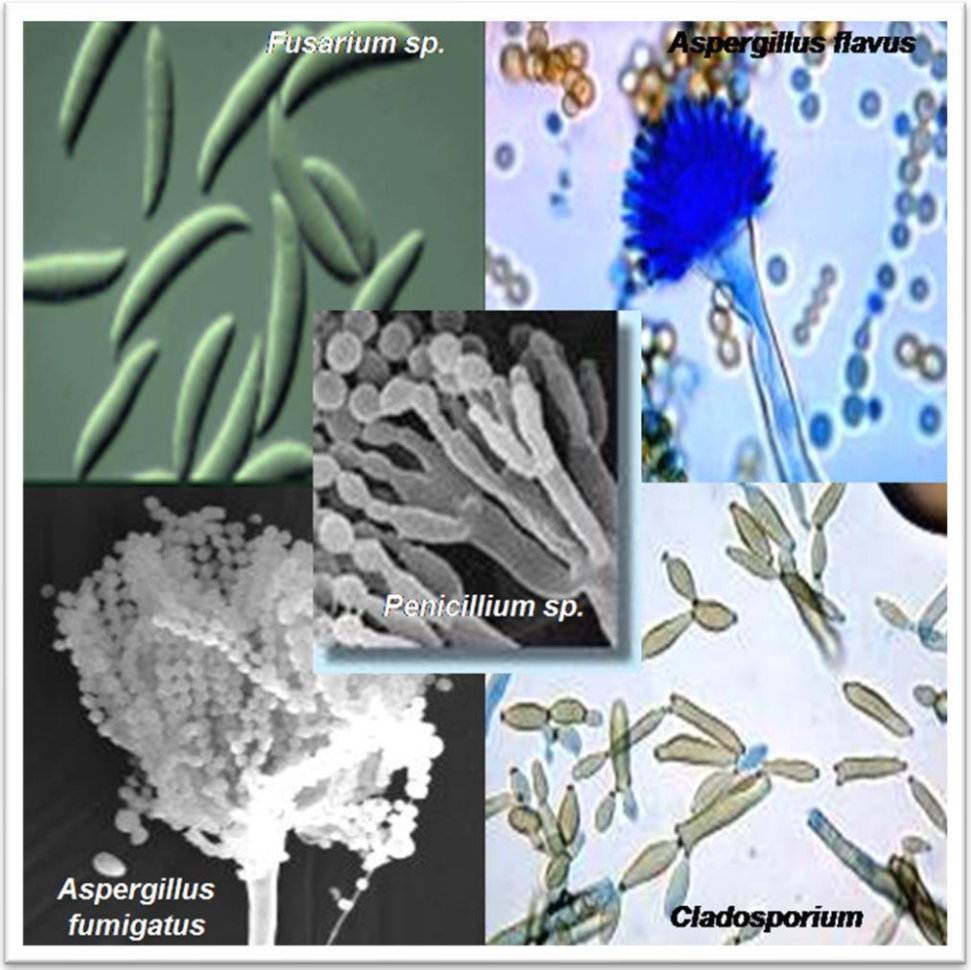
TOXIBOND

¿What are mycotoxins ?

- Mycotoxins are toxic substances resulting from secondary metabolism of different strains of fungi.
- They are present in raw materials and ingredients used in animal feed around the world.
- Mycotoxins are produced to reduce competition for substrates from other fungi.
- More than 400 Mycotoxins, produced by approximately 100 fungi, have been identified

