Fungus Species

- More than 50 species of Fungus produce more than 400 types of Mycotoxins:
- Fusarium sp
- Aspergillus sp
- Penicilium sp
- Claviceps sp

Important Points

- Generally, Mycotoxins in feed are mixed and rarely occurs singular (**Solution should take care of Mixed toxins)**
- Mycotoxins are synergistic in action- Mixed mycotoxins are more Dangerous
- Aflatoxins entry from feed to milk average 6%
- Mycotoxins can enter Milk within 6 hours after animal has taken feed
- As Calves have Rumen at developing stage, mycotoxins are more toxic for Calves.
- Toxins also interact with Amino acids and Minerals absorption present in the feed.

Source of mycotoxins in ruminant feed

Ingredient	Mycotoxin occurrence	Inclusion rate in diet	Contribution in total mycotoxin risk
Maize silage	All mycotoxins, high occurrence	High	**High**
DDGS	All mycotoxins, very high occurrence	Medium	**High**
Maize	All mycotoxins, high occurrence	High	**High**
Grass (pasture)	Ergot alkaloids, occurrence depends on year	High	Medium
Wheat bran	Trichotecenes, ZEA, ergot alkaloids, occurrence depends on year	High	Medium
Grass silage	Low occurrence	High	Low
Oilseeds	OTA, ZEA	High	Low
Wheat	Trichotecenes, ZEA, ergot alkaloids, occurrence depends on year	Medium	Low

Mycotoxins in ruminants

Reproductive system
ZEA
- Irregular heats
- Low conception rates
- Ovarian cysts
- Embryonic loss

Central nervous system
ERG
- Neck paralisis

Gastro-intestinal tract
FUM, T2, DON
- Gastroenteritis
- Intestinal hemorrhages
- Impaired rumen function
- Diarhea
- Ketosis

Udder
AFL , T2, DON,
- Milk contamination
- Decreased milk production
- Mastitis

Hoofs
FUM, DON, ERG
- Laminitis

Performance
T2, DON
- Decreased feed intake
- Lower milk production
- Decreased feed efficiency

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Negative effects of mycotoxins in ruminants

- Calves
- Heifers

Common symptoms:

- Decreased feed intake
- Reduced weight gain
- Inhomogeneous growth
- Higher mortality
- Diarrhoea
- Gastroenteritis
- Enlarged and reddened teats in heifers
- Poor response to vaccination
- Lesions on the muzzle, lips, tongue, and pharynx

- Dairy cattle
- Beef cattle

Common symptoms:

- Decreased feed intake, increased feed refusal, anorexia
- Reduced weight gain, weight loss
- Decreased milk production, agalactia
- Depressed butterfat in milk
- Elevated somatic cell count, mastitis
- Diarrhoea
- Gastroenteritis
- Higher incidence of ketosis (fatty liver), retained placenta, metritis, fertility disorders, displaced abomasum
- Lameness, hoof necrosis
- Ovarian cysts
- Vaginitis, vaginal secretions
- Increased body temperature/heat stress
- Staggering gait
- Poor response to vaccination
- Aflatoxin M1 in milk

