be reduced. Absorption of calcium and vitamin D3, which are critical for eggshell formation, depends on gut integrity and the efficiency of digestion and absorption. These factors can be adversely affected by even low mycotoxin levels: eggshells can become thin and brittle, thereby reducing hatching eggs and increasing early embryo mortality.

Prevention is the key to success in day-old chick production, therefore:

- avoid the use of raw materials with known mycotoxin contamination.
- use feed additives prophylactically, especially with anti-mycotoxin and antioxidant properties.

Prevention is an alternative approach to assure health and productivity in -many times unknown- mycotoxin challenges.

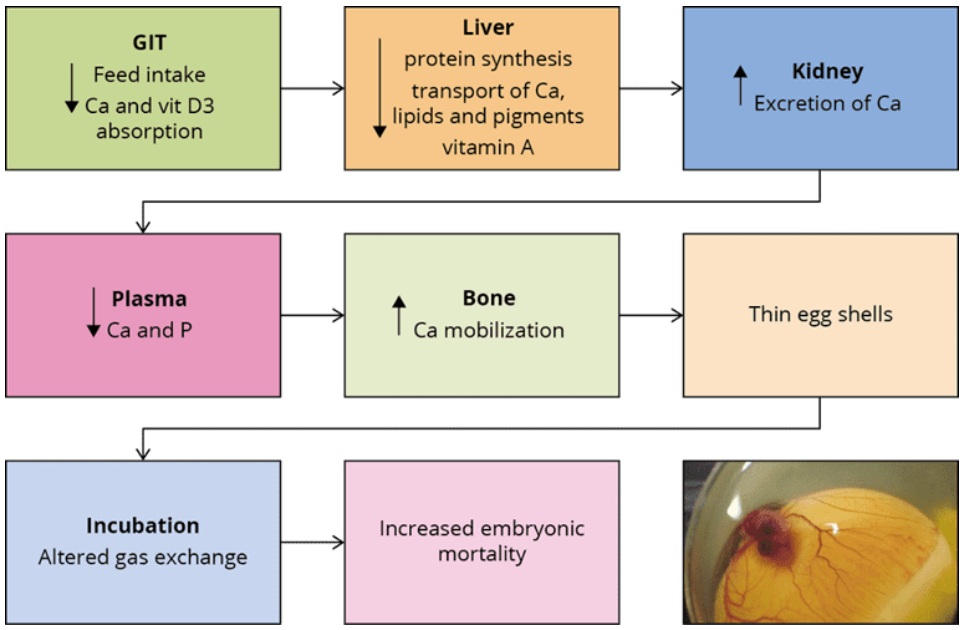

Figure 1: Effect of mycotoxins on eggshell quality and embryo death (Caballero, 2020)

University trial shows anti-mycotoxin product improving performance

A recent study by the University of Zagreb confirmed that long-term (13 weeks) exposure to feed contaminated with mycotoxins has an impact on egg production performance – a challenge that could be counteracted by using an anti-mycotoxin product.

The negative control (NC) was offered feed without mycotoxins. In contrast, the challenged control (CC), as well as a third group, received feed contaminated with 200ppb of T2, 100ppb of DON, and 2500ppb of FMB1. To the feed of the third group, an anti-mycotoxin feed additive (Mastersorb Gold, EW Nutrition) was given on top (CC+MG).