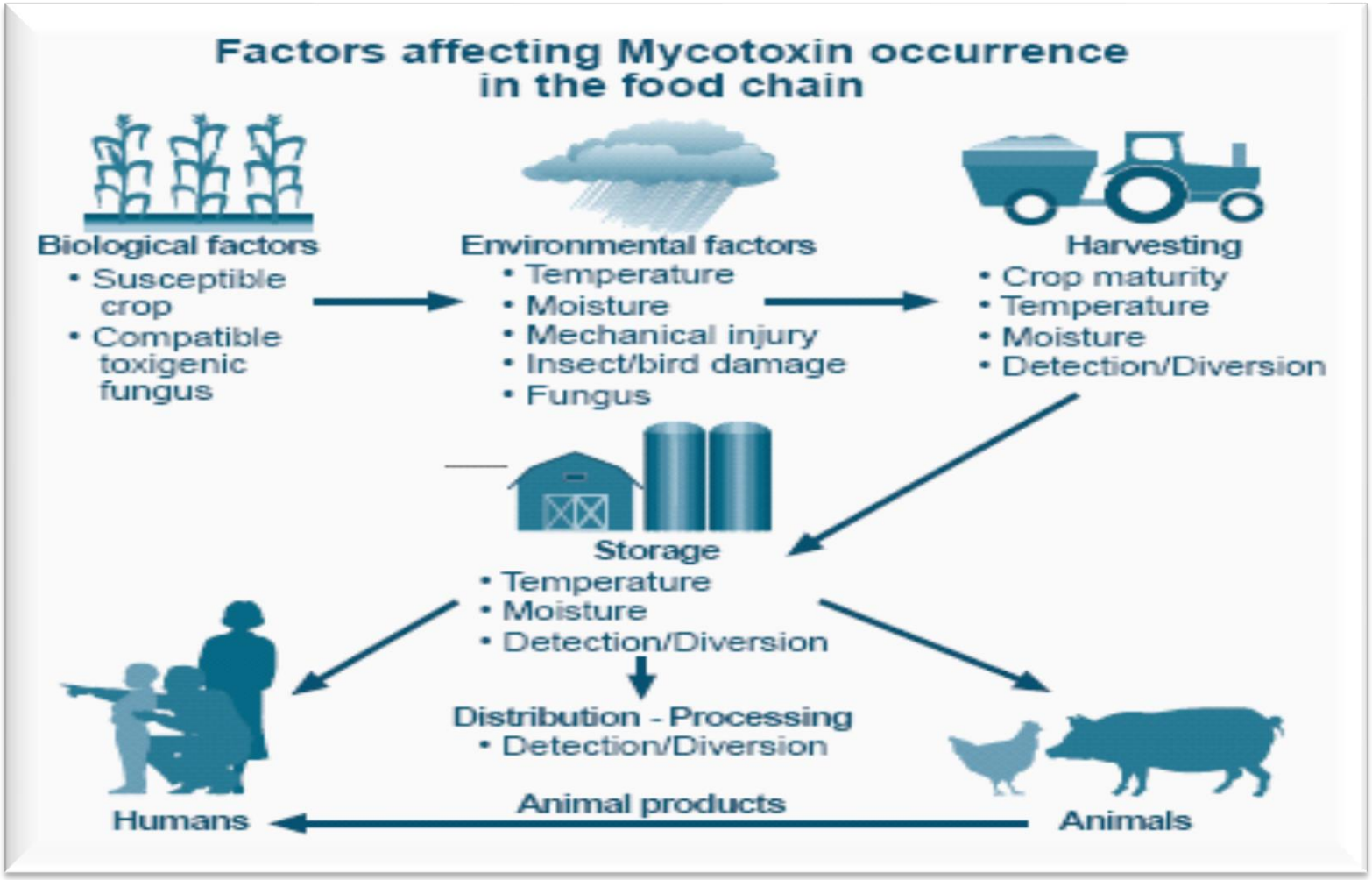


Characteristics of mycotoxins

- Chemically unstable.
- High temperature resistant.
- Resistant to different storage conditions.
- Resistant to different feed manufacturing processes.
- Invisible.
- Odorless.
- Add no flavor to feed.
- Toxicity synergisms have been established between:
  - Fumonisin and T2
  - DON and ZEN
  - T2 and DON
  - Aflatoxin and T2
  - Aflatoxin and Citrinin

Main mycotoxins

- They may be divided into three groups:
  - **Aflatoxins:** produced by fungi of the *Aspergillus gender as A. flavus and A. parasitucus*
  - **Ochratoxins:** produced by fungi such as the *Aspergillus ochraceus* and fungi of the *Penicillum* gender
  - **Fusariotoxins:** including *Trichothecenes*, Zearalenone and Fumonisin, which are produced by several species of the *Fusarium gender*


Factors affecting Mycotoxin occurrence in the food chain
Biological factors
• Susceptible crop
• Compatible toxigenic fungus
Environmental factors
• Temperature
• Moisture
• Mechanical injury
• Insect/bird damage
• Fungus
Harvesting
• Crop maturity
• Temperature
• Moisture
• Detection/Diversion
Storage
• Temperature
• Moisture
• Detection/Diversion
Distribution - Processing
• Detection/Diversion
Humans
Animal products
Animals

Mycotoxins: declared a risk.