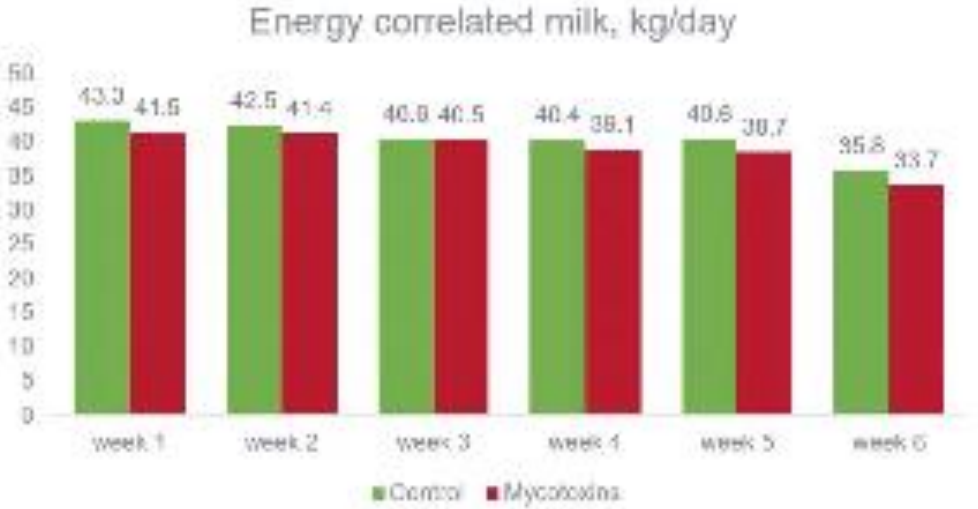


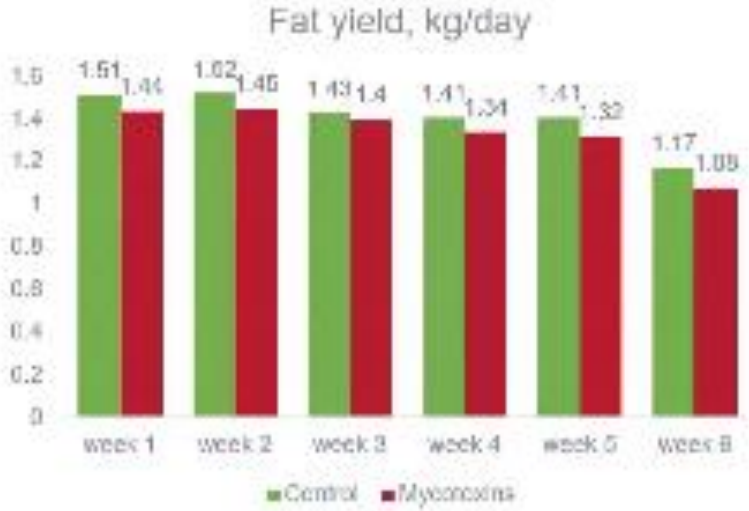



Effect of mycotoxins on milk production and quality

- ↓ milk production
- ↓ milk fat
- ↑ SCC
- ↑ Milk contamination by Aflatoxin M1

FUM 1054 ppb, ZEA 628 ppb, DON 4771ppb





natural contamination - fusarium mycotoxins DON, 15-acetyl DON and ZEA (Korosteleva et al. 2009)

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Typical symptoms of mycotoxicosis

- Aflatoxin B1 – hepatotoxic
  - 0.05 ppb

- Aflatoxin B1 – food quality concern
  - 0.002 ppb (0.02 ppb):

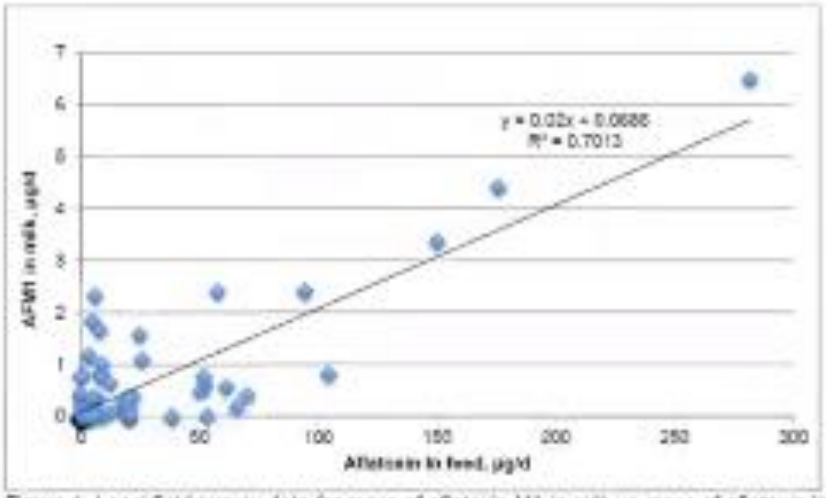

Figure 1. Local field survey data for mass of aflatoxin M1 in milk vs mass of aflatoxin in feed.

K. A. Churchill, N. Kochendoerfer, M. L. Thonney, D. L. Brown
Department of Animal Science Cornell University, USA

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Life phase – different metabolism

medium

heifer

Lower feed/mycotoxins turnover in rumen – better ruminal deactivation (e.g. DON)

Consider health of cow+fetus due to stable mycotoxins (e.g. ZEA, ERG, AFL)

Mycotoxins stable in rumen can cause abortion (e.g. ZEA, ERG)

High

dry cow

Lower feed/mycotoxins turnover in rumen – better ruminal deactivation (e.g. DON)

Consider health of cow+fetus due to stable mycotoxins (e.g. ZEA, ERG, AFL)

Mycotoxins stable in rumen can cause abortion (e.g. ZEA, ERG)

Mycotoxins can cause oxidative stress (AFL)

high

1/3 lactation

Higher feed/mycotoxins turnover in rumen – worse ruminal deactivation (e.g. DON)

Mycotoxins will affect performance (DON – yield and fat) and milk quality (AFL)

ZEA can cause false oestrus and ineffective insemination

medium

2-3/3 lactation

High feed/mycotoxins turnover in rumen – worse ruminal deactivation (e.g. DON)

Mycotoxins will affect performance (DON – yield and fat) and milk quality (AFL)

Mycotoxins stable in rumen can cause abortion (e.g. ZEA, ERG)

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Maximum legal limits in complete feed, ppb

Mycotoxin	Dairy cows	Calves, lambs	Others
Aflatoxin*	5	10	50
DON**	5.000	2.000	5.000
Ochratoxin	200	100	200
Zearalenone**	500	500	500
T+HT-2 toxins	100	100	100
Fumonisin B1+B2**	50.000	20.000	50.000

*DIRECTIVE 2002/32/EC
**COMMISSION RECOMMENDATION 2006/576/EC

strategy in mycotoxin management → Protect

Multiple Toxin Binder- Toxynil

Detoxify

TOXY-NIL®

UNIKE® Plus

Adsorption

High adsorbent modified clay minerals

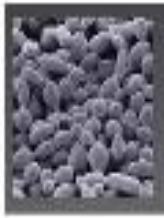
Bentonite → AFB1
Sepiolite → ZEA, OTA, FUM, ER
Yeast wall → ZEA
(*In vitro* evaluation)

Bio-inactivation

Yeast and fermentation extracts

inactivation of mycotoxins by the intestinal microflora or by host cells, stimulated by the yeast

Repair



Immune system revival

Fermentation extracts

↗ Innate immunity (macropha cytokines)
↗ Adaptive immunity (antibodies, ↗ vaccination efficacy)

Oxidative stress inhibition

Antioxidant and preservative mixture

Strong oxidant: ZEA
Moderate oxidant: Fum, AFB1,
Low oxidant: DON, OTA
→ ROS production and then, o damage

Aid to affected organs

Botanicals

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R&D results to support the mode of action of TOXY-NIL®

Protocol

University of Missouri

- 24 mid-lactation Holstein cows (183 ± 70 DIM)
- Randomized block design, blocks formed on days in milk, milk yield, and parity (n=8/treatment)
- Trial duration : 21 days (7 days adaptation / 7 days experiment / 7 days recovery (NC))
- 3 treatments :
  - **NC:** no aflatoxin B_1 and no mycotoxin deactivator
  - **PC:** 2.8 mg of aflatoxin B_1/cow/day*
  - **TN:** 2.8 mg of aflatoxin B_1/cow/day* + 100 g of TOXY-NIL®/cow/day
- Measured parameters :
  - Aflatoxin M_1 concentrations in milk and urine
  - Gene expression (RNA-sequencing) in blood leucocytes and milk somatic cells

*aflatoxin B_1 (650 mg/kg) culture material was incorporated into the diets. 5X FDA limit

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A Bluestar Company

R&D results to support the mode of action of TOXY-NIL®

Results: aflatoxin intake, excretion, clearance

University of Missouri

	NC	PC	TN	SEM
Intake of aflatoxin, µg/kg of diet	0.0^{a}	106.5^{b}	107.6^{b}	2.9
Intake of adsorbent, % of diet	0.0^{a}	0.0^{a}	0.4^{b}	0.0
Milk				
AFM_1 concentration, µg/kg	0.0^{a}	0.6^{b}	0.2^{c}	0.1
AFM_1 excretion, µg/d	0.0^{a}	20.5^{b}	8.1^{c}	1.7
AF transfer, %	0.0^{a}	2.7^{b}	1.0^{c}	0.2
Clearance of AFM_1, %/d	0.0^{b}	46.1^{a}	66.5^{a}	6.7
Urine				
AFM_1 concentration, µg/l	0.5^{c}	14.2^{a}	6.9^{b}	1.5
AFM_1 excretion, µg/d	15.4^{c}	521.6^{a}	225.8^{b}	53.1
AF transfer, %	0.0^{c}	18.6^{a}	8.0^{b}	1.9

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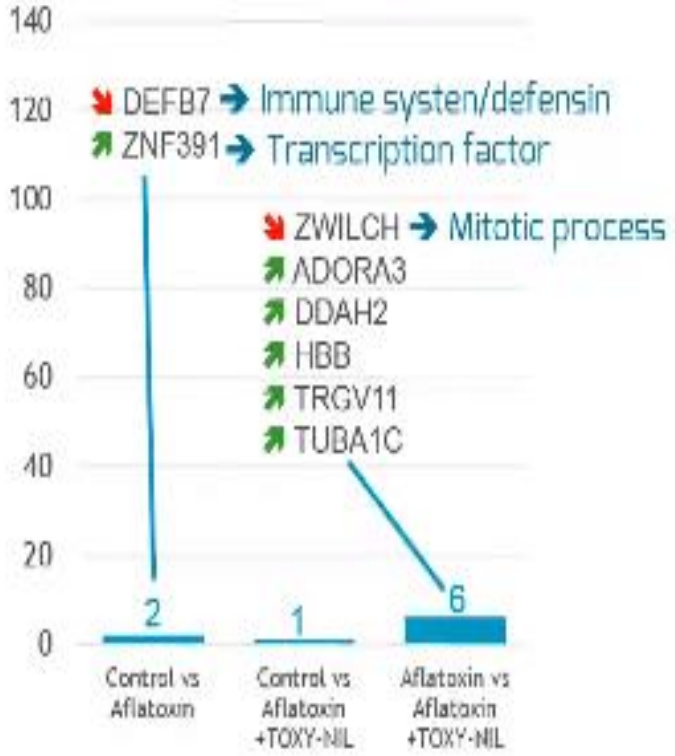
R&D results to support the mode of action of TOXY-NIL®

University of Missouri

Results: gene expression

Blood leucocytes

Differently expressed genes



Downregulation
Upregulation

Glycoproteins and milk proteins
Secretion
Signaling
Protein binding
Transporter activity
Response to steroid hormones

Milk leucocytes

Differently expressed genes