

Combating aflatoxins: Can we win the war?

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Nutrition working group platform

Berlin, Germany

1 October 2014



RESEARCH
PROGRAM ON
Agriculture for
Nutrition
and Health

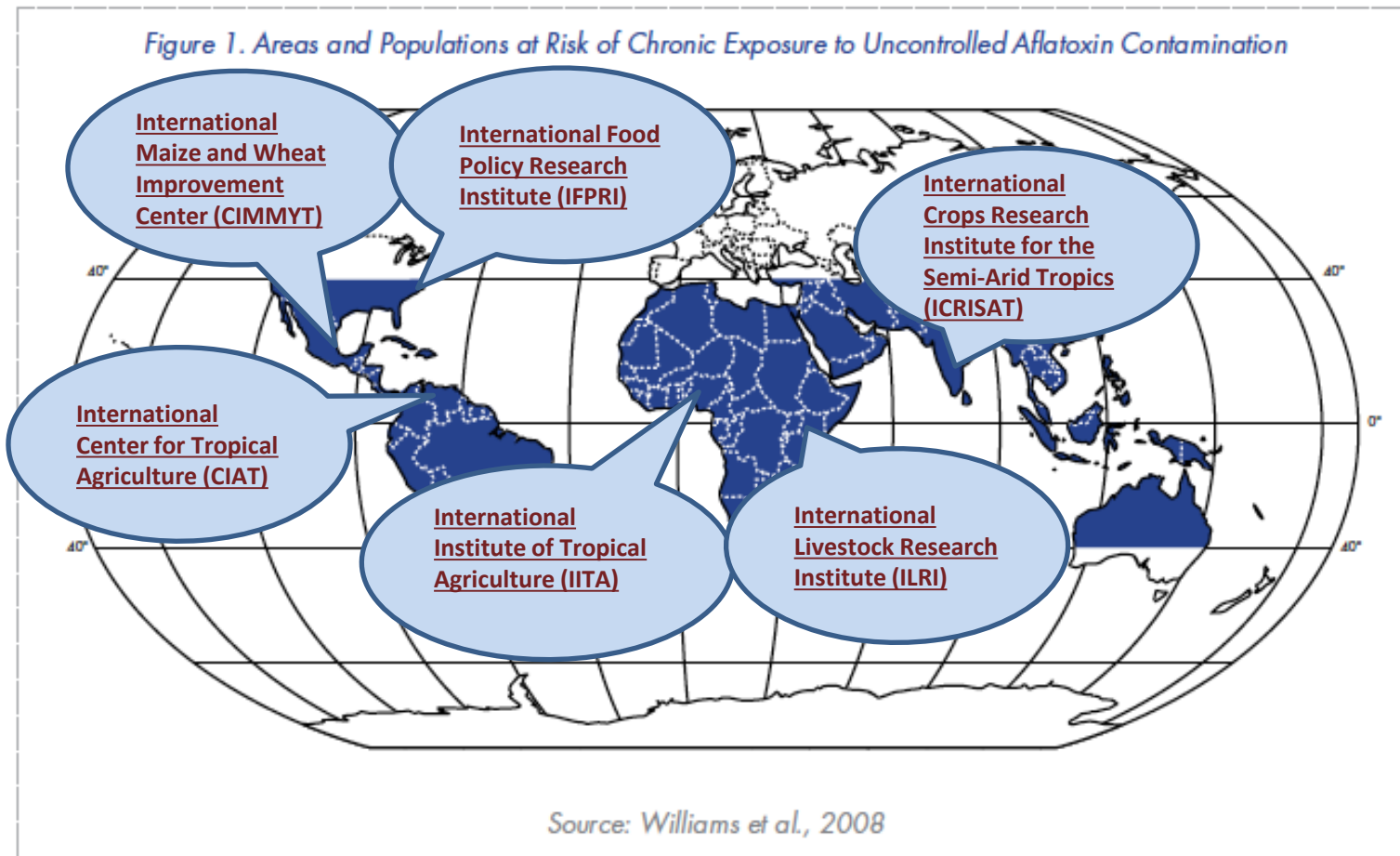


LED BY IFPRI

The topic of today

- What are the possible interventions and why are they not out there on full scale yet?
- What research needs priority?
- What does livestock have to do with it?
- What harm can be done by interventions?