FAO on mycotoxins:

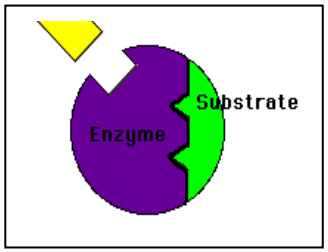
"PREVENTION REDUCES BUT DOES NOT ELIMINATE THE RISK OF MYCOTOXINS CONTAMINATION."

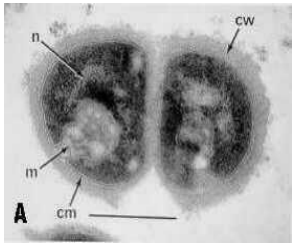
FAO estimates that 25% of the world harvest are affected by mycotoxins whether during their growth or during their storage.

Clinical signs in animals consuming feed contaminated with mycotoxins

CLINICAL SIGN	AFB1	OCHRA	D.O.N.	T-2	FB1	ZNR	ERGOT
Sudden Death	+	+			+++		
Anorexia	+	+	+++	+++	+		
Slow Growth	+++	+	+	+	+		+
Liver damage	+++	+			++		
Kidney damage		+++			+		
Vomit		+	+++	+++	+		
Abortion					+		
Infertility						+++	
Immunosuppression	+++	+		++	+++		
Agalactia						++	+++

Mycotoxin Control Methods





- **Physical:**
  - Grain cleaning
  - U.V. Radiation
  - Adsorbents.

- **Biotechnological:**
  - Enzymes
  - Yeast wall
  - Mannanoligosaccharides (MOS)

- **Chemical:**
  - Organic Solvents
  - Gases and other compounds.

Drawbacks of chemical and physical methods to control mycotoxins

Variable	Chemical	Physical
Cost	High	High
Duration	High	High
Palatability	Alteration	Light
Nutritional Quality	Reduced	Unknown
Toxicity	May be toxic	Unknown
Practical Applicability	Limited	Limited

Strategies to control mycotoxins.

Harvest

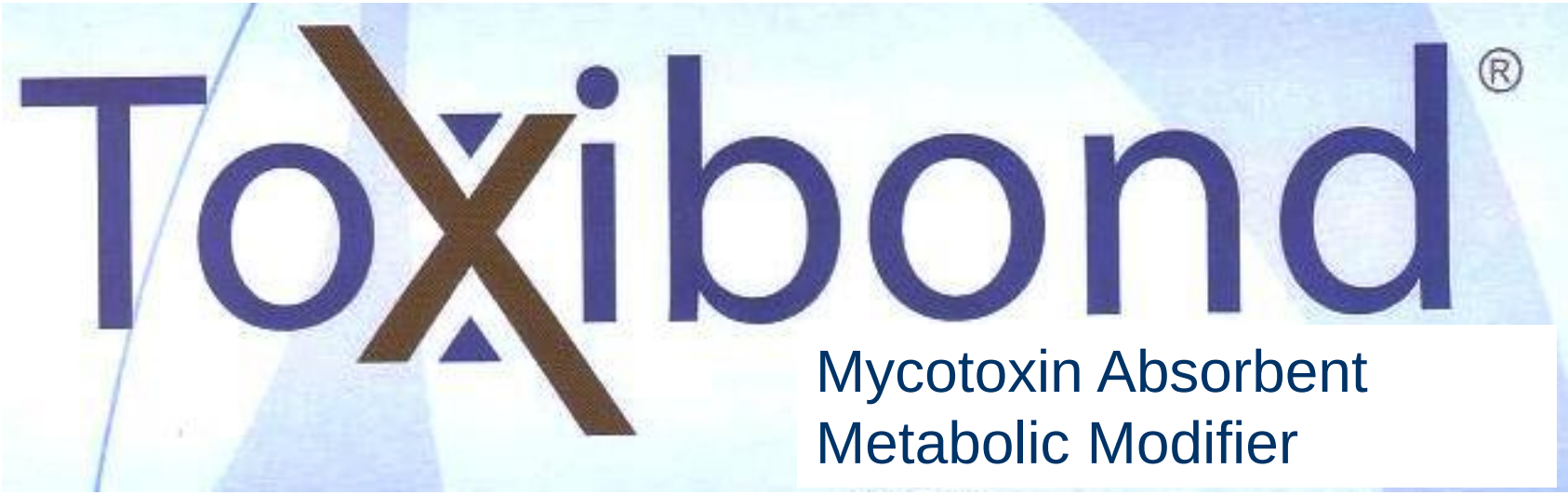
- **Prevention**
  - Selection of Seeds
  - Pest Control
  - Fertilization
  - Proper Equipment

Storage and Processing.

