Benchmark study of premium commercial mycotoxin management preparations

The co-occurrence of multiple mycotoxins in feed has a serious impact on the performance and well-being of production animals. Several mycotoxin management preparations can alleviate this threat by binding the mycotoxins inside the digestive tract. A new preparation can do more than that …

The mycotoxin challenge

Feedstuff contamination with mycotoxins occurs worldwide at a higher level than generally assumed. The Food and Agricultural Organisation (FAO) stated in 2001 that not less than 25% of the world's feedstuffs are contaminated (FAO, 2001). Recent scientific updates indicate even higher percentage of contaminated feeds and in particular emphasize on co-occurrence of mycotoxins at low levels. Due to their toxicity, mycotoxins affect the immune system and can lead to depressed health, growth and fertility. Relieving animals of this threat is a challenge, but can be achieved by prevention (mould control, storage management of feed), adsorption and deactivation of the mycotoxins.

Alleviating the mycotoxin threat is more than binding alone

Commercial mycotoxin management preparations are (partially) based on adsorbents. These adsorbents are able to bind, to a certain extent, specific mycotoxins in the gastro-intestinal tract. The binding efficiency of an adsorbent towards a specific mycotoxin depends on the chemical structure of adsorbent and mycotoxin. Most tested/used adsorbents are aluminosilicates, mainly zeolites and hydrated sodium calcium aluminosilicates (HSCAS), and aluminosilicate-containing clays. Most aluminosilicates can alleviate the toxic effects of polar mycotoxins, aflatoxins and fumonisins. Yeast derived products are also known for their binding properties, but here the focus is more on the non-polar mycotoxins. Studies evaluating different binders showed that yeast-wall derived products efficiently adsorbed zearalenone which is more difficult to bind by aluminosilicates. Adsorption of mycotoxins is a valid strategy, but complete binding is not achievable for some mycotoxins. As a preventive measure propionate compounds are useful as they reduce the growth of mycotoxin-producing fungi in the feed.

Model to compare binding capacities

An *in vitro* model was set-up by the Centre of Excellence in Mycotoxicology and Public Health at the university of Ghent (Belgium, MYTOX member) together with Orffa to test different single compounds and mixtures for their binding capacity (%) of mycotoxins. Binding of the mycotoxin by the adsorbent is tested at pH3 and subsequent raised to pH7. The mycotoxin standard mixture tested consists of aflatoxins (AFB1, AFB2, AFG1, AFG2), fumonisins (FB1, FB2), zearalenone (ZEN), ochratoxin (OTA), deoxynivalenol (DON), HT-2 Toxin (HT-2), T-2 Toxin (T-2) and enniatin B (ENN B).

The model was applied to analyse a large number of ingredients. These can be divided into inorganic adsorbents, yeast-based adsorbents and organic adsorbents (non-yeast). Several compositions of ingredients were also screened. This screening resulted in the discovery of a best synergistic composition, consisting of 4 ingredients. The best synergistic composition is based on the binding properties of the zeolite, clinoptilolite, fortified with a specific phyllosilicate and complemented with yeast-derived and propionate compounds.

Benchmark study

A benchmark study (Table 1) was set up using the developed *in vitro* model comparing the best synergistic composition (Excential Toxin Plus, ETP) to 8 premium mycotoxin management preparations (1-8). To make an assessment of the general binding capacity, the binding percentages obtained from the study are converted using the following legend: Complete binding ("+++">90%), partial binding ("++">50%; < 90%), limited binding ("+">10%; <50%) and no significant binding ("0"<10%).

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The majority of premium preparations show a complete binding of the aflatoxins tested, although some have difficulties binding AFG2 to the fullest extent. For fumonisins, all premium preparations show a clear negative pH effect. These premium preparations release the bound fumonisins to a certain extend at pH 7. In general, all premium preparation score badly regarding the binding of ZEN. This is in large contrast with the binding of enniatin B, where all premium preparations show complete binding at pH7. For ochratoxin, there is a big negative pH effect. Trichothecenes (DON, T-2 and HT-2) are in general difficult to bind. For DON, in particular, a large part is not bound by any preparation and detected in the supernatant by LC-MS/MS. This suggests that biotransformation by any preparation into less toxic metabolites is minimal.

Considerations for feed formulators

Adsorbents can be the first line of defence inside the animal for some mycotoxins, but there should also be a focus on other defences for mycotoxins that are not easy to bind. Biotransformation of DON is becoming a popular term, but analyses of supernatant does not show effective reduction of DON levels in the premium mycotoxin management preparations tested. Propionate compounds can act as a preventive measure by supressing the growth of fungi during storage and this way reduce the production of mycotoxins. Binding is only one part of the solution.

Results from this benchmark study indicate that there are clear differences between premium mycotoxin management preparations and that Excential Toxin Plus can match the results of the best products in the market. Excential Toxin Plus was recently tested *in vivo* in broilers and laying hens and this in the African countries Senegal and Togo, respectively. The incorporation of the additive at standard preventive dosage in the broiler diet resulted in a beneficial effect on performance. In the laying hens, the additive was able to positively influence the feed conversion rate, the egg production rate and support the egg weight and this in a mycotoxin contaminated diet. The positive effect was more pronounced in older birds. Excential Toxin Plus has also been evaluated recently on its adsorption capacity towards the alpha-toxin produced by *Clostridium perfringens*. It seems that the product is highly capable of adsorbing the exotoxin and could therefore have a positive effect on the development of *Clostridium perfringens*-associated necrotic enteritis.

Excential Toxin Plus, manufactured by Orffa India, combines three binders with the activity of a mould inhibitor to offer a complete solution.

For further information or references, please contact dingore@orffa.com.

		1	2	3	4	5	6	7	8	ETP [1]
AFB1	pH3	+++	+++	+++	+++	+++	+++	+++	+++	+++
	pH7	+++	+++	+++	+++	+++	+++	+++	+++	+++
AFB2	pH3	+++	+++	+++	+++	+++	+++	+++	+++	+++
	pH7	+++	+++	+++	+++	+++	+++	+++	+++	+++
AFG1	pH3	+++	+++	+++	+++	+++	+++	+++	+++	+++
	pH7	++	+++	+++	+++	+++	+++	+++	+++	+++
AFG2	pH3	++	+++	+++	+++	+++	+++	+++	+++	+++
	pH7	+	++	++	++	+++	+++	+++	++	+++
ENN B	pH3	++	+++	+++	+++	+++	+++	+++	+++	++
	pH7	+++	+++	+++	+++	+++	+++	+++	+++	+++
ZEN	pH3	++	+	++	+	+	++	++	++	+++
	pH7	++	+	+	+	+	++	++	0	++
DON	pH3	+	+	+	0	0	+	0	+	0
	pH7	+	0	0	0	0	0	+	+	+
HT-2	pH3	+	0	0	0	+	0	+	++	+
	pH7	++	0	0	0	0	0	+	++	+
T-2	pH3	+	0	+	0	+	+	+	+	++
	pH7	+	0	0	0	0	+	+	+	+
FUM B1	pH3	0	+	+++	+++	+++	++	+++	++	+++
	pH7	0	0	0	0	+	+	0	0	+
FUM B2	pH3	++	+	+++	+++	+++	++	+++	++	+++
	pH7	0	++	0	0	+	++	0	0	++
OTA	pH3	++	0	++	+	++	++	+++	++	+++
	pH7	0	0	0	+	0	+	+	0	+

[1]: ETP = Excential Toxin Plus by Orffa