Aflatoxin work by CGIAR



What do we want to prevent?

1. Negative health effects in humans
2. Negative health effects in animals affecting livestock production (nutrition & poverty reduction)
3. Negative economic impacts
4. Negative publicity
5. Negative health effects in animals (animal welfare)

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Kids at centre of toxic food saga are 270,000

By CATHERINE KARONGO | November 3, 2011



School Children /FILE

NAIROBI, Kenya, Nov 3 – The number of school going children feared to have consumed the aflatoxin contaminated Unimix during the Kenyans4Kenya initiative is more than 270,000 and not 60,000 as earlier thought.

Public Health Minister Beth Mugo said on Thursday that 726 schools had been supplied with the contaminated food at the time of the recall.

"My ministry in collaboration with the Kenya Red Cross Society and manufacturers are still recalling the consignment which was distributed irrespective of

whether it is suspected to be contaminated or not," the Public Health Minister said.

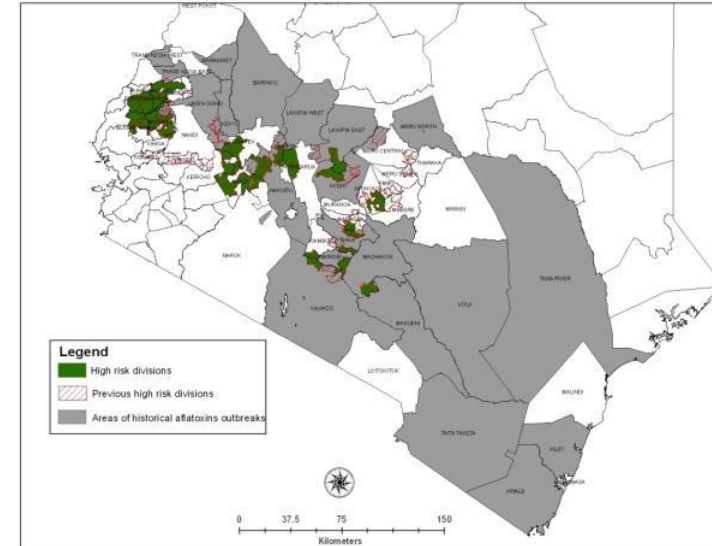
While issuing a ministerial statement in Parliament, Mugo blamed the Kenya Red Cross Society for failing to immediately inform the ministry about the contamination.

She said the ministry was notified of the contamination on October 6 by one of the manufacturers, Proctor & Allan.

Need to fill the knowledge gaps

1. Documenting occurrence of aflatoxins

1. Maize
2. Groundnuts
3. Milk
4. Animal feed
5. Risk mapping



2. Exposure assessment in humans

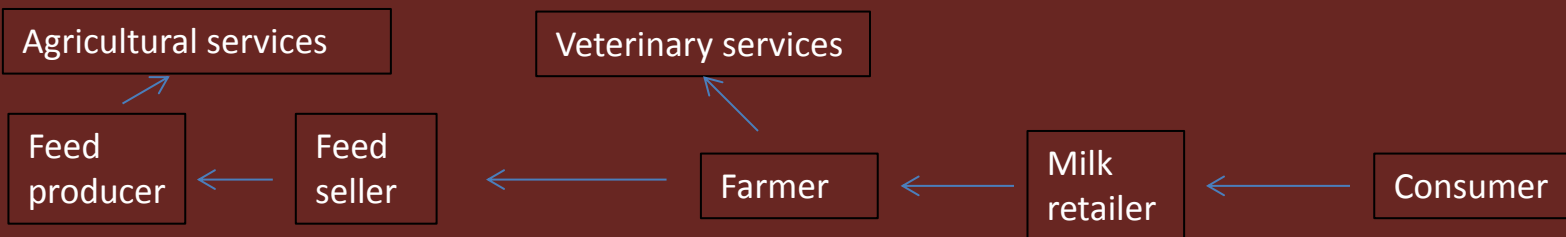
3. Risk assessment (health impacts and likelihood)

Quick reminder-why is the toxin there?