- Cleaning
- De-contamination
- Moisture Control
- Temperature Control
- Pest Control
- Use of mold inhibitors
- Grain Dilution

Animal

- Biotransformation
- Detoxification
- Immunopotenciation
- Use of adsorbents in feed


Toxibond®
Mycotoxin Absorbent
Metabolic Modifier

What is Toxibond?

- **TOXIBOND®** is Hydrated and Heat Activated Sodium and Calcium Aluminum Silicate (HSCAS), innocuous for humans and animals, and due to its chemical and physical properties (such as pH, Cationic Exchange Capacity, Expansibility, Particle Size, Pore Size, Water Absorption and Activation Temperature), can be used as broad-spectrum mycotoxin adsorbent.

Toxibond

Calcium and Sodium Aluminum silicates:

- ✓ Hydrated
- ✓ Activated
- ✓ Expanded
- ✓ Pillared

Toxibond Composition

FRACTION	AMOUNT
SiO_2	63.90%
AL_2O_3	16.20%
CaO	1.95%
Fe_2O_3	3.32%
MgO	2.90%
Na2O	3.90%
K2O	0.80%

Toxibond Composition

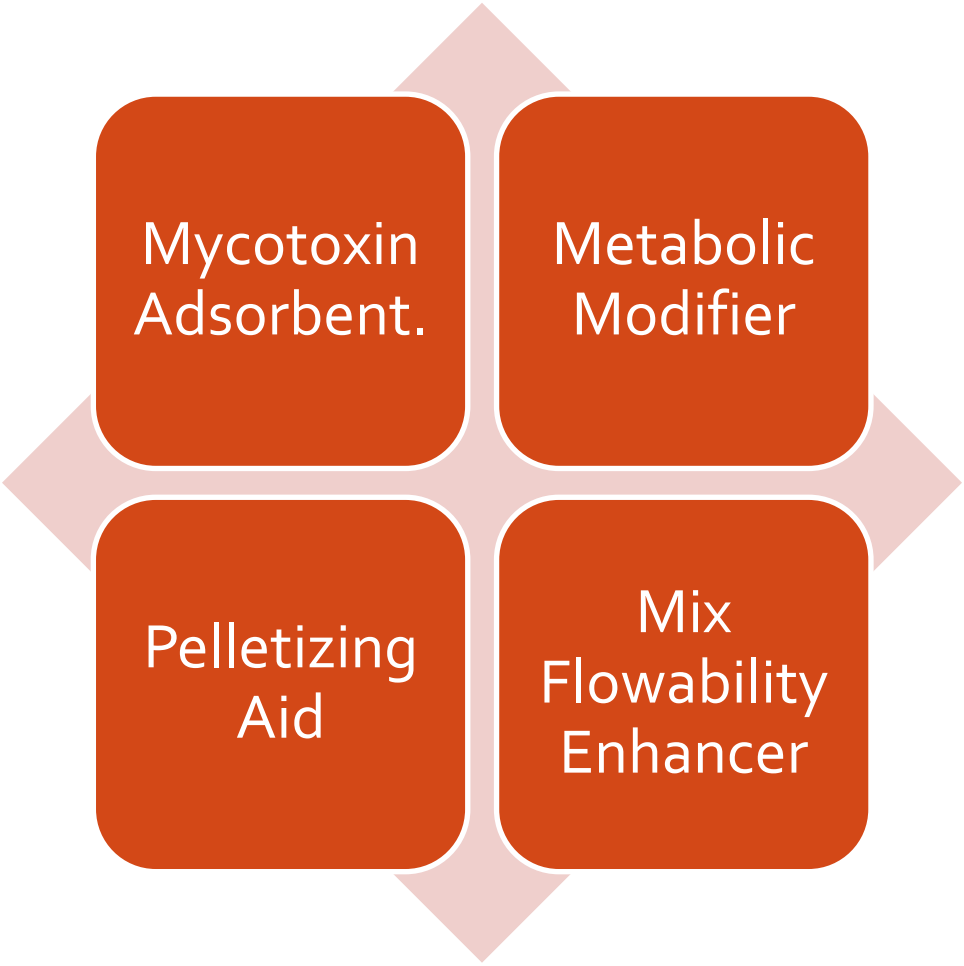
Clay Minerals Polarity		
Clay Minerals	**C.E.C.**	**Polarity**
Illites/ Chlorites	20-60 mEq	Bi -polar(+/-)
Montmorillonites/Bentonites	60-100 mEq	Polar (+)
Caolinites	0-20 mEq	Polar (+)

Toxibond is a synergetic compound mixture of three different clay minerals: Illites, Bentonites and Caolinites. Due to this combination Toxibond has a capability to adsorb a wide range of mycotoxins.

Toxibond: Physical and Chemical Characteristics

Property	Value
pH	7.5-9.5
C.E.C.	**38.52 mEq**
Color	Light Brown (Beige)
Toxicity	Nil (Innocuous)
Water Absorption	Low
Granulometry	250 – 325 mesh
Thermal Activation	**at 120 °C**
Electric Charge	**Bipolar (+ / -)**
Pore Size	2.8 A°
Category	Broad-Spectrum

Toxibond


Mycotoxin Adsorbent.
Metabolic Modifier
Pelletizing Aid
Mix Flowability Enhancer

How does it Work?

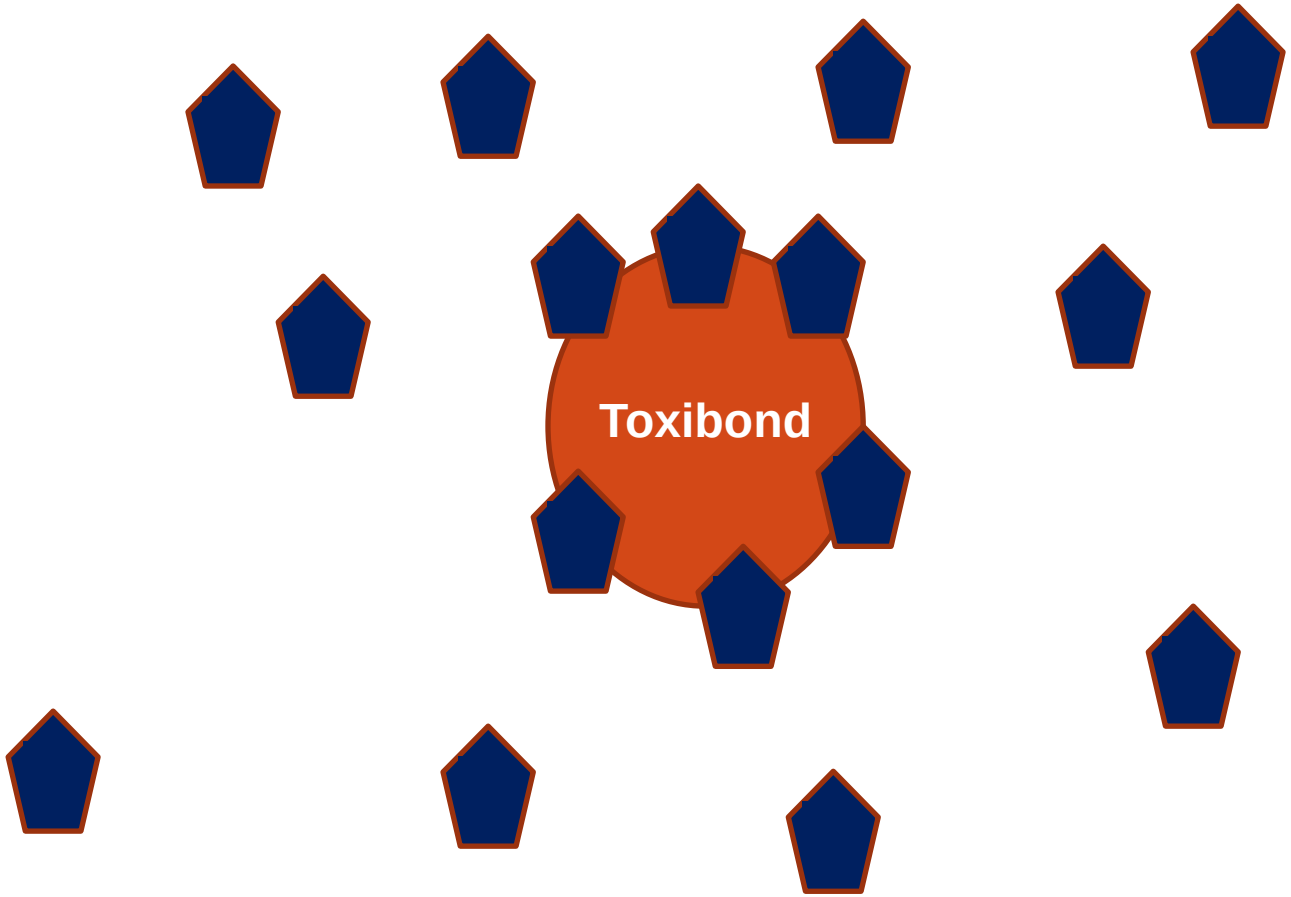
- As a mycotoxin adsorbent
  - **TOXIBOND®** has low Cationic Exchange Capacity (C.E.C.) and bipolar electric charges, which makes it an excellent alternative to adsorb (by electric binding) a broad range of mycotoxins among them: Aflatoxin B1, Zearalenone, Ochratoxin, Vomitoxin, Fumonisin, T2 and Citrinin.
  - Using Van der Waals forces **TOXIBOND®** binds to active toxin´s chemical groups, turning them into larger size compounds and avoiding their absorption into the small intestine

Efectiveness of Toxibond as Mycotoxin Adsorbent

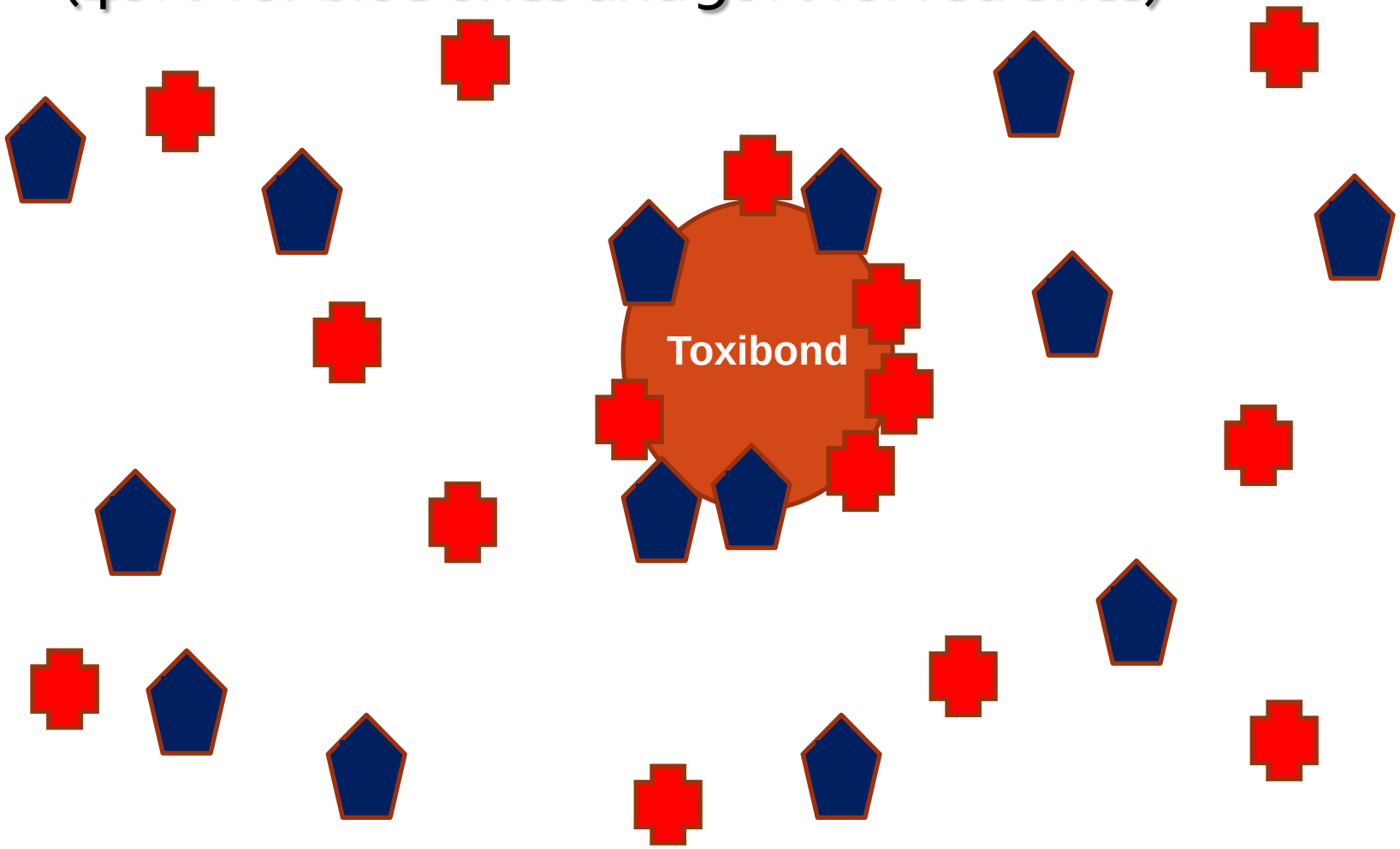
Average results of different *in-vitro* tests, using a **pH of 6, and a dosage of 2,500 grams of TOXIBOND per metric ton** of feed,

