
agrimex NV
agricultural products
Starbind
Upgrade your feed
to star quality
THE POLYVALENT MYCOTOXIN BINDER

Mycotoxins and moulds

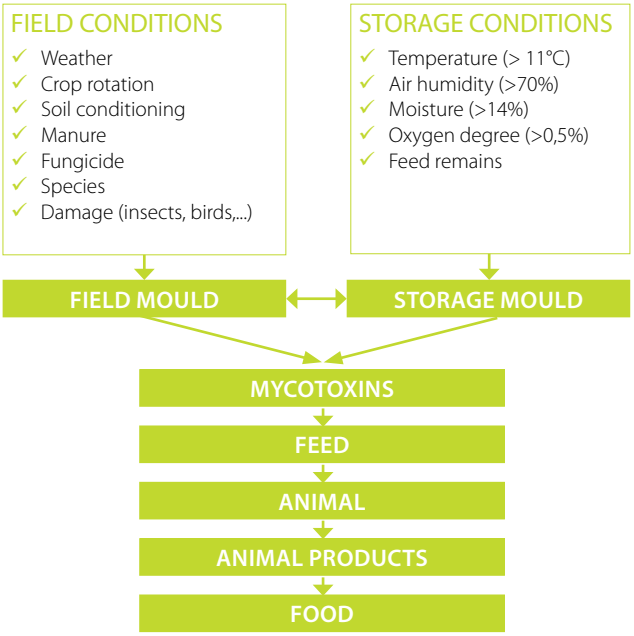
Moulds can grow in the field or develop during storage., and are well known to produce mycotoxins as secundary metabolites which are **toxic for animals and humans after ingestion.** Moulds can perfectly grow without producing mycotoxins. Therefore, the occurence of mould doesn't necessarily imply the presence of mycotoxins. The inverse is also true: mycotoxins can be present without any visual sign of mould growth.

Mycotoxin production depends on a number of parameters such as oxygen and moisture levels, climate conditions, substrate presence,... The production and presence of a specific mycotoxin is not strictly linked to one type of mould. Inversely, one mould can produce a range of mycotoxins.

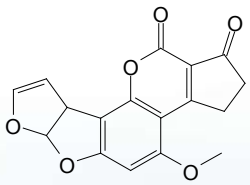
TABLE 1: ORIGIN OF MAJOR MYCOTOXINS

	MOULD	MYCOTOXIN	INGREDIENT
STORAGE	*Aspergillus*	Aflatoxin Ochratoxin	cereals oil seeds ground nuts
	Penecillium	Ochratoxin Citrinin	cereals coffee leguminose soy
FIELD	*Fusarium*	Deoxynivalenol T-2 Zearalenone Fumonisin	cereals soy
	Claviceps	Ergot	cereals

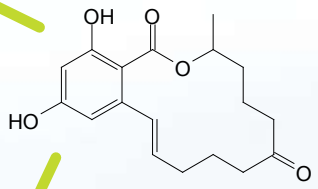
FIGURE 1: MYCOTOXINS IN FEED AND FOOD CHAIN



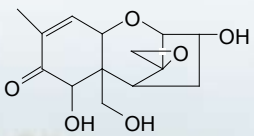
In animal nutrition **aflatoxin B_1** ($AF B_1$), **trichothecenes** (DON and T-2), **ochratoxin A** (OTA) and **zearalenone** (ZEA) are considered as the major mycotoxins



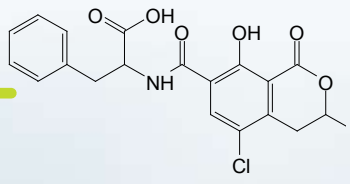
Aflatoxin B1



Zearalenone



Deoxynivalenol



Ochratoxin A

Contamination

Table 2 summarizes the results of a survey of mycotoxins in agricultural commodities (corn, wheat, barley, oat, titricale) and feed samples in Europe.