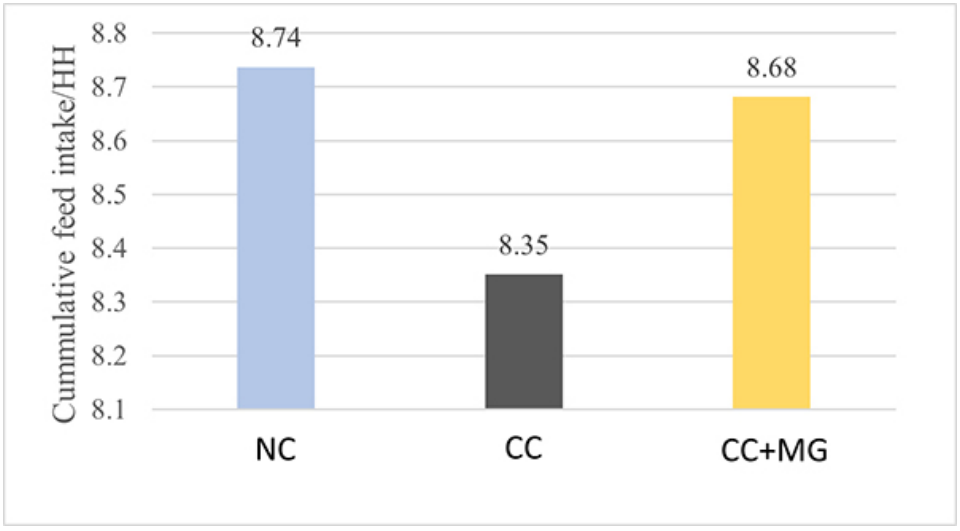

Figure 2: Influence of mycotoxins on feed intake and the effect of the anti-mycotoxin product Mastersorb Gold

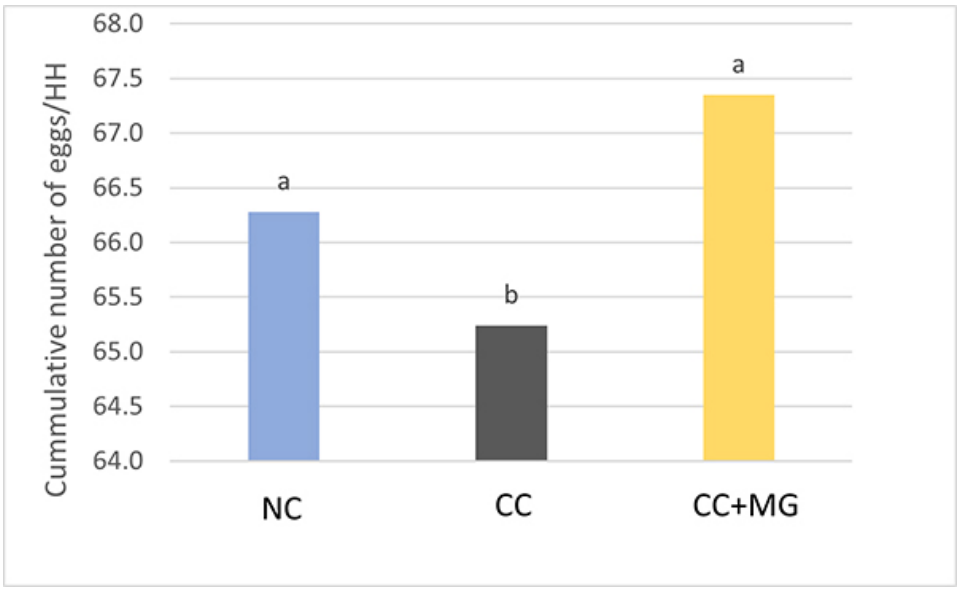

Figure 3: The effect of mycotoxins on the cumulative number of eggs and the compensating effect of Mastersorb Gold

