nutrex NV

the finishing touch for nutrition

Free-Tox

No escape

Mycotoxins and moulds

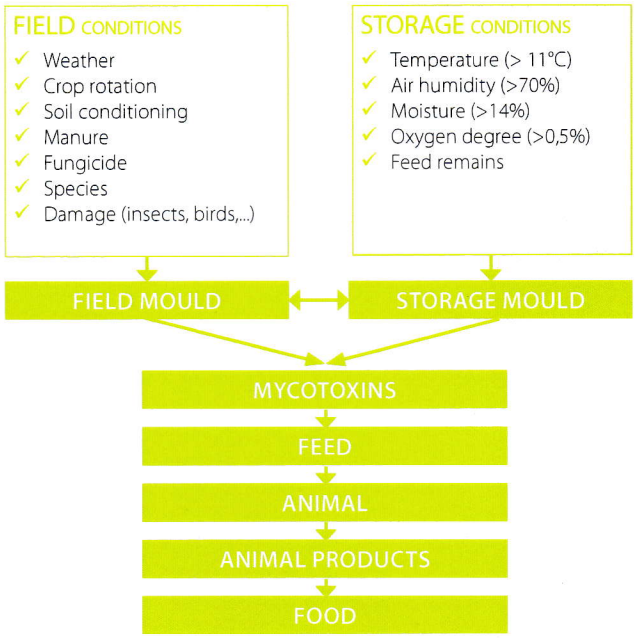
Moulds can grow in the field or they can develop during storage. Mycotoxins are secundary metabolites of these moulds and **toxic for animals and humans after ingestion.** Moulds can grow very well without producing mycotoxins. So the occurence of mould doesn't neccessarily imply the presence of mycotoxins. The inverse situation is also true: mycotoxins can be present without a visual sign of mould growth.

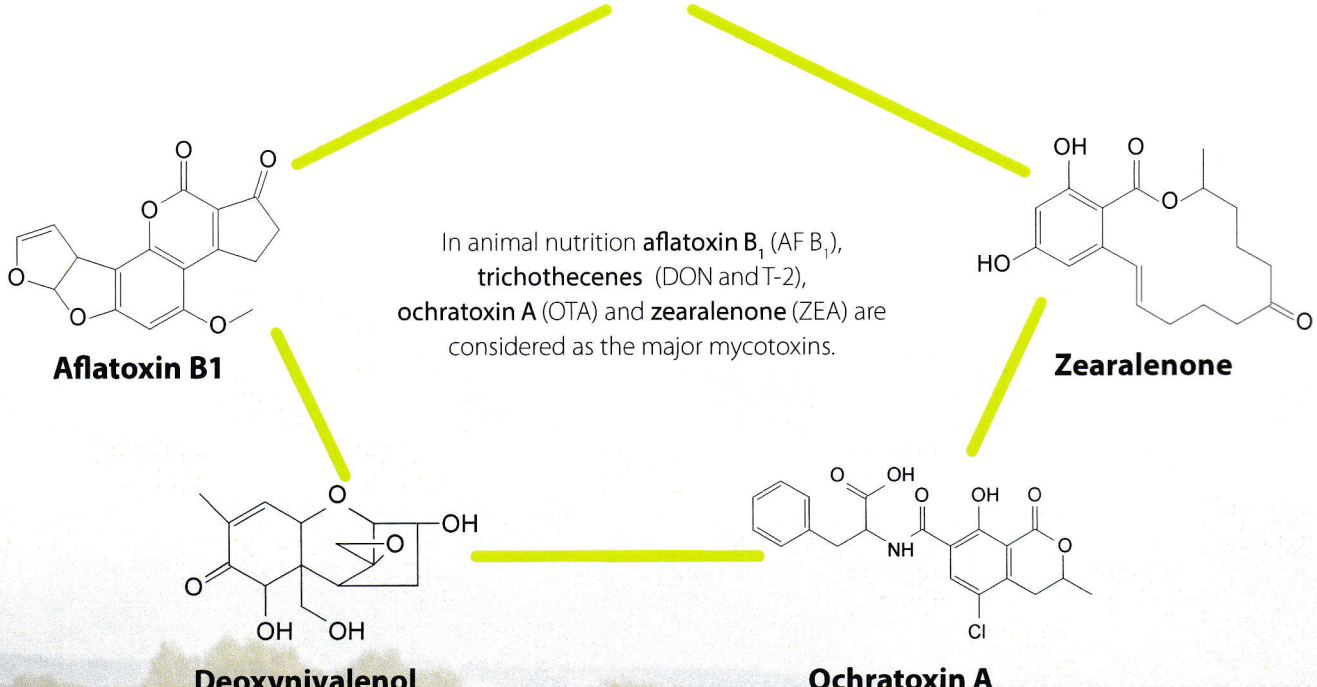
The production of mycotoxins depends on a number of parameters such as oxygen levels, climate, moisture, substrate,... The production of a certain mycotoxin is not the exclusive property of one type of mould. Inversely, one mould can produce a range of mycotoxins.