TABLE 2: OVERVIEW CONTAMINATION OF COMMODITIES AND FEED: EU-SURVEY

	B-TRICHOTHECENES	ZEA	OTA	AFB_1	FUM
No. of samples	654	413	38	57	26
% positive	63	22	13	26	38
Average (ppb)	653	29.6	3.0	33.8	2097
Max. level (ppb)	24019	902	54	1621	13622

Grains are not the only constituents of the plant contaminated with mycotoxins after fungal infection. Other parts such as straw and chaff could be contaminated. Straw is often used as bedding material to be beneficial for the welfare of pigs and ruminants, but it is often an important additional source of contamination *(table 3)*.

TABLE 3: DON AND ZEA TOXINS IN STRAW

ORIGIN OF STRAW	DON	ZEA	REF.
Wheat	1935	-	S. Sonderman
	200	62	T. Buckley
	964	-	E. Christensen
	1640	273	Own source
	1400	900	A. Gutzwiller
Barley	834	-	S. Sonderman

TABLE 4: TOXIC LEVEL

MYCOTOXIN	SPECIES	PPB
AF B1	pigs	20
	poultry	20
	dairy cattle	5
	beef cattle	20
	young animals	10
DON	pigs	800
	poultry	3200
	calves	1600
	dairy cattle	2400
	beef cattle	4000
ZEA	piglets <25 kg	80
	fattening pigs	200
	gilts	80
	sows	200
	poultry	-
	calves / dairy cattle	400
	beef cattle	-
OTA	pigs	40
	poultry	160
	ruminants	-

Table 4 presents an overview of the toxical level of mycotoxins in pigs, poultry and ruminants. Comparing the animal species clearly indicates the difference in sensitivity between pigs, poultry and ruminants. Moreover, a lower mycotoxin contamination (subtoxic) can substantially impair animal performance and even cause more severe problems on long term than an acute dosage.

Clinical signs

TABLE 5: CLINICAL EFFECTS

	PIGS	POULTRY	RUMINANTS
AFB1	Carcinogenic effects Liver damage (pale) Higher mortality Reduced feed intake **Residues**: in liver and milk	Carcinogenic effects Liver damage (enlargement, pale) Decreased performance and hatchability Paleness of legs **Residues**: in liver, meat and eggs	Carcinogenic effects Liver damage (enlargement, pale) Decreased milk production Impaired rumen function **Residues**: in milk (AFM_1)
TRICHO-THECENES	Reduced feed intake (DON) Vomiting (DON) Feed refusal (DON) Immunosuppression (DON & T-2) Oral and dermal lesions (T-2)	Immunosuppression (DON & T-2) Decreased performance (DON & T-2) Oral and dermal lesions (T-2)	Immunosuppression (DON & T-2) Decreased milk production Reduced protein content in milk Oral and dermal lesions (T-2)
OTA	Impaired FCR Kidney damage Increased urinating Diarrhea **Residues**: in kidneys, liver and meat	Kidney damage Higher water consumption Poor shell quality Reduced feathering **Residues**: in liver, meat and eggs	Less sensitive to OTA
ZEA	Reddening and swelling vulva Increased embryo mortality Reduced productivity Impaired semen quality Splaylegs	Less sensitive to ZEA	Decreased milk production Infertility Abortions

OESTROGENIC
IMMUNOTOXIC
NEUROTOXIC
MUTAGENIC
CARCINOGENIC

Synergism

Due to synergism, the effect of different mycotoxins is bigger than the sum of the individual effects.

Decontamination of mycotoxins

The frequent occurrence of mycotoxins in an animal feed and the possible negative consequences for animal performance, has resulted in an elaborate search for methods to eliminate the toxic effects of mycotoxins *(table 6)*.

TABLE 6: DECONTAMINATION METHODS

PHYSICAL	separation thermal inactivation irradiation (UV) solvent extraction
CHEMICAL	ozone ammonia
BIOLOGICAL	biotransformation **ADSORBENTS**

These adsorbents are indigestible components that bind the mycotoxins in the aqueous environment of the gastro intestinal tract and prevent their uptake into the blood. Complex of adsorbent and mycotoxins is excreted via the faeces.

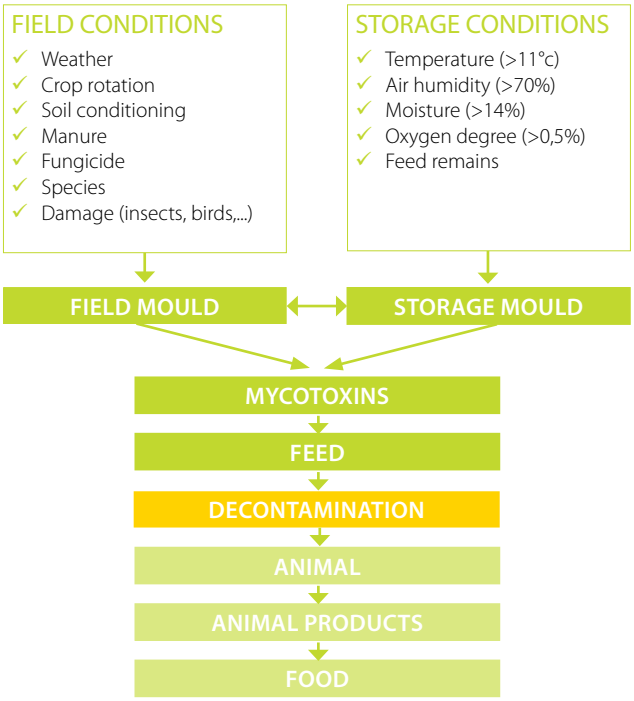
CONDITIONS OF A GOOD MYCOTOXIN ADSORBENT

- ✓ High binding at high and low levels of contamination
- ✓ Stable over a wide pH range
- ✓ Low inclusion rate
- ✓ Ability to adsorb a wide range of mycotoxins

TYPES OF MYCOTOXIN ADSORBENTS

- ✓ Inorganic (eg. silicates)
- ✓ Organic (eg. yeast derivates)
- ✓ Multi-component (blends)

FIGURE 2: MYCOTOXINS IN FEED AND FOOD CHAIN



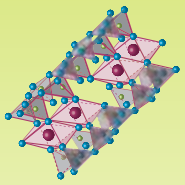
DECONTAMINATION METHODS (TABLE 6)

Extraction is a good way to isolate mycotoxins from a raw material. Unfortunately, this method is practically unfeasible in animal feed.

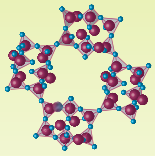
A **chemical** treatment with ammonia or ozone converts the mycotoxins into less toxic components. The completeness of this reaction is a prerequisite for a good result.

A simple and reliable method is the addition of a **mycotoxin binder** to the feed.

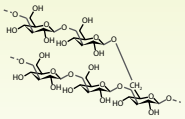
Starbind
star quality



clay mineral



+ clinoptilolite



+ yeast products

+ organic salts and acids

Starbind - an efficient mycotoxin binder

COMPONENT 1: ACID ACTIVATED CLAY MINERALS

Clay minerals are aluminosilicates with a layered structure. In the separate layers isomorphic substitution can occur, resulting in electrically charged layers. This affects the adhesion between the different layers and their ability to bind polar molecules at their surface.

The activation of clay minerals with acid makes the clay mineral more porous and electrochemically more active, resulting in an increased adsorption capacity.

COMPONENT 2: CLINOPTILOLITE

Like the clay minerals, clinoptilolite is an aluminosilicate with a porous, honeycomb-like structure that acts as a "molecular sieve".

COMPONENT 3: YEAST PRODUCTS

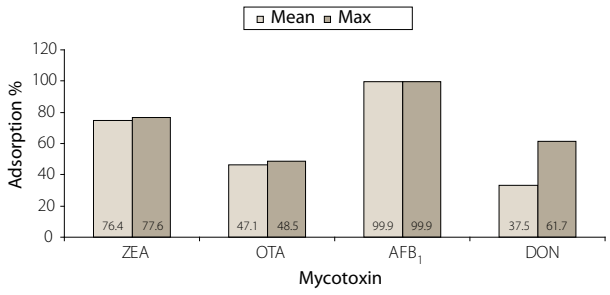
Yeast cell walls contain1-3,1-6-beta-glucans that can adsorb mycotoxins such as DON and ZEA, structures that are more difficult to bind than aflatoxins.

COMPONENT 4: ORGANIC ACIDS AND SALTS

Short chain organic acids and their salts are known mould inhibitors. These components avoid repeated contamination of the feed by mycotoxins.

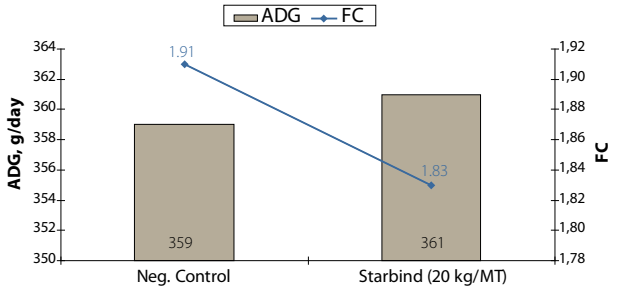
Starbind - in vitro / in vivo

FIGURE 3: ADSORPTION PERCENTAGE OF STARBIND



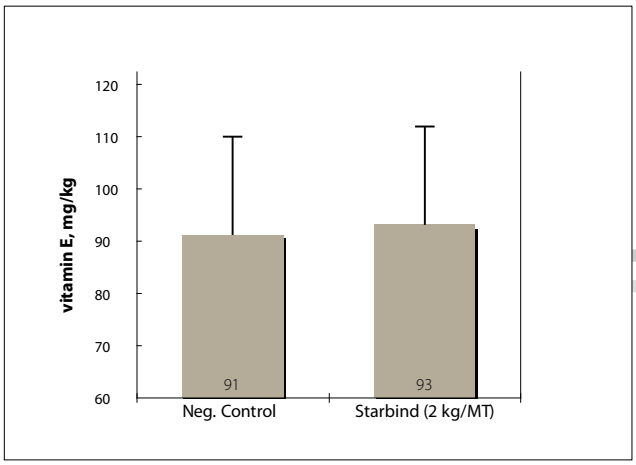
Mean and maximum adsorption capacity of Starbind by high performance liquid chromatography (HPLC) tests for 4 mycotoxins through a pH change (3 - 6.5), simulating the gastrointestinal tract of monogastric animals. Starbind included at a commercially recommended dosage.

FIGURE 4: TOLERANCE TEST (PIGLETS)



Regarding nutrient absorption of clays, as mentioned by some literature, we can conclude that even at an inclusion of 20 kg / MT (10x the advised maximum dosage) of Starbind there is no risk of binding essential nutrients such as vitamins and minerals.

FIGURE 5: VITAMIN E ADSORPTION



The results clearly show there is no anti-nutritional effect. (No adsorption of Vitamin E)

Starbind - optimal solutions

TABLE 7: STARBIND - PRODUCT RANGE

SPECIES	PRODUCT	DESCRIPTION
	STARBIND	Broad range mycotoxin binder
	311 STARBIND	Mycotoxin binding blend especially developed for ruminants
	220 STARBIND	Blend of silicates especially for Aflatoxin, Zearalenone and Ochratoxin

TABLE 8: STARBIND - PREVENTIVE DOSAGE

SPECIES	PRODUCT	AMOUNT	
Poultry & pigs	Starbind, Starbind 220	0.5 - 1.0	kg / MT
Dairy cows	Starbind 311	15	g / cow / day

TABLE 9: STARBIND - DOSAGE IN CASE OF SEVERE PROBLEMS

SPECIES	PRODUCT	AMOUNT	
Broilers	Starbind, Starbind 220	1.5 - 2.0	kg / MT
Layers	Starbind, Starbind 220	2.0	kg / MT
Piglets < 25kg	Starbind, Starbind 220	2.0 - 3.0	kg / MT
Pigs > 25kg	Starbind, Starbind 220	1.0 - 2.0	kg / MT
Sows	Starbind, Starbind 220	2.0 - 3.0	kg / MT
Dairy cows	Starbind: 311	25 - 30	g / cow / day close up period + begin lactation
		15	g / cow / day mid + end lactation