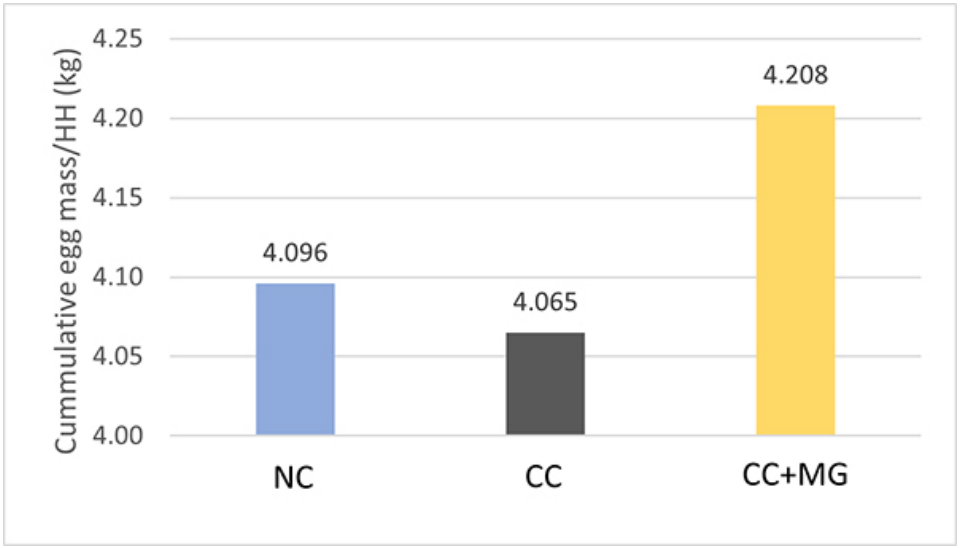

Figure 4: The impact of mycotoxins on the cumulative egg mass and the countereffect of Mastersorb Gold

As expected, the contaminated feed reduced feed intake, egg production, and egg weight (Fig. 2-4). Moreover, the liver and gut were affected which was evidenced in histopathological lesion scores of the

organs: the control group had the lowest score, followed by the group fed Mastersorb Gold. The challenged group without any anti-mycotoxin product scored the highest.

Breeders are susceptible to mycotoxins and need our support

Broiler breeders and day-old chick production can be affected by long-term exposure to mycotoxins, which often exceeds the tolerance range of average flocks. To reduce or even prevent the potential impact of mycotoxins, a comprehensive management strategy is crucial. This includes responsible raw material procurement, storage, and feed processing leading to high feed quality, and the consideration of breeders' nutrient demands. The inclusion of highly effective products to manage mycotoxin risk is an additional tool to maintain breeder performance.

Mycotoxin interactions amplify damages – What are the right solutions?

By Technical Team, EW Nutrition

Contamination with multiple mycotoxins is the rule for animal feeds, rather than the exception. Trial data shows that producers can prevent negative effects on animal health and performance by using high-performing toxin binders.

Multiple mycotoxins contaminate animal feed – problems and solutions

Mycotoxins pose an exceptional challenge for feed and animal producers. Generated by common molds, they occur in a great variety and numbers. Difficult to diagnose, mycotoxicosis in farm animals shows in a range of acute and chronic symptoms: decreased performance, feed refusal, poor feed conversion, reduced body weight gain, immune suppression, reproductive disorders, and residues in animal food products.

Regulatory mycotoxin thresholds don’t account for interactions

Regulatory thresholds for permissible mycotoxin levels in feed are derived from toxicological data on the effects of exposure of a certain species, at a certain production stage, to a single mycotoxin. This makes practical sense: while aflatoxins are carcinogens, fumonisins attack the pulmonary system in swine, for example. Mycotoxins also affect poultry in a different way than cattle, and broilers in a different way than breeders or laying hens, to mention more cases.

The problem is that, in reality, individual mycotoxin challenges are the exception. Animal diets are usually contaminated by multiple mycotoxins at the same time (Monbaliu et al., 2010; Pierron et al., 2016). Since 2014, EW Nutrition has conducted more than 50,000 mycotoxin tests on both raw material and finished feeds samples, across the globe. 85% of these samples were contaminated with more than one mycotoxin and one third positive for four or more mycotoxins.

How does contamination with multiple mycotoxins occur in animal feed?

The concurrent appearance of mycotoxins in feed can be explained as follows: each mold species has the capacity to produce several mycotoxins simultaneously. Each species, in turn, may infest several raw materials, leaving behind one or more toxic residue. In the end, a complete diet is made up of various raw materials with individual mycotoxin loads, resulting in a multitude of toxic challenges for the animals.