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





Contamination

Table 2 gives a summary of 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 like straw and chaff could be contaminated. Straw is often used as bedding material to be beneficial for the welfare of animals, 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: MAX TOLERABLE LEVEL

MYCOTOXIN	SPECIES	PPB
AF B1	poultry	20
	dairy cattle	5
	beef cattle	20
	young animals	10
DON	poultry	3200
	calves	1600
	dairy cattle	2400
	beef cattle	4000
ZEA	poultry	-
	calves / dairy cattle	400
	beef cattle	-
OTA	poultry	160
	ruminants	-

Table 4 presents an overview of the max tolerable level for mycotoxins in poultry and ruminants. Moreover, a lower mycotoxin contamination (subtolerable) can substantially impair animal performance and even cause more severe problems on long term than an acute dosage.

Clinical signs

TABLE 5: CLINICAL EFFECTS

	POULTRY	RUMINANTS
AFB1	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	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	Kidney damage Higher water consumption Poor shell quality Reduced feathering **Residues**: in liver, meat and eggs	Less sensitive to OTA
ZEA	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)*.

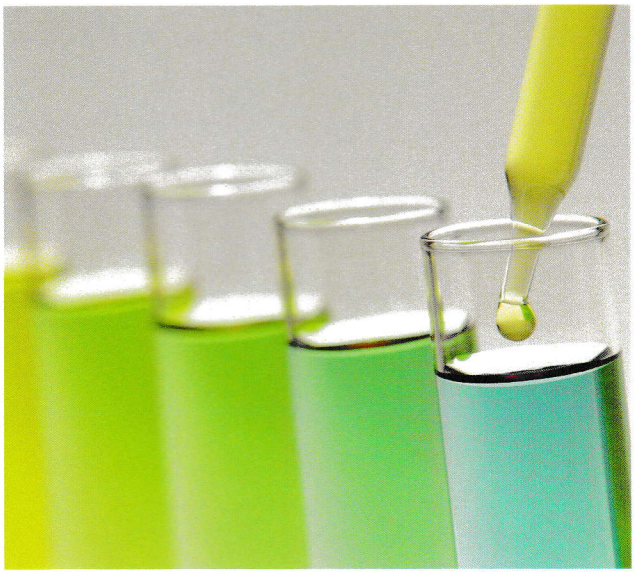


FIGURE 2: MYCOTOXINS IN FEED AND FOOD CHAIN

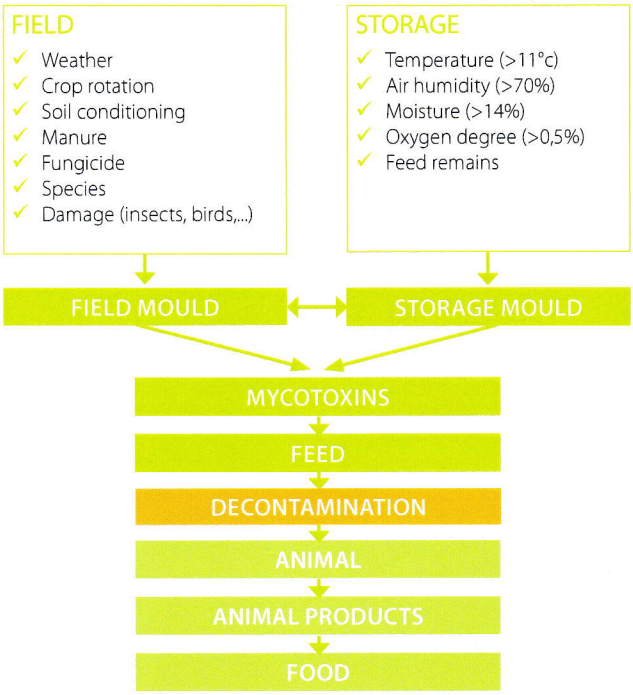


TABLE 6: DECONTAMINATION METHODS

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)

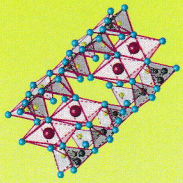
DECONTAMINATION METHODS (TABLE 6)

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

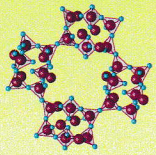
A **chemical** treatment with ammonia or ozone converts the mycotoxins into less toxic components. The completeness of this reaction is a prerequisite for a good result.

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

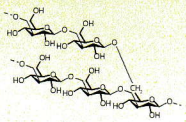
Free-Tox
no escape



clay mineral



+ clinoptilolite



+ yeast products

+ organic salts and acids

Free-Tox - 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 adsoprtion 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

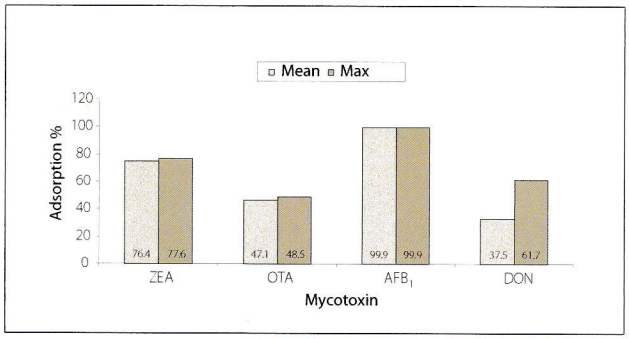
Yeast cell walls contain1-3,1-6-beta-glucans that can adsorb mycotoxins such as DON and ZEA, structures that are more difficult to bind than aflatoxins.

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.

Free-Tox - in vitro / in vivo

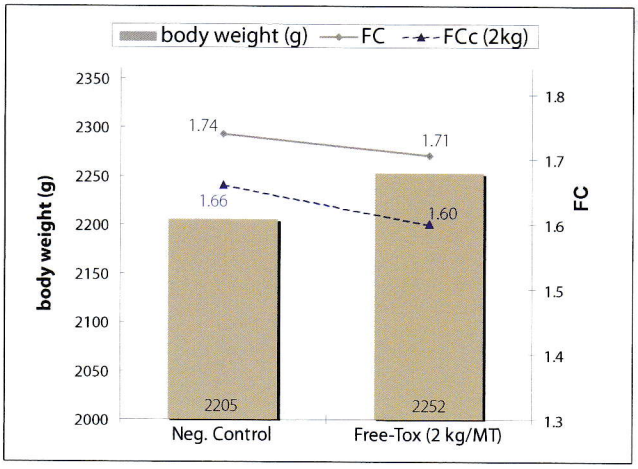
FIGURE 3: ADSORPTION PERCENTAGE OF FREE-TOX



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

FACILITY:	Zootechnical Centre - Catholic University Leuven, Belgium
BROILERS:	Ross 308
FEED:	Wheat - soy based ration (DM < 12 %)
MYCOTOXINS:	Feed was naturally contaminated (222 ppb of DON)
TREATMENTS:	Negative control vs Free-Tox (2 kg / MT)
CONCLUSION:	Free-Tox improved daily gain with 2.1 % and the FC with 1.8 %

FIGURE 4: BROILER TRIAL (2009)



Free-Tox - optimal solutions

TABLE 7: FREE-TOX - PRODUCT RANGE

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

TABLE 8: FREE-TOX - PREVENTIVE DOSAGE

SPECIES	PRODUCT	AMOUNT	
Poultry	Free-Tox, Free-Tox 220	0.5 - 1.0	kg / MT
Dairy cows	Free-Tox 311	15	g / cow / day

TABLE 9: FREE-TOX - DOSAGE IN CASE OF SEVERE PROBLEMS

SPECIES	PRODUCT	AMOUNT	
Broilers	Free-Tox, Free-Tox 220	1.5 - 2.0	kg / MT
Layers	Free-Tox, Free-Tox 220	2.0	kg / MT
Dairy cows	Free-Tox 311	25 - 30	g / cow / day close up period + begin lactation
		15	g / cow / day mid + end lactation

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Research & Innovation

Our multidisciplanary team of nutrition professionals combines scientific reasearch with hands-on experience to translate their knowledge into workable solutions, adjusted to our customers' needs. All of our products and applications are the result of intensive research and development, in-house as well as in close cooperation with customers, universities and research institutes around the world.

We are constantly alert to emerging trends and receptive to input from our customers and partners. A continuous screening of scientific information unveils new opportunities to create innovative products and solutions.

Quality & Safety

Our internal quality assurance system provides us with a transparant organisation, efficient procedures and ensures we're a reliable partner to our customers. Our quality control, based on GMP standards, makes our products fully traceable and safe for animal, man and environment.

Flexibility & Customer Service

We aim to offer flexible solutions in all aspects of our business, touching anything from tailor-made products to providing nutritional advice, aid with product registration procedures and logistical support.