Mycotoxin binders
An option for safer milk in Kenya?

Florence Mutua, Johanna Lindahl, Delia Grace

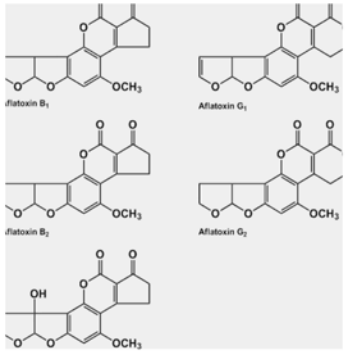
20- 24 May 2019

Food safety conference, Kenyatta University, Nairobi, Kenya

CGIAR RESEARCH PROGRAM ON Agriculture for Nutrition and Health

ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

Introduction (1)



- Aflatoxins are **toxic** substances produced by certain species of moulds.
- Best-characterised of many mould toxins in food and feed
- Common in **Kenya** *(human outbreaks / much food and most feed above permissible levels)*
- **AFB1:** most common / toxic in humans and animals

ILRI
CGIAR

AFB1 in the dairy value chain

- Exposure to **cows** is through contaminated feed
- Contamination: *use of spoilt raw materials, poor feed storage practices, giving food thought unfit for humans to animals*
- Exposure to **humans** is through contaminated milk and milk products

ILRI CGIAR

The link between AFB1 in feed and release of AFM1 in milk

Feed

- Feed with **AFB1** is given to cows

In the rumen

- **AFB1** is broken down in the rumen and metabolites removed (waste)
- A fraction of AFB1 is absorbed / reaches the liver

In the liver

- **AFB1 is broken down to a reactive (toxic) form**
- ***DNA binding*** *(mutagenic/ carcinogenic)*
- ***protein / RNA binding*** *(cell processes disrupted)*
- *detoxified to less toxic forms* ***(AFM1 in*** *milk)*

ILRI CGIAR

Implications in human health…

- AFM1 is the main AFB1 metabolite in milk; *~a carry-over rate of 1-7% has been reported~*
- *Other ASF (except sun-dried, secondarily contaminated) much less carry-over*

- Why focus on AFM1? It *retains ~10% of AFB1 effects(health); high milk consumption rates; infant*

ORIGINAL ARTICLE

Aflatoxin M_1 levels in different marketed milk products in Nairobi, Kenya

Johanna Frida Lindahl[1,2,3] · I. N. Kagera[1,4] · D. Grace[1]

ILRI CGIAR

Very little aflatoxin is transferred to animal tissue or eggs

Ratios of aflatoxin in feed to that in edible animal tissues and products

Animal	Tissue	Aflatoxin	Feed/Tissue ratio (ppb)
Chicken (Layer)	Egg	B_1	2,200[a]
Chicken (Broiler)	Muscle	B_1	33,800[b]
Swine (Pigs)	Muscle	B_1	182[b]
Cattle (Dairy)	Milk	M_1	75[a]
Cattle (Beef)	Muscle	B_1	500[b]

[a]Adapted from Park and Liang. 1993; [b]Adapted from Manning et al. 2005

Replicated from Njapau, *et al.* EAC Policy Paper, 2015

Implications in animal health…

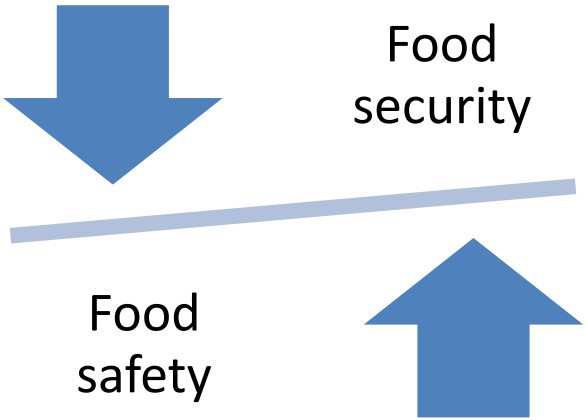
- Variable susceptibilities (species, age, status etc.):<100ppb (calves); <300ppb (cattle); are more tolerant than humans

- Acute toxicity, hepatotoxic, nephrotoxic, carcinogenic, mutagenic, immuno-suppression, growth impairment

Regulations and standards

- AF standards (food / feed) are necessary to protect health (human, animals) *[..compliance issues]*
- Milk use in child nutrition demands stricter AFM1 standards *(which is also variable,* ***0.05 ppb (EU); 0.5 ppb (FDA); EAC*** *limit is 0.05 ppb)*

