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Efficient mycotoxin binders for various mycotoxin absorption

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ARIE VAN OOIJEN and TANJA SCHAFFER* explain how mycotoxin levels can be controlled and feed safety can be increased.

The burden of mycotoxins in feed

Mycotoxins are very stable toxic secondary metabolites produced by several fungi, particularly by many species of *Aspergillus, Fusarium, Penecillium, Claviceps* and *Alternaria.* It has been estimated that at least 300 of these fungal metabolites are potentially toxic to animals and humans. The most intensively investigated mycotoxins are aflatoxin B1 (AFB1), ochratoxin (OTA), zearalenone (ZEN), deoxynivalenol (DON, 'Vomitoxin'), T2 toxin, HT-2 toxin and fumonisins (FUM). Mycotoxins are produced by fungi, mainly during growth (est. 95%) and during storage (est. 5%) of raw materials like grains and other agricultural commodities.

The mycotoxins AFB2, T-2, DON and OTA have a negative effect on the immune system. This may result in decreased effectiveness of medication and increased sensitivity towards many diseases (e.g. lung diseases, laminitis, mastitis, ketosis, PIA and Circo). OTA, FUM and AFB1 also cause damage to many organs such as the liver, the kidneys and the pancreas. Besides that, OTA, T-2 and DON mycotoxins function as free radicals, causing damage to essential amino acids, carotenoids and vitamins in the digestive tract.

Other well-known negative effects of mycotoxins are reduced fertility, delayed sexual maturation, lower conception rates, ovarian cysts and embryotic loss (mainly caused by ZEA, T-2 and DON). Most mycotoxins cause reduced feed intake and decrease the production results.

The presence of one mycotoxin is usually an indication for the presence of several other mycotoxins: e.g. *Fusarium graminearum* produces DON as well as ZEN.

Adsorption of AFB1 *in vitro*

A study was organized at Kasetsart University Bangkok, to demonstrate the efficiency of the Toxybind products for the absorption on alfatoxin B1 (AFB1) *in vitro* also in comparison to other products available in the market.

This trial enrolled in total six products, Toxybind Plus and Toxybind Perfect (FF Chemicals BV) , as well as four different commercial products used the markets for AFB1 binding, as shown in Table 1.

In this experiment AFB1 standard was added to simulate a mycotoxin contamination. The percent adsorption was detected/calculated via a commercial ELISA (enzyme-linked immunosorbent assay) as shown in Figure 1.

Trial results

The percent adsorption of AFB1 by the various trial products is presented in Table 2.

The experiment shows that the adsorption rate of both Toxybind types is above 90% and equal or slightly better compared to other commercial products in the markets.

The good results for the AFB1 lies in the mineral component of the Toxybind products: several types of modified hydrated sodium calcium aluminium silicates (double layer HSCAS) function as a chemical sponge and adsorb mycotoxins, especially the AFB1 in the gastrointestinal tract as illustrated in Figure 2. The most important characteristics of these HSCAS are their unique structure, the total negative or positive ionic charge and charge-distribution, the size of the pores and the accessible surface.

Conclusion

The Toxybind products could demonstrate excellent binding of AFB1, minimum in the same range as the tested alternative commercial products to reduce the absorption of mycotoxins into the animal's body and promote their excretion. This can therefore increase feed safety and avoid adverse effects in the animals. AF

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Table 1: Products enrolled into the trial.

Product	Composition
A – Toxybind Plus	HSCAS, Yeast Cell Wall, Antimold and Antioxidant
B – Toxybind Perfect	HSCAS, Yeast Cell Wall, Antimold, Antioxidant, Enzymes and Plant derivatives
C- commercial product	HSCAS, Yeast Cell Wall
D- commercial product	HSCAS, Yeast, Enzymes, Microorganisms, Plant and Algae extracts
E- commercial	Modified HSCAS
F- commercial product	Modified HSCAS

Table 2: *in vitro* percent adsorption of ABF1 by the enrolled products.

Product	% Adsorption (20 ppb ABF1 added)
A – inclusion rate equivalent to 0.5kg/MT feed (Toxybind Plus)	90.16
A – inclusion rate equivalent to 1.0kg/MT feed	91.57
B – inclusion rate equivalent to 0.5kg/MT feed (Toxybind Perfect)	90.36
B – inclusion rate equivalent to 1.0kg/MT feed	93.17
C – inclusion rate equivalent to 0.5kg/MT feed	87.35
D – inclusion rate equivalent to 0.5kg/MT feed	91.16
E – inclusion rate equivalent to 0.5kg/MT feed	79.32
F – inclusion rate equivalent to 0.5kg/MT feed	40.38

Figure 1: Typical ELISA as used for Mycotoxin analysis. *(Image reproduced by kind permission of ProGnosis Biotech SA)*

Figure 2: Modified mineral clays (HCAS) absorb mycotoxins like AFB1 (symbolized in red).