Mycotoxin	Level Of Adsorption
Aflatoxin B1	92-96%
Ochratoxin	68-70%
T2 toxin	82-85%
Citrinin	85-90%
Vomitoxin	75-80%
Zearalenone	48-51%
Fumonisin	60-65%

Adsorption of one mycotoxin (60%): Laboratory conditions



Adsorption of two mycotoxins: Field Conditions (40% for blue ones and 50% for red ones)



Toxibond Effectiveness as Mycotoxins Absorbent

Dose: 2.5 Kg/TM Reading: HPLC	T2	Zea	Afla	Fum	Ochra
	ppb	ppb	ppb	ppb	ppb
Feed with Toxibond*	10.20	9.87	12.54	2.10	7.16
Variation Coefficient	20.59%	11.96%	13.16%	23.81%	14.53%
Contents in Feces	5.80	4.32	11.34	1.12	4.81
Variation Coefficient	16.90%	11.96%	20.28%	7.14%	12.47%
Apparent Adsorption	56.86%	43.77%	90.43%	53.33%	67.18%

*Each value is the average of 4 laboratory tests

Toxibond

- This presentation contains information resulting from the use of Toxibond® as a Metabolic Modifier in phase I

Head Researcher: Juan David Sorza Z.

Animal nutritionist, PhD.

Director Innovation & Development - Biomix S.A.

Animal Nutrition Professor, U. of Antioquia, Colombia

Promoters and Modifiers

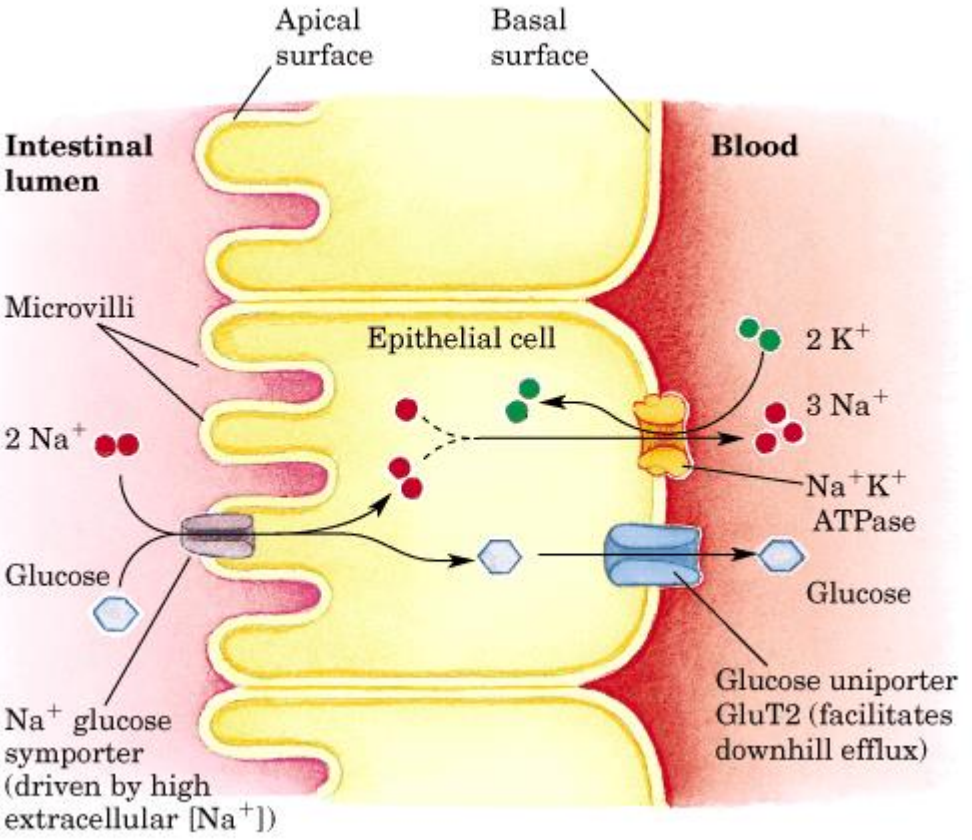
- Growth Promoter: Ingredient (nutritional or additive) stimulates the availability of nutrients in favor of increased body weight (Zinc Bacitracine, Olaquindox, and so on)
- Promoter of Production: Ingredient (nutritional or additive) stimulates availability of nutrients in favor of improved production indicators (Zinc Bacitracine, Olaquindox, and so on)
- Metabolic modifier: Collier (2001) classified the compound altering metabolism to improve efficiency in a productive process. (Enzymes, Raptopamine, Anabolic implants, Toxibond). This includes improved rate of growth, production, body composition or utilization of nutrients. The challenge to producers is on how to assess or calculate the effects of metabolic modifiers over the animal nutritional requirements.