If animals were exposed to only one mycotoxin at a time, following the regulatory guidelines on maximum

challenge levels would usually be enough to keep them safe. However, several studies have shown that the effects of exposure to multiple mycotoxins can differ greatly from the effects observed in animals exposed to a single mycotoxin (Alassane-Kpembi et al., 2015 & 2017). The simultaneous presence of mycotoxins may be more toxic than one would predict based on the known effects of the individual mycotoxins involved. This is because mycotoxins interact with each other. The interactions can be classified into three main different categories: *antagonistic, additive,* and *synergistic* (Grenier and Oswald, 2011).

Types of mycotoxin interactions

- **Additivity** occurs when the effect of the combination equals the expected sum of the individual effects of the two toxins.

- **Synergistic** interactions of two mycotoxins lead to a greater effect of the mycotoxin combination than would be expected from the sum of their individual effects. Synergistic actions may occur when the single mycotoxins of a mixture act at different stages of the same mechanism. A special form of synergy, sometimes called **potentiation**, occurs when one or both of the mycotoxins do not induce significant effects alone but their combination does. Fumonisin alone, for example, requires high levels to exerts effects on broiler performance. When aflatoxin is also in the feed, the effects are higher than those of aflatoxin alone (Miazzo et al., 2005)
- **Antagonism** can be observed when the effect of the mycotoxin combination is lower than expected from the sum of their individual effects. Antagonism may occur when mycotoxins compete with one another for the same target or receptor site. In an *in-vitro* study using human colon carcinoma cells (HCT116), Bensassi and collaborators (2014), found that DON and Zearalenone individually caused a marked decrease of cell viability in a dose-dependent manner; when combined, the effect was drastically reduced.

Most of the mycotoxin mixtures lead to additive or synergistic effects. The actual consequences for the animal will depend on its species, age, sex, nutritional status, the dose and duration of exposure as well as environmental factors. What is clear is that mycotoxin interactions pose a significant threat to animal health and critically impede risk assessment.

From awareness to action: risk

assessment and toxin binders

Given their complex interactions, the toxicity of combinations of mycotoxins cannot merely be predicted based upon their individual toxicities. Mycotoxin risk assessments have to consider that even low levels of mycotoxin combinations can harm animal productivity, health, and welfare. Feed and animal producers need to be aware of which raw materials are likely to be contaminated with which mycotoxins, be able to accurately link them to the risk they pose for the animal and consequently take actions before the problems appear in the field.

Trials demonstrate effectiveness of toxin mitigation solutions

Toxin binders that are effective against a broad spectrum of mycotoxins significantly reduce the risks of mycotoxin exposure. *In vitro* trial data shows that EW Nutrition's cost-effective toxin-mitigating product Solis Max shows a high mitigation capacity, even at low inclusion rates (Figure 1). Importantly, Solis Max helps to reduce various mycotoxins' negative effects on performance without any negative effects on nutrient absorption.

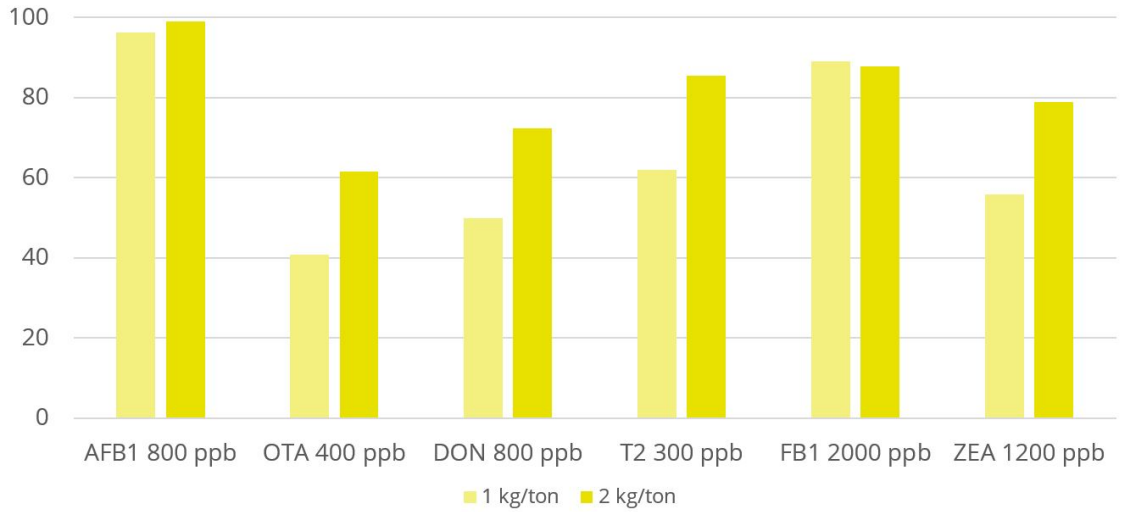

Figure 1: Solis Max shows mitigation capacity in in vitro trial (%)

In another trial with 480 Ross 308 broilers, Solis Max 2.0 has demonstrated its ability to support animals coping with multiple mycotoxin challenges. For broilers challenged with 30 ppb AFB1 and 500 ppb OTA, Solis Max 2.0 supplementation resulted in a significantly 16% higher weight gain, an 18.5% higher final weight, and a 22% better FCR than the challenged group (Figure 2), which means a total recovery of the performance when compared with the non-challenged control.

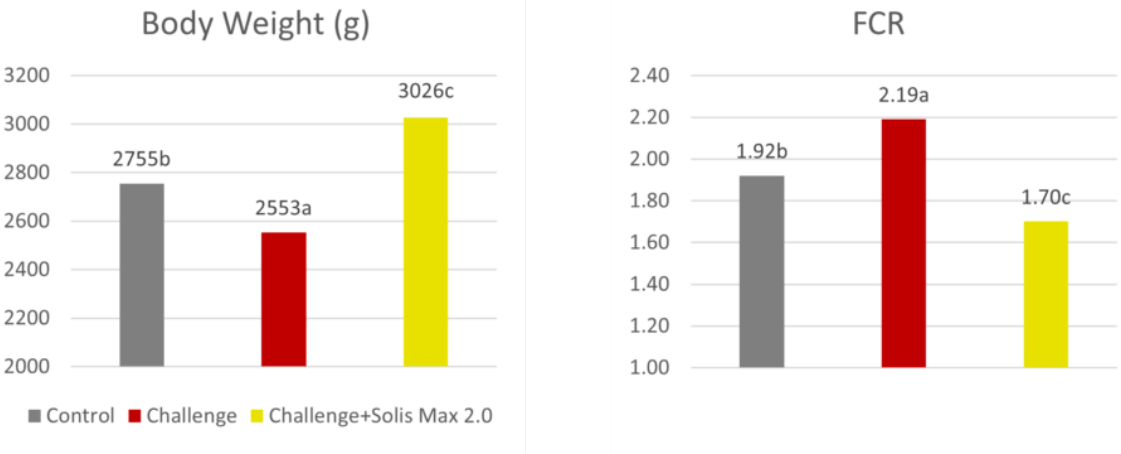

Figure 2: Solis Max 2.0 improves body weight and FCR of broilers challenged with AFB1 and OTA; different letters indicate significant difference ($p<0.05$)

Liver health also improved: after 42 days of mycotoxin exposure, broilers receiving Solis Max 2.0 showed lower AST (-13%) and ALT (-44%) levels compared to the challenged group.

Proactive management: tackle multiple mycotoxin challenges head on

Mycotoxins interactions are the norm, not the exception. Yet, regulatory standards currently only cover the effects of individual mycotoxins, leaving productions exposed to risks of additive and synergistic mycotoxin interactions animals' health and performance. Luckily, management options are available: Careful risk evaluation explicitly includes the threat of multiple contaminations. And producers can proactively ensure better health, welfare and productivity of their animals by investing in the right toxin mitigation solution for their business.

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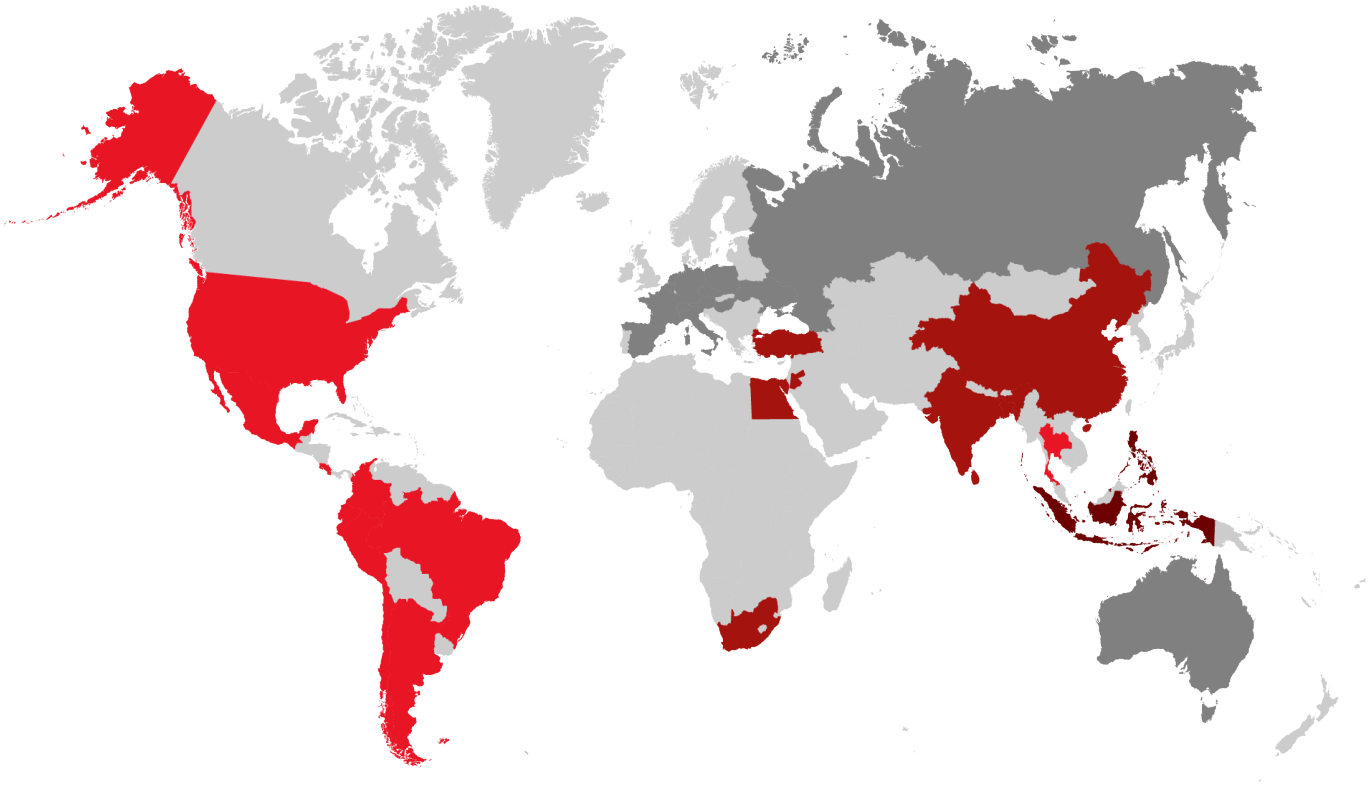
Global mycotoxin challenges: 2021 report



By Marisabel Caballero, Global Technical Manager Poultry, EW Nutrition

Climate around the globe has changed, increasing atmospheric temperatures and carbon dioxide levels. This change favors the growth of toxigenic fungi in crops and thus increases the risk of mycotoxin contamination. When contaminating feed, mycotoxins exert adverse effects in animals and could be transferred into products such as milk and eggs.