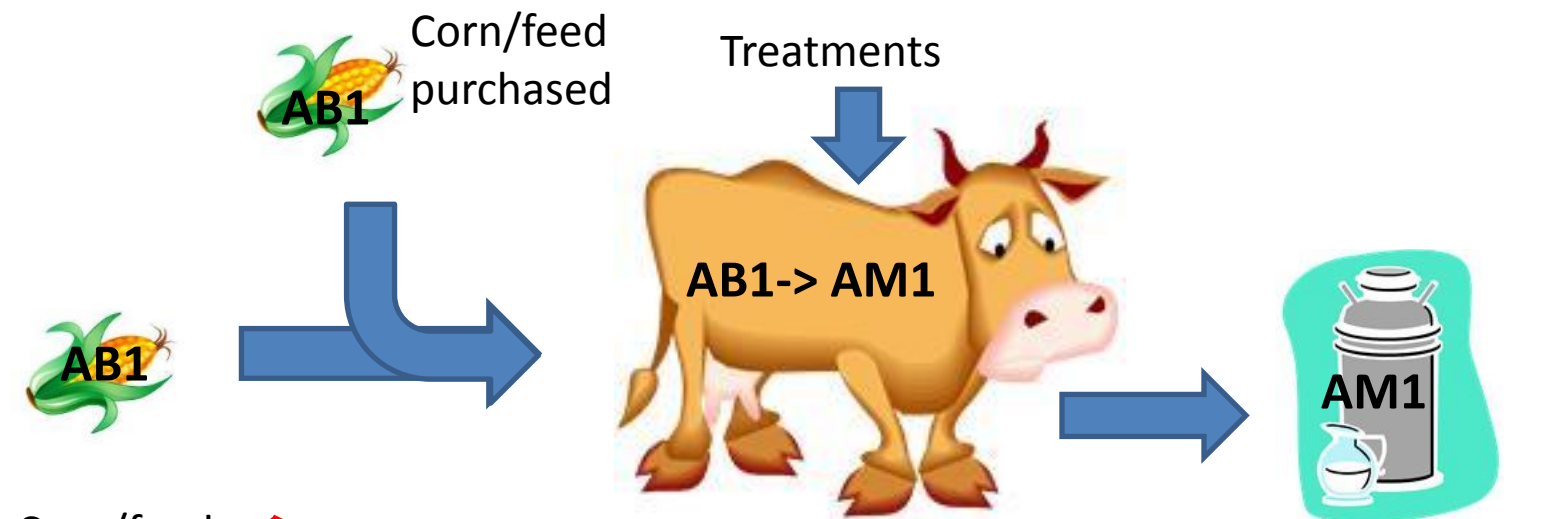
- Fungi (*Aspergillus*) infect crops pre-harvest, during harvest or during storage
- If crops are stressed they are more susceptible
- Especially susceptible crops: maize, groundnuts
- Optimum temperature 37°C (range 12-48)
- Mainly tropical disease



Economic
flow



Aflatoxin
flow



Human
exposure



Farmer



Consumer

At what points can we make interventions?

1. Growing crops
2. Harvest
3. Storage
4. Before consumption
5. Mitigating the effects after consumption

Pre-harvest

Prevent fungal growth pre-harvest: Insects and drought is predisposing

1. Breeding for resistance

- ☐ Drought-tolerant, or insect-resistant maize

2. Good agricultural practices

- ☐ Fertilizers, pesticides, irrigation

3. Biological control using atoxigenic strains

- ☐ Aflasafe, Afla-guard

Post harvest

Poor storage conditions pre-disposing

1. Good agricultural practices

- ❑ Pest control

2. Improved drying technologies



Improper drying of grains - Different grains being dried on roadside with rains looming in the horizon. Photo by IITA

Preventing consumption

1. Sorting

2. Legislation

- ☐ Limits for human and animal consumption

3. Treatment (detoxification)

- ☐ Ammoniation
- ☐ Ozone treatment
- ☐ Nixtamilization
- ☐ Fermentation
- ☐ Binders

Mitigating effects in the consumer

Hepatitis B vaccination – Good effect!