Toxibond as Phase I Metabolic Modifier

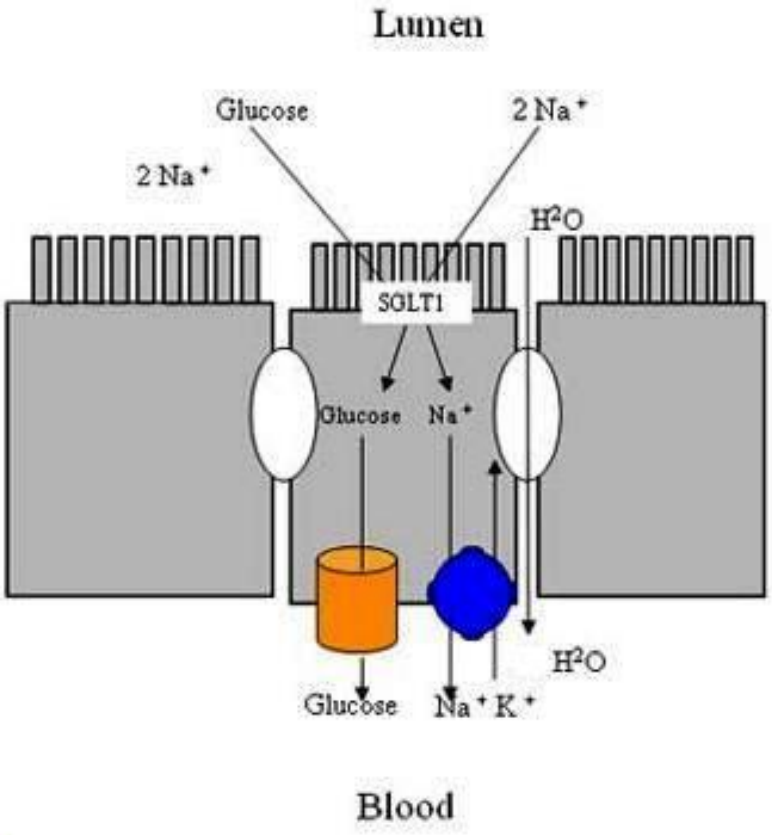
Research and field testing have demonstrated that Toxibond acts as metabolic modifier on phase I through three mechanisms:

1. Increases gastrointestinal retention time which favors endo and exo-enzymatic action. This is due to TOXIBOND® low percentage of hydration (6%) which does not cover the villi and, therefore, does not impair the absorption of nutrients.
2. Increased trans-cellular absorption of glucose through increased trans-mural potential differential (PDT) at the enterocyte of the micro-villi; as a result more energy retention is produced and in turn a reduction in feed consumption which does not affect productive parameters.
3. Indirect increase in Para-cellular absorption of water favoring a reduction in fecal humidity and stench.

Toxibond: Mode of Action



Toxibond: Mode of Action



Toxibond in Ruminants

- Using a Toxibond dose of 30-70 g/animal/day in Dairy Cattle has demonstrated to be effective in controlling Polar mycotoxins such as Aflatoxins (Absorption Level over 95%).
- Using the Toxibond increases productive parameters has been observed (+600 Kg Milk per 305 day Lactation) in animales consuming Toxibond against negative controls.