Mycotoxin control: diagnostic tools and cost effective toxin binders

Mycotoxins are toxic compounds produced by various fungal species that grow on various agricultural commodities. The death of 100,000 turkey poults and other poultry in the UK just before Christmas in 1960 was traced to a toxic contaminant (later determined as aflatoxin) present in ground nut meal used in the diet.

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Fig. 2. Efficacy of MT.X+ to alleviate mycotoxin effects on body weight (Samitec, Brazil, 2016).

This incident illustrated the potential threat posed by mycotoxins. The toxicity of mycotoxins varies, ranging from hepatotoxic or even carcinogenic (aflatoxin) effects, to oestrogenic (zearalenone), immunotoxic (patulin, trichothecene, fumonisin), nephrotoxic (ochratoxin A) and neurotoxic (tremorgens, ergot alkaloids) effects.

In the field, one of the most important effect of mycotoxin (mainly trichothecene) is the impact on feed conversion ratio and growth due to lower nutrient absorption (with or without feed intake reduction).

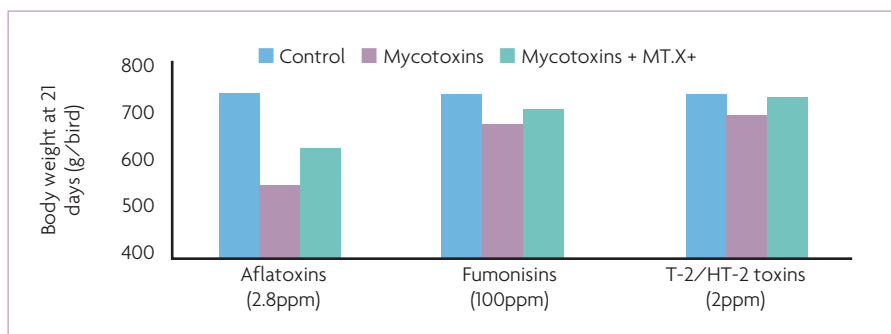The losses in performance, the increased incidence of diseases and the reduced reproductive performance are of great economic impact in the field. The fate of mycotoxin along the gastrointestinal tract and their metabolism varies between animal species and explains the different animal sensitivity. For instance, deoxynivalenol (DON) is less absorbed in the poultry gut than in the pig gut and birds can effectively biotransform DON into deoxynivalenol-sulphate, a non-toxic metabolite. On the contrary, birds show higher sensitivity to type A trichothecene (T-2/HT-2 toxin), ochratoxin, citrinin and fumonisin.

In order to help detect mycotoxin contamination, Olmix has developed a methodology of diagnosis. As a starting point, Olmix recommends using a predictive model of mycotoxin risk for poultry, named 'Myco'Evaluator' that is available for free on its website. This predictive model will identify the risk factors on the farm and calculate the probability of having high levels of mycotoxins in the feed.

Mycotoxins can be formed in the field, pre-harvest (fusariotoxins: trichothecene, fumonisin and zearalenone) and/or under poor storage conditions, post-harvest (aflatoxin and ochratoxin mainly).

Depending on field and storage conditions, the occurrence of mycotoxins will be more or less important.
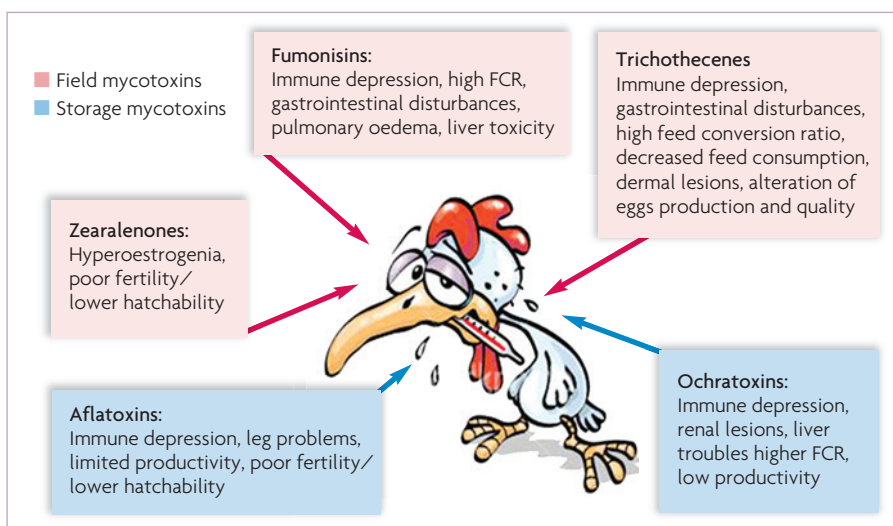
The developed predictive model is based on risk factors for presence of mycotoxins in the feed, which were defined by a literature review and classified into two categories: feed production and storage conditions, and disorders observed on the animal. If the predictive model calculates a high risk of having mycotoxins, Olmix recommends running an analysis (by chromatography or ELISA) in order to confirm the mycotoxin contamination and quantitatively measure the level of contamination in the feed. Most official analytical methods are chromatographic.

Alternative strategies such as enzyme linked immunosorbent assay (ELISA) are also largely used as they are easy to implement, cheap and quick. Chromatographic methods are very reliable and can be used on any kind of feed matrix and mix of feed.

Matrix effect or matrix interference commonly occurs in ELISA methods resulting in underestimations or overestimations in mycotoxin

Fig. 1. Effect of the main mycotoxin types on poultry.

Field mycotoxins
Storage mycotoxins

Fumonisins:
Immune depression, high FCR, gastrointestinal disturbances, pulmonary oedema, liver toxicity

Trichothecenes
Immune depression, gastrointestinal disturbances, high feed conversion ratio, decreased feed consumption, dermal lesions, alteration of eggs production and quality

Zearalenones:
Hyperoestrogenia, poor fertility/ lower hatchability

Aflatoxins:
Immune depression, leg problems, limited productivity, poor fertility/ lower hatchability

Ochratoxins:
Immune depression, renal lesions, liver troubles higher FCR, low productivity

concentration in complete feeds. ELISA methods are reliable on single material matrices and not always recommended for complex matrices such as complete feed.

In order to choose the appropriate test according to each situation, Olmix has developed a comprehensive set of tools, the Myco'Screen, aiming at supporting feed millers, nutritionists and farmers optimising their mycotoxin analysis strategy for feedingstuffs. The Myco'Screen package is composed of four sections: sampling procedure, mycotoxins analysis, personalised reports and contamination overview that give practical and realistic information to evaluate the encountered mycotoxin risk.

Once the contamination is confirmed and quantified, the use of a mycotoxin binder in feed, in combination with optimum farm management practices, is the best possible method to reduce the mycotoxin impact.

The choice of a wide spectrum binder is a key factor to sustainably protect the animals from mycotoxins.

Olmix is an expert in that field, and has recently proven again the efficacy of MT.X+ to alleviate mycotoxins effects on poultry. The latest study was conducted by the Samitec Institute in Brazil.

The study was conducted on broilers from day 1-21 and evaluated the efficacy of MT.X+ to reduce the effects of T-2/HT-2 toxin, fumonisin and aflatoxin. The inclusion of MT.X+ in the feed containing very high levels of T-2/HT-2 toxin or fumonisin or aflatoxin always significantly improved the birds' feed consumption, body weight and the relative weight of the liver (RWL) compared with those exposed to mycotoxins only.

The inclusion of MT.X+ in the diets containing aflatoxin improved significantly the Lamic/Samitec Index compared with those from the birds fed with aflatoxin only ($P \leq 0.05$) and diminished significantly the Sa/So compared with those from the birds exposed to fumonisin only ($P \leq 0.05$).

According to the evaluated parameters, MT.X+ significantly ($P \leq 0.05$) reduced the deleterious hepatic effects and performance losses caused by very high levels of three types of mycotoxin on broilers (Fig. 2).

Moreover, in order to guarantee a homogenous intake by the animals, Olmix has also developed a microgranulated form (MMi.S) particularly suitable for poultry mash feeds. Thanks to its adapted granulometry size it is not impacted by poultry natural particle size selection behaviour for optimum efficacy.

The full set of tools and solutions developed by Olmix help feed-millers, nutritionists and farmers to optimise mycotoxin management in the feed.

Finally, in order to optimise the use of MT.X+/MMi.S to each field situation, Olmix has recently launched a new online tool, the Myco'Calculator. It is a complex and unique tool that permits the optimum dosage of MT.X+ and MMi.S to be calculated depending on the type of analysis, the animal species, the stage of the animal, the profile and level of mycotoxin contamination and the health status.

Olmix Myco'Calculator is the result of two years of development and modelling of a large number of situations in pigs, poultry and ruminants. It has the unique capacity to handle complex polycontaminations as calculations are based on 13 major mycotoxins. Dosage recommendations are provided with a precision of 100g/ton, which allows the best cost-effective use of MT.X+/MMi.S. Olmix Myco'Calculator aims to help feed mills and nutritionists to better adapt MT.X+ and MMi.S dosage in feeds, with a high reactivity and accuracy to optimise technical and economic performance.

To conclude, the use of an adapted and efficient wide spectrum binder is important to protect poultry against mycotoxins, but as important are the full set of technical tools to identify the risks and adapt the strategy to get the optimum cost efficacy of the product. ∎