Standards that are "too strict" can impact on food security / trade



Many countries allow higher aflatoxin in feed than in food for human consumption

Commodity	For consumption by	Tolerable levels (ppb)			
		EU	USA	Kenya	Ghana
Maize	Humans	4	20	10	15
Groundnut	Humans	4	20	10	20
Maize	Immature animals	10	20	10	15
Maize	Mature animals	20	100	10	15
Maize	Mature feedlot cattle	20	300	10	15
Maize	Dairy cattle	5	20	10	15
Milk	Humans	0.5	0.5	0.5	
Milk	Infants	0.025	0.5	0.5	

Assessment of standards

- Rarely evidence-based
  - Some have zero standards
  - Not related to consumption or liver cancer risk
  - Not related to species vulnerability
  - Very little enforcement in LMIC
- Tend to ratchet-up
- Countries with more aflatoxins tend to have laxer standards

Mitigation strategies

- Several approaches exist (pre- and post harvest) but none, on its own, is adequate
- **Mycotoxin binders**, applicable at the level of animal feeding, are one such options
- Are mainly **clays** *(aluminosilicates—e.g.* hydrated sodium calcium aluminosilicate (*HSCAS)* or yeast /bacterial cell wall extracts

How mycotoxin binders work in dairy (1)

- Binders are mixed with **feed**, and when ingested by cows, **bind** the toxins in the gastro-intestinal tract of the animal.

- Bound toxins are **eliminated** in faeces and their bio-availability is reduced.

- The cow is protected from ill effects and safer milk is produced

How mycotoxin binders work in dairy (2)

- Many different binders are marketed worldwide
- Their effectiveness varies by type and amount used, and some may not be effective in binding aflatoxins
- Effectivess of NovaSil® (an HSCAS) has been demonstrated in many studies: *0.5-1kg/ tonne of feed*

ILRI CGIAR

Which mycotoxin binders are available in Kenya

- ILRI study – *visits to agrovet and animal feed outlets (Nairobi / Kisumu)*

- Focused on binder types sold / used in animal feeds.

Availability and use of mycotoxin binders in selected urban and Peri-urban areas of Kenya

Florence Mutua [1,2] · Johanna Lindahl [1,3,4] · Delia Grace [1]

Received: 18 September 2018 / Accepted: 6 March 2019

ILRI CGIAR

Our observations (1)……

	Description
Imported as	Feed additives
Types	9 different types
Sources within the country	Agrovets, feed millers
Who buys	Smallholders for home feed formulation; feed millers
Cost	Variable depending on binder type

Our observations (2)……

- Feed millers source raw materials from distant places with high likelihood of spoilage during handling, transportation and storage
- Awareness about mycotoxin binders is low; and their inclusion in feed is not regular
- There are no standards that govern the use of mycotoxin binders in Kenya
- The products include substances that are unknown

Our observations (3)…

https://www.biomin.net/en/products/mycofix/

Mycofix®

Absolute Protection

ILRI

CGIAR

Our conclusions (1)

- Relaxing aflatoxin standards in feed for meat animals may be appropriate
- Mycotoxin binders can reduce pass-through of aflatoxin to milk
- Mycotoxin binders are an option to reducing risk of aflatoxin exposure
- Their effectiveness, when used in local smallholder systems *(e.g. quantities for feed batches of different contamination levels),* need to be investigated
- Findings from such studies can be used to inform development of standards for their use in the country

Conclusions (2)

- Binders are sold in large quantities (~25kg) which may be expensive for smallholders
- Marketing approaches that meet the need of all producers *(home feed formulation, purchased feeds etc.)* need to be explored
- Binders are not a stand-alone strategy and raising awareness on other mitigation approaches is equally important

better lives through livestock

ilri.org

ILRI thanks all donors and organizations who globally supported its work through their contributions to the **CGIAR system**

Patron: Professor Peter C Doherty AC, FAA, FRS
Animal scientist, Nobel Prize Laureate for Physiology or Medicine–1996

Box 30709, Nairobi 00100 Kenya
Phone +254 20 422 3000
Fax +254 20 422 3001
Email ilri-kenya@cgiar.org

ilri.org
better lives through livestock

ILRI is a CGIAR research centre

Box 5689, Addis Ababa, Ethiopia
Phone +251 11 617 2000
Fax +251 11 667 6923
Email ilri-ethiopia@cgiar.org

ILRI has offices in East Africa • South Asia • Southeast and East Asia • Southern Africa • West Africa