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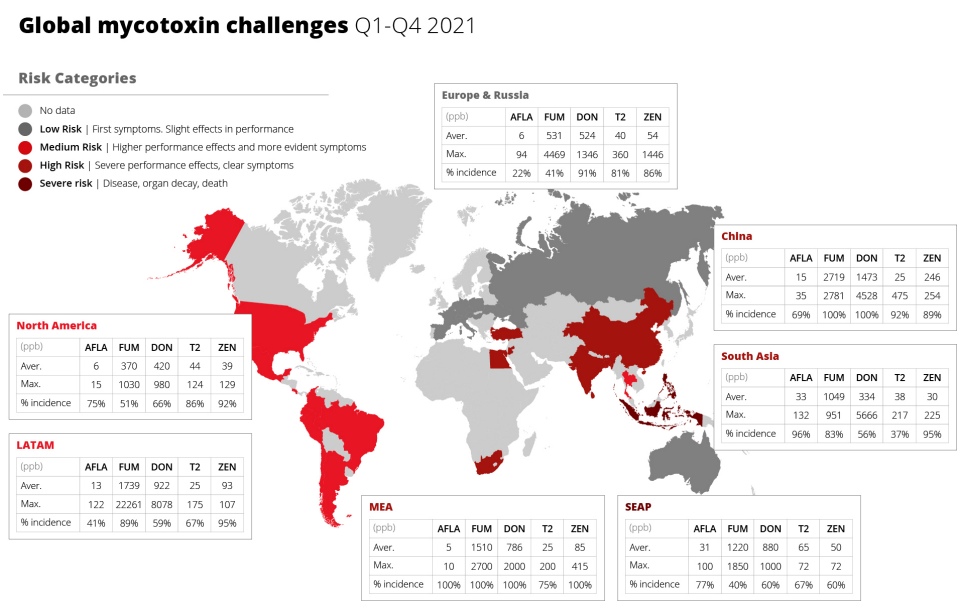

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Mycotoxins: a worldwide challenge in 2021

Amongst naturally occurring mycotoxins, the five most important ones are aflatoxin, ochratoxin, deoxynivalenol, zearalenone, and fumonisin. Their incidence varies with the different climates, the prevalence of plant cultures, the occurrence of pests, and the handling of harvest and storage. Worldwide, farmers faced various and sometimes extremely high mycotoxin contamination in their feed materials in 2021. In the following, we show the major challenges in five main regions.

Asia faced high aflatoxin contamination

In Asia, high temperatures and humidity favor Aspergillus growth in grains. As a result, 95 % of the samples in South Asia and three-quarters of the samples in the China and the SEAP region (Indonesia, Philippines, Vietnam) showed aflatoxin contamination. The average contamination being higher than the threshold for all farm animals represents an increased risk for their health and performance.
In China and the SEAP region, also DON and T-2 were highly prevalent. Showing an incidence of more than 60%, they pose a severe risk when combined with aflatoxin.

Fumonisins afflicted the LATAM region

In Mexico, Central and South America, fumonisin contamination prevailed with an incidence of almost 90% at average levels that can be considered risky for swine and dairy. Together with incidence levels of around 60% found for DON and T2, fumonisin may act synergically in the animals, raising the risk for health and performance.
The Fusarium species linked to these mycotoxin contaminations occur in the grains on the field. Amongst others, insect damage, droughts during growing, and rain at silking favor their development.

Trichothecenes prevailed in North America

Contamination with trichothecenes (DON and T2) is the rule in the United States. The interaction of these mycotoxins is at least additive. The damage they cause to the gut opens the door to dysbiosis and disease, decreasing performance and profitability.
Also in this case, the responsible molds for the contamination are Fusarium species that develop when grains are in the field. As with fumonisins, the molds are favored by insect damage, moderate to warm temperatures and rainfall.

Fusarium toxins contaminated grain in the MEA region

Fusarium toxins such as Fumonisin, DON, and T2 prevail in the region of Egypt, Jordan, and South Africa. In combination, these mycotoxins have additive effects at the intestinal level, which increases the risk of dysbiosis in poultry.

A challenging year with long-term repercussions

Since mycotoxin contamination affects animal health, measures must be taken to provide the best protection. Besides improving agricultural practices in the field, smart in-feed solutions and mold inhibitors can be used in stored grain. These measures help producers preserve feed quality after a troubled year for crops around the world.