Public awareness and dietary considerations

Dietary diversification, switching from high-risk crop

Consumption pattern

Consumer awareness



The risks with uncertainty

Do no harm!

Interventions can not be allowed to increase risks of other hazards.

Mycotoxin	Main fungi	Impact on animal health
Aflatoxins	Aspergillus spp	All livestock susceptible to different degrees. Acute toxicity, hepatotoxic and nephrotoxic. Carcinogenic and mutagenic. Growth impairment. Immunosuppression.
Ochratoxin A	Aspergillus spp, Penicillium spp	Nephrotoxic Immunosuppression Possibly carcinogenic
Fumonisin	Fusarium spp	Toxic to liver and central nervous system Possibly carcinogenic
Zearalenone	Fusarium spp	Swine highly sensitive, cattle less sensitive. Endocrine disruption. Estrogenic effects, reduced reproduction, feminisation, malformations.
Trichotecenes	Fusarium spp	Gastrointestinal disturbance. Reduced feed intake. Ill-thrift. Immunosuppression.

Regulatory benefits must be balanced with regulatory burdens

The economic cost of regulatory enforcement, testing and quality control is high. Furthermore, stringent regulatory enforcement is not always feasible.

- In the USA, the annual cost of regulatory enforcement, testing and other quality control measures for aflatoxin is \$0.5 billion USD annually.
- Regulation costs 3.3% of the total value of corn produced.
- In one study, a turkey farm used 2,200 tests for aflatoxins at a cost of \$2.67 each for 400,000 tons of maize used as feed:
- Testing costs 1.8% of the total value of the corn used.
- The value of maize in East Africa was \$3.4 billion USD in 2012.
- This implies the cost of regulating aflatoxins would be a least \$68 million USD

The consequences of export barriers

- The best products are exported
- The bad products are left to the national markets



Photo by IITA.

Kenya to mop up contaminated maize

By | May 10, 2010

NAIROBI, Kenya, May 10 – The government has announced that it will purchase contaminated maize from farmers in Eastern and Coast provinces in an attempt to stop the circulation of the deadly aflatoxin fungi in the market.

Problems moping up: What to do with contaminated crops?

1
iers

“We have directed the NCPB to buy back any contaminated maize either from individuals, retail stores or millers. We will install reliable aflatoxin test kits at all Cereals Board depots within one week,” said the PM adding that a taskforce would be formed to analyse the issues and recommend actions to be taken.

The PM was speaking after receiving a report from the cereals body on the toxic grains in the country which was undertaken in March after his office was told that the Agriculture Ministry might have purchased large quantities of the bad maize.

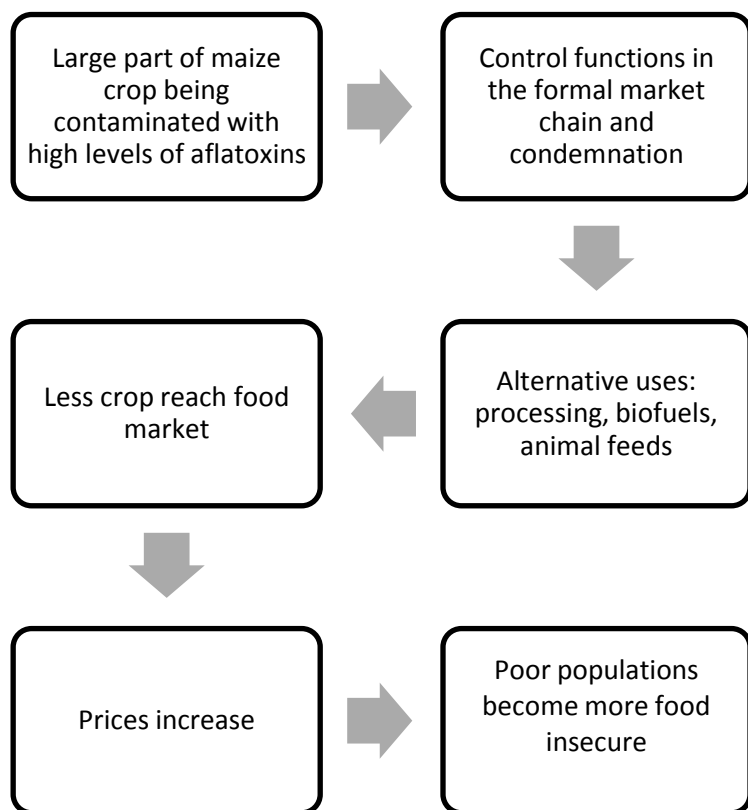
The contamination of grains is not new to Kenya and has in the past claimed lives as happened in 2004 when 150 people died after they consumed aflatoxin-infected maize. This time however, no deaths have been reported.

High humidity caused by continuing heavy rains has caused extensive damage to farmers' harvests in the two regions due to what has largely been attributed to limited knowledge on how to dry and store the grains. The grains that are believed to be highly contaminated are those harvested in the last few months during the on-going long rains.

What happens when we condemn the food?

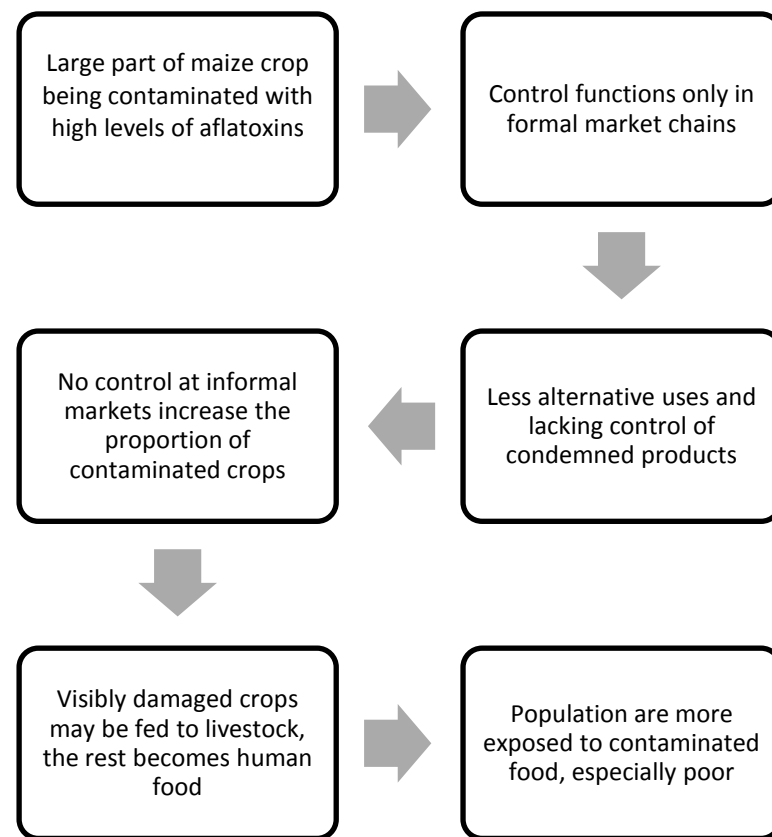
Developed country

Large food secure population –
smaller food insecure population



Developing country

Relatively large food insecure population



What is done with mouldy food?

- Feed to chicken
- Feed to other animals
- Discard in pit, manure
- Mix with good crop and mill
- Wash, dry, re-cook

Objectives of feed standards

1. Protect humans from harmful aflatoxins in animal source foods
 - Milk is the most high risk animal source food because relatively large amounts of aflatoxins are carried over, and milk is consumed especially by infants
2. Safeguard the benefits people derive from livestock and fish by protecting valuable assets that provide multiple benefits
 - These include income, food and nutrition security, draft power, manure and social/cultural benefits
3. Protect value chain actors from fraudulent or defective products
4. Encourage fair trade, competition and economic growth through promoting standards and credibility
5. Safeguard the welfare of animals

National regulation on aflatoxins in livestock and fish feeds

Species	Range of aflatoxin limits ppb	Average aflatoxin limit ppb
All animals	5-300	48
Pigs	0-300	40
Cattle	0-300	41
Poultry	0-300	33
Sheep goats	5-75	26
Dairy	0-75	19
Duck/turkey/rabbit/trout	10-10	10

- Very wide range in standards (suggests lack of coherