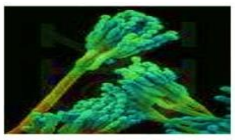
Mycotoxins

Hidden threat to Poultry Feed

Aspergillus flavus

Approx. 50% of the world's grain supply is contaminated with Mycotoxins. (FAO, 2012)



Penicillium citrinum

"Mycotoxins are considered to be among the most important feed-borne stress factor" (Surai and Dvorka,2005).

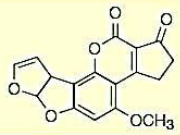
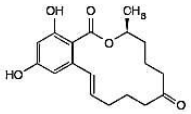
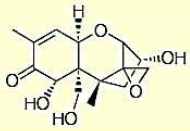
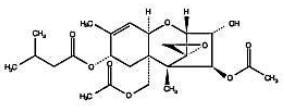
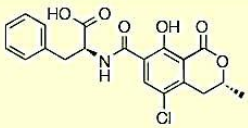
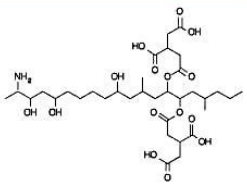
Under practical conditions, no poultry feed is completely free of Mycotoxins (Devegowda and Murthy, 2005).

More than 300 types of Mycotoxins are effecting poultry feed ingredients and have harmful effects on overall productivity.

The Mycotoxins of greatest concern include:

- ✓ **Aflatoxin**, which is generally produced by Aspergillus;
- ✓ **Deoxynivalenol**, **Zearalenone**, **T-2 Toxin**, and **Fumonisin**, which are produced by Fusarium;
- ✓ **Ochratoxin** and **PR toxin** produced by Penicillium.

Several other mycotoxins such as the ergots are toxic and may be prevalent at times in certain feedstuffs.

Mycotoxins	Chemical structure	Productivity loss	Immuno toxicity	Frequently related clinical signs	Main affected organ/system
Aflatoxins		+++++	+++++	Hepatitis, poor response to vaccination, unspecific infections, increased susceptibility to diseases	Liver, kidney, immune system
Zearalenone		+++++	++	Hyperestrogenism, reproductive disorders	Reproductive tract - mainly female.
Deoxynivalenol		+++++	++++	Feed refusal, vomiting	Central nervous system, GUT epithelium, liver, immune system
T-2 toxin		+++++	+++++	Oral and epithelial lesions, loss of apetite	GUT epithelium, liver, immune system
Ochratoxin A		+++++	+++++	Nefritis (kidney damage - enlarged kidney), hepatitis	Kidney, liver, immune system
Fumonisins		+++++	+++	Porcine Pulmonary Edema (PPE), Equine Leukoencephalomalacia (ELEM)	Lungs and heart (pig), central nervous system (horse), liver, immune system

Prevention and control of Mycotoxins: The presence of Mycotoxins is unavoidable as they are environmentally induced. Control is very important to the feed manufacturer and livestock producer.

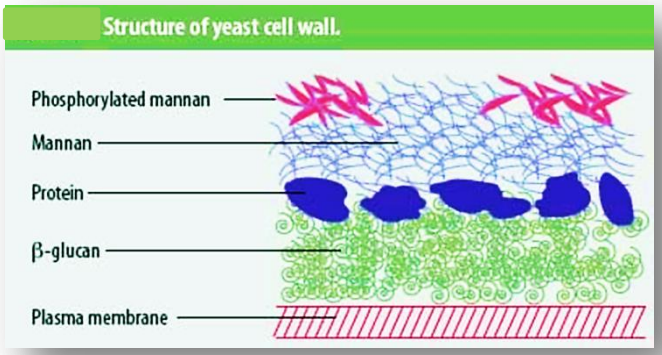
Control Measures:

- ✓ Detoxification and Physical treatment
- ✓ Chemical Agents
- ✓ Use of Adsorbents/Binders

Classification of Toxin Binders:

Silica-based inorganic compounds
- Aluminosilicates
  - Phylosilicates
    - Bentonites
    - Montmorillonites
    - HSCAS
    - Smectites
    - Kaolinites
    - Illites
  - Tectosilicates
    - Zeolites
- Activated charcoal
- Synthetic polymers
  - Dietary fi bre
  - Polyvinylpyrrolidone
  - Cholestyramine

Carbon-based organic polymers
- *Saccharomyces cerevisiae*
  - Live yeast
  - Yeast cell wall components Glucomannans
- Lactic acid bacteria
  - *Lactococcus*
  - *Lactobacillus*
  - *Leuconostoc*
  - *Pediococcus*



ZOVFACT Xpel
Innovative Mycotoxin Binder

Binary effect of
- **Inactivation of Zearalenone , Ochratoxin, Vomitoxin, Fumonisin, Aflatoxin, Citrinin & Trichothecenes (*T-2 toxin)* Toxin and**
- **Immune enhancement**

ZOVFACT^{xpel}, a Broad spectrum in-feed Mycotoxin solution, with a special formulated combination of

- **Carbon-based organic polymer Saccharomyces cerevisiae yeast products and Lactic acid bacteria and**
- **Silica-based inorganic compound Tribomechanically Activated Clinoptilolite**

in a balanced ratio that provides an effective way of controlling mycotoxicosis through creation of multiple binding sites to absorb the range of threatening mycotoxins.

1. Carbon-based Organic polymers as binders :

Organic mycotoxin binders which are commonly used are cell wall component from Saccharomyces cerevisiae yeast. Mycotoxin binding can

be enhanced by using yeast cell wall (composed of β-glucan and mannan oligosaccharides) instead of whole cell

Saccharomyces cerevisiae live yeast was shown to reduce the detrimental effects of aflatoxin in broiler diets (Stanley et al., 1993).

Fibrous material from the yeast cell wall was shown to have a potential to bind several mycotoxins (Devegowda et al. 1998).

Esterified glucomannan polymer extracted from the yeast cell wall was shown to bind with aflatoxin, ochratoxin and T-2 toxin, individually and combined (Raju and Devegowda 2000).

Additions of esterified glucomannan at 0.5 or 1.0 g/kg to diets supplying 2 mg of total aflatoxin resulted in dose dependent responses in broiler chicks (Basmacioglu et al. 2005).

ZOVFACT^{xpel} Contains highly refined polysaccharide complex derived from the cell wall of *Saccharomyces cerevisiae* yeast.

Mechanism of Binding:

Mannan Oligo Saccharides (MOS):

Mannan is present in the inner side of the cell wall of *Saccharomyces cerevisiae, yeast* which is glucan-rich. Yeast gluco-mannan showed high affinity for aflatoxins (75 to 90%) in vitro as well as in vivo and is widely used for detoxification of aflatoxins in poultry birds.

- ✓ Adhesion most important Pathogenic bacteria
- ✓ Adhesion mycotoxins (Zearalenone, T-2 and Deoxynivalenol)
- ✓ Stimulation adaptive immunity similar to Clinoptilolite

B-D-glucans:

It has recently demonstrated that the β-D-glucan fraction of yeast cell is directly involved in the binding process with ZON, and that the structural organization of β-D-glucan modulates the binding strength.

Efficacy:

Based on in vitro assays, this glucomannan (GMA) binder has shown to effectively bind to:

- ❖ **DON**
- ❖ **T-2 Toxin**
- ❖ **ZON**
- ❖ **OTA**
- ❖ **AFB1**

Mechanism of Immune response:

Inclusion of purified yeast β-glucan have been shown to stimulate phagocytosis, bactericidal killing and oxidative burst in chickens.

Two Major Components of Immune System

- Innate Immune Response
- Acquired Immune Response

β-glucan works to activate both components of the immune system.

In the Innate Immune system, β-glucan binds with macrophages, activates and increases their availability to identify and destroy foreign organism.

Lactic Acid Bacteria (LAB):

LABs are gram-positive, catalase-negative, non-sporulating, usually non-motile *rods* and *cocci* that utilize carbohydrates fermentatively and form lactic acid as major end product.

These bacteria are mainly divided into four genera:

- **Lactococcus**
- **Lactobacillus**
- **Leuconostoc**
- **Pediococcus**

Mechanism of Binding:

- The interaction mechanism between LAB and mycotoxins is thought to be similar to the interactions involved in adsorption by GMA.
- The polysaccharide components (glucans and mannans) are common sites for binding, with different toxins having different binding sites.

2.Silica-based Inorganic compound : Tribomechanically Activated Clinoptilolite

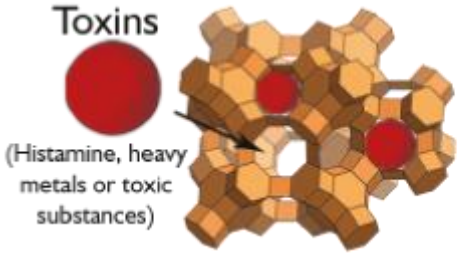
Clinoptilolite is a natural zeolite comprising a micro porous arranged of silica and alumina tetrahedral.

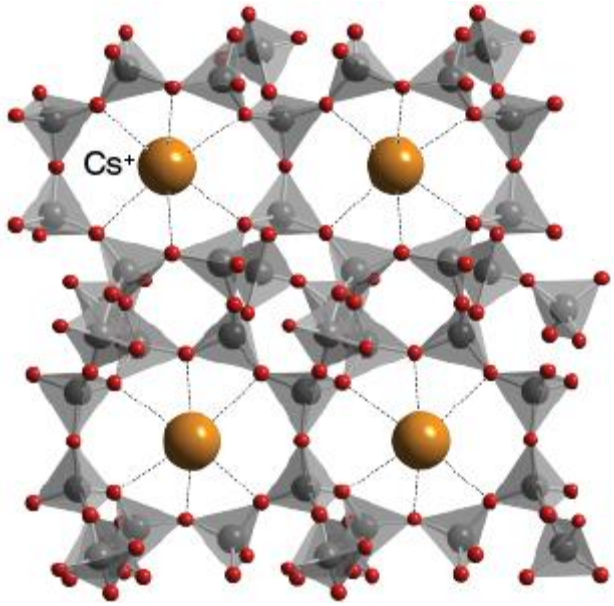
Clinoptilolite, a magnet for toxic matters.

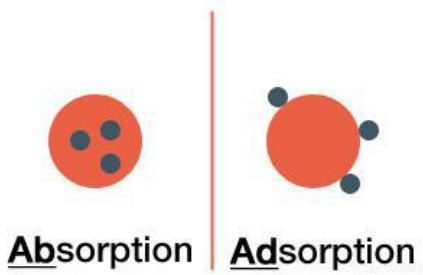
Clinoptilolite crystals have a hollow framework with numerous tunnels and pores evenly spaced out creating powerful absorbing capacity due to vast surface area resulting in molecular absorption capability.

Due to Clino's unique crystalline structure physical and chemical, it has two outstanding properties:

A. **Absorption and**
B. **Cation Exchange Capacity**







- **Absorption: Assimilation of molecular species throughout the bulk of the solid or liquid is termed as absorption. It is bulk phenomenon.**
- **Adsorption: Accumulation of the molecular species at the surface rather than in the bulk of the solid or liquid is termed as adsorption. It is a surface phenomenon.**

Powerful negative charges (ion exchange power):

"Remove heavy metals, Dioxins (Chlorinated hydrocarbons), PCB's (Ploychlorinated byphenyl), herbicides, radioactive particles and some viral particles from the body in a process known as cation exchange".

Mechanism of Immune response:

Tribomechanically activated Clinoptilolite (TMAZ)

Particles smaller than 5 micron are taken up by M cells or Dendritic cells (DC) in intestinal wall. They are then transported to the lymph nodes where they stimulate B cells for improved antibody production.

*Irreversible binding of polar aflatoxins and NH_4^+
*Anti-caking effects due small particle size
*Helps Calcium uptake in the intestines.