nutrex NV

the finishing touch for nutrition

Free-Tox

No escape

THE POLYVALENT MYCOTOXIN BINDER

Mycotoxins and moulds

Mycotoxins are secondary metabolites produced by moulds growing on crops in the field or which develop during storage under poor conditions of crops and/or finished feed (figure 1). Despite the fact that mycotoxins are tasteless, odorless and invisible, they are a big concern in animal production as they can cause severe economical losses due to their toxic effect after ingestion. The main negative effects in livestock are seen in performance, feed intake, reproduction, organ damage,...

In animal nutrition **aflatoxin B_1** (AFB_1), **trichothecenes** (DON and T-2) **ochratoxin A** (OTA), **fumonisin** (FUM) and **zearalenone** (ZEA) are considered as the major mycotoxins, which are spread worldwide:

- 25% of world's crops are contaminated with mycotoxins (Source: FAO)
- 95% of feed mycotoxins are produced already in the feed (Source: Pioneer Hi-Bred)
- Occurrence and concentration are depending on environmental conditions

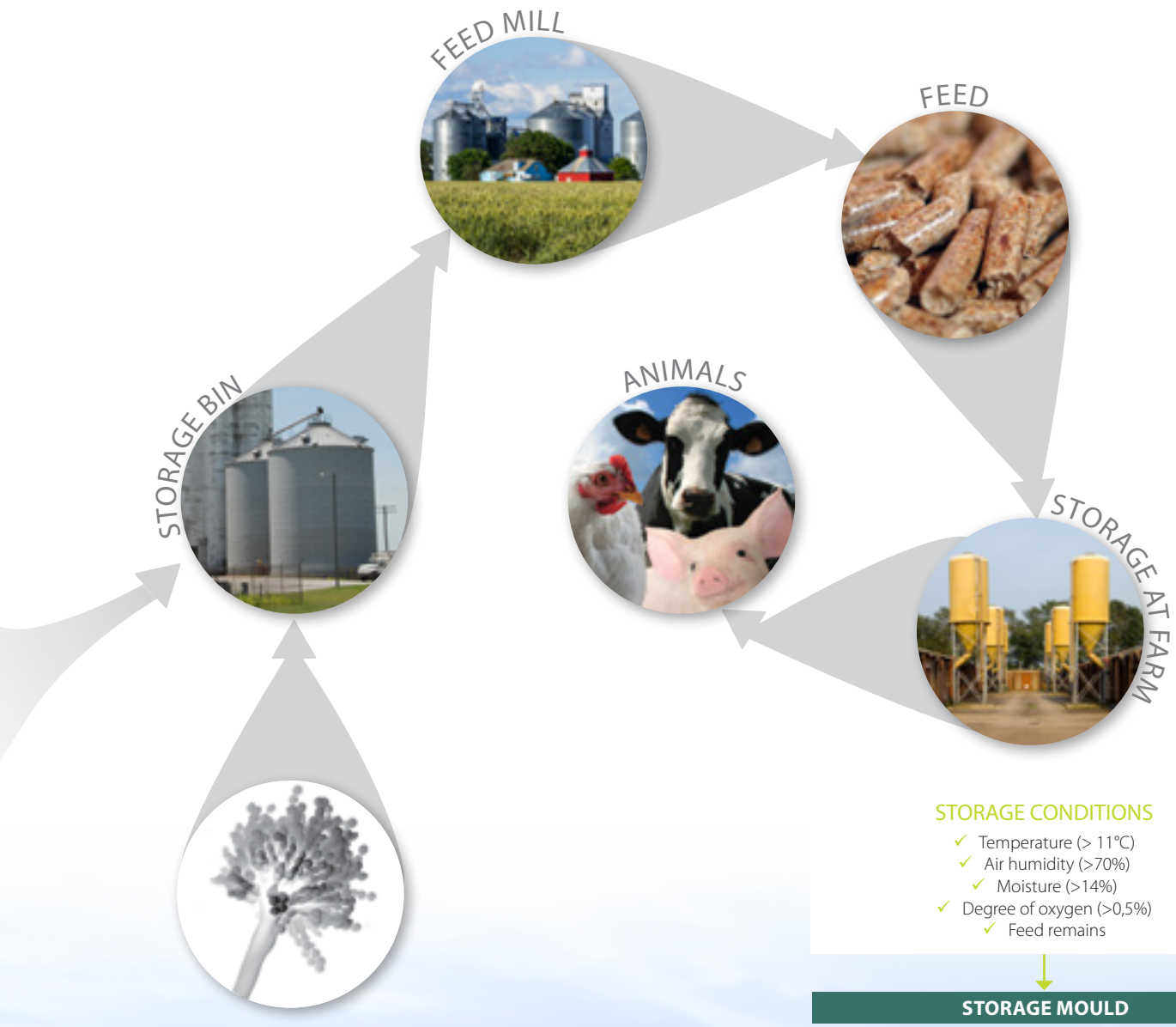
Field mycotoxins

FIELD CONDITIONS

- ✓ Weather
- ✓ Crop rotation
- ✓ Soil conditioning
- ✓ Manure
- ✓ Fungicide
- ✓ Species
- ✓ Damage (insects, birds,...)

FIELD MOULD

Storage mycotoxins



STORAGE CONDITIONS

- ✓ Temperature (> 11°C)
- ✓ Air humidity (>70%)
- ✓ Moisture (>14%)
- ✓ Degree of oxygen (>0,5%)
- ✓ Feed remains

STORAGE MOULD

Origin and maximum tolerable levels

TABLE 1: ORIGIN OF MAJOR MYCOTOXINS		
	MOULD	MYCOTOXIN
STORAGE	*Aspergillus*	Aflatoxin Ochratoxin
	Penecillium	Ochratoxin Citrinin
FIELD	*Fusarium*	Deoxynivalenol T-2 Zearalenone Fumonisin
	Claviceps	Ergot

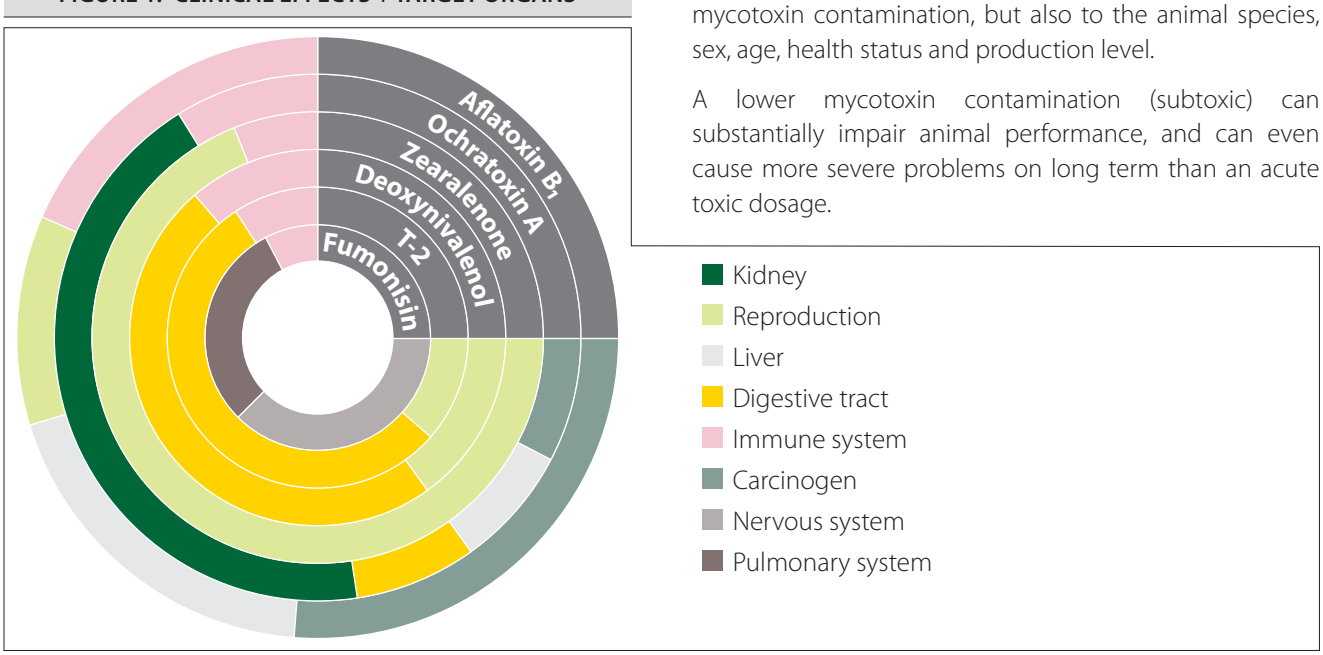
Table 2 presents an overview of the maximum levels of contamination that are considered to be tolerable in complete feed, according to EU-legal guidance values. Comparing the animal species clearly indicates the difference in sensitivity between pigs, poultry and ruminants.

TABLE 2: MAXIMUM TOLERABLE LEVEL IN COMPLETE FEED (DIRECTIVE 2002/32/FC) (RECOMMENDATION 2006/576/EC + 2013/ 165/EC)

MYCOTOXIN	SPECIES	PPB
AF B_1	pigs	20
	poultry	20
	dairy cattle	5
	ruminants	20
	young animals	10
DON	pigs	900
	calves	2000
ZEA	piglets and gilts	100
	fattening pigs and sows	250
	ruminants	500
OTA	pigs	50
	poultry	100
FUM $B_1 + B_2$	pigs	5000
	poultry	20000
	calves	20000
	ruminants	50000
	horses	5000
	fish	10000
T-2 & HT-2	all species	250

Clinical effects

FIGURE 1: CLINICAL EFFECTS + TARGET ORGANS



Clinical signs are not only related to the type and level of mycotoxin contamination, but also to the animal species, sex, age, health status and production level.

A lower mycotoxin contamination (subtoxic) can substantially impair animal performance, and can even cause more severe problems on long term than an acute toxic dosage.

Synergism

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

OESTROGENIC
IMMUNOTOXIC
NEUROTOXIC
MUTAGENIC
CARCINOGENIC

Free-Tox | An efficient mycotoxin binder

Free-Tox is **specifically designed** for animal feed to protect livestock against the negative effects of a broad spectrum of mycotoxins produced by moulds.

TABLE 3: FREE-TOX

Free-Tox is a combination **of specifically selected and processed**:

Silicates (bentonite & clinoptilolite)	Yeast cell walls	Organic acids & salts

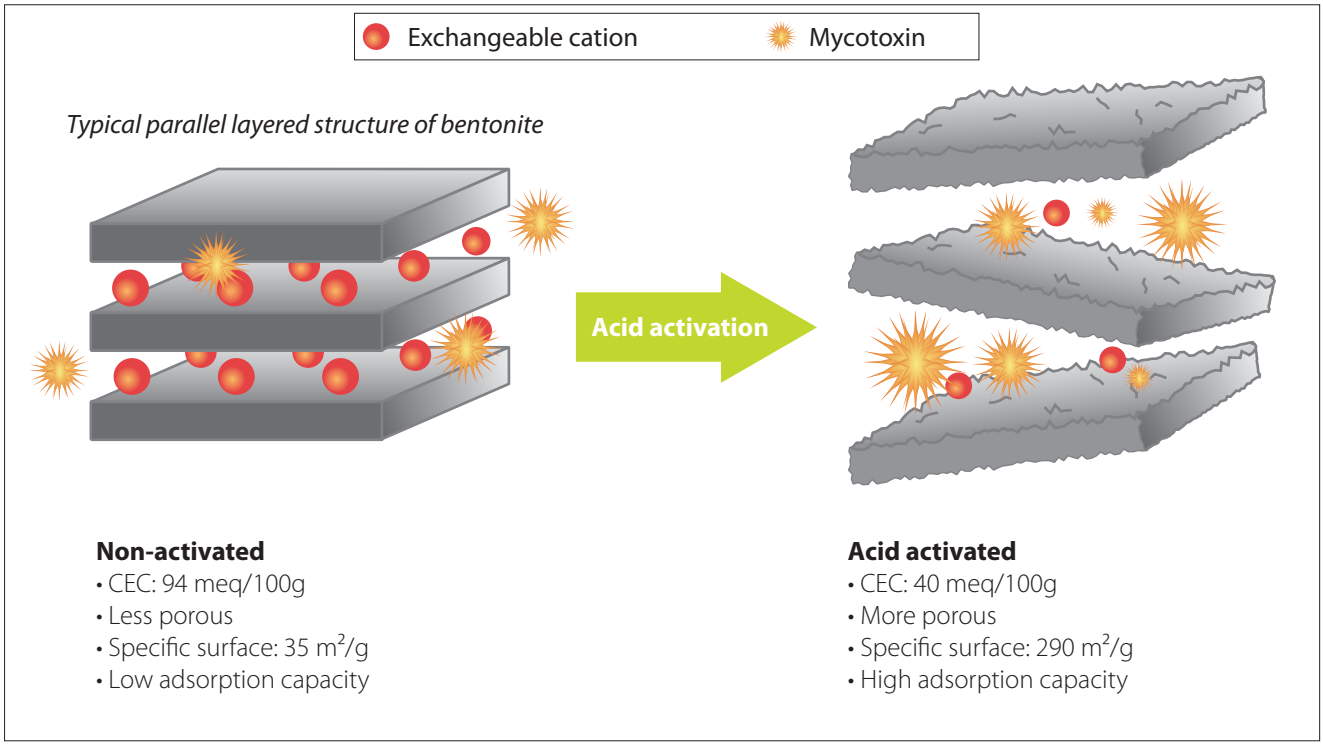
Free-Tox | Active components

COMPONENT 1: ACID ACTIVATED BENTONITE

Due to the natural electrical imbalance in bentonite, polar mycotoxins, such as aflatoxin, can be readily attracted to the bentonite. This way they are adsorbed quite easily on the outer surface, but only to a limited extent on the inner layers. Due to the fact that the cations in between the layers (Na+, Ca2+,…) keep those layers closely together and occupy a lot of space, it is even more difficult for larger, non-polar mycotoxins to be adsorbed between those layers. So, for non-polar mycotoxins such as ZEA, OTA, T-2, etc. this adsorption by a natural bentonite may not be appropriate to obtain a positive effect in animal production.

By using a specific acid activation process, the overall layered structure of the bentonite in Free-Tox is drastically changed. This results in an increased specific surface area, in formation of bigger pores and thus in an increased adsorption capacity, also for larger mycotoxins such as ZEA. Due to the removal of interlaminary cations, the CEC of the bentonite will also be altered, reducing the risk of nutrient binding.

FIGURE 2: ACID ACTIVATION OF FREE-TOX BENTONITE



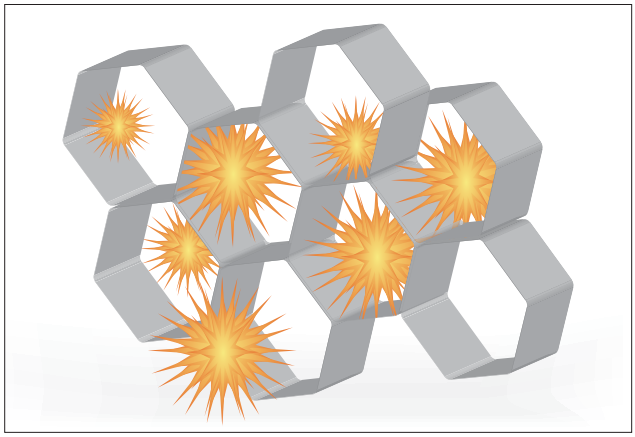
COMPONENT 2: CLINOPTILOLITE

Besides binding mycotoxins, clinoptilolite is also known to have other positive effects related to use in animal production.

Free ammonium coming from undigested proteins is excreted via the litter which can cause ammonium pollution of the environment, and can also irritate foot pads of poultry resulting in foot pad lesions.

Clinoptilolite has a specific selectivity for ammonium cations in the gastro intestinal tract, that results in binding them. So, thanks to the inclusion of clinoptilolite, Free-Tox contributes to reduced ammonium excretion in the litter, leading to less environmental pollution and less foot pad lesions (poultry).

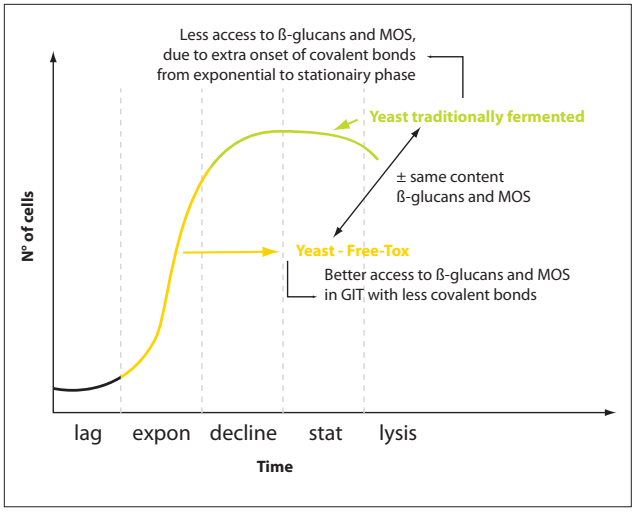
FIGURE 3: 'HONEYCOMB'-LIKE STRUCTURE OF CLINOPTILOLITE



COMPONENT 3: YEAST CELL WALL

The cell wall of Saccharomyces cerevisiae is composed of a dense network of ß-glucans and mannan oligosaccharides (MOS) tightly linked to each other by covalent bonds. The ß-glucans provide next to the mechanical strength of the wall, also the binding sites for mycotoxins. Not only the amount of ß-glucans (more ß-glucans = more binding sites) is important, but also the accessibility of these binding sites.

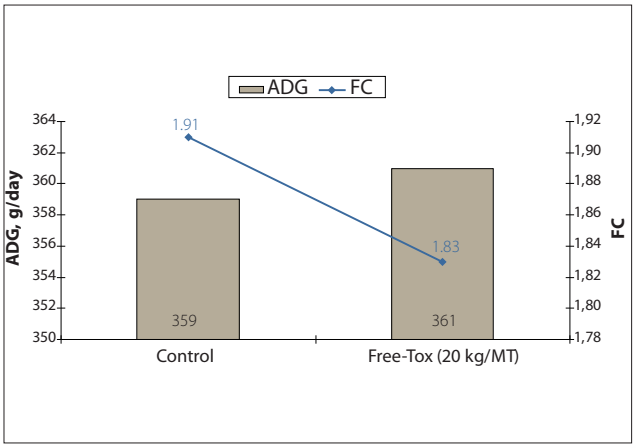
FIGURE 4: YEAST HARVESTING



Yeast cell walls used in Free-Tox are extracted and harvested in the early stage of the fermentation (figure 4), during which the network of covalent bonds is less dense which offers more flexibility and a maximal accessibility of the mycotoxin binding sites. Many yeasts (mainly brewer's yeast) are harvested in a later stage of fermentation and have more covalent bonds, more rigidity and less accessibility of the binding sites.

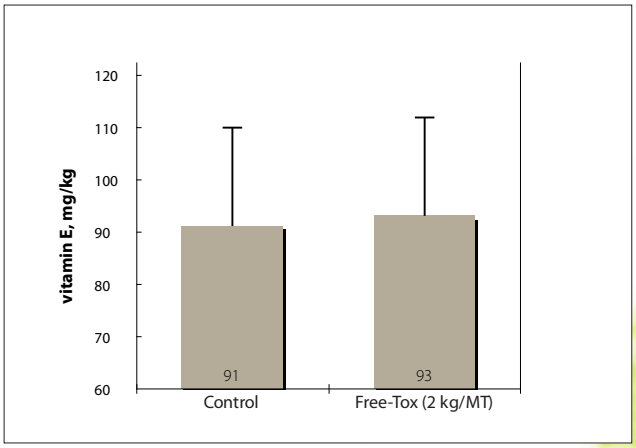
Free-Tox | Safety in animal & feed

FIGURE 5: TOLERANCE TEST (PIGLETS)



In literature, it's often suggested that there is a potential risk for nutrient binding with use of mycotoxin binders. To evaluate the effect of Free-Tox on nutrient binding, a tolerance trial was performed at the University of Leuven trial facility with inclusion of 20kg/MT (10x the advised maximum dosage) in an uncontaminated piglet diet. Given the result in figure 5, it's clear that no essential nutrient binding could have taken place.

FIGURE 6: VITAMIN E ADSORPTION



As shown in figure 6, it was also confirmed that no vitamin E is adsorbed at the maximum advised dosage of 2kg/MT Free-tox compared to a control feed.

Free-Tox | Trials

TABLE 4: TRIALS						
	TRIAL	MYCOTOXIN	CONTAMINATION (ppb)	DOSE Free-Tox (kg/T)	Improvement growth (%)	Effect on FC (%)
PIGS	ZTC/W/1148	DON	1300	2	+2.3	-
		ZEA	70			
	UG/W/1304	DON	740	2	+2.7	-3.0
	ZTC/W/1311			20	+0.6	-4.2
	UG/W/1450	DON	5200	2	+3.9	-4.0
	ZTC/C/1632	DON	300	1	+6.8	-5.3
		ZEA	25			
BROILERS	ZTC/W/1348	DON	220	2	+2.1	-1.7
	ZTC/W/1523	T-2	1500	2	+6.9	-2.6
	ZTC/C/1702	AFB1	300	2	+1.3	-2.8

	TRIAL	MYCOTOXIN	CONTAMINATION (ppb)	DOSE Free-Tox (g/d/sow)	Improvement weight of weaned piglets (%)	
					Day 0	Day 28
SOWS	ZTC/W/1609	DON	120	10	+9.8	+13.7
		ZEA	20			
	W/1702	DON	300	10	+4.2	na
		ZEA	20			

Free-Tox | Optimal solutions

TABLE 5: 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 6: FREE-TOX - PREVENTIVE DOSAGE			
SPECIES	PRODUCT	AMOUNT	
Poultry & pigs	Free-Tox, Free-Tox 220	0.5 - 1.0	kg / MT
Dairy cows	Free-Tox 311	15	g / cow / day

TABLE 7: 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
Piglets < 25kg	Free-Tox, Free-Tox 220	2.0 - 3.0	kg / MT
Pigs > 25kg	Free-Tox, Free-Tox 220	1.0 - 2.0	kg / MT
Sows	Free-Tox, Free-Tox 220	2.0 - 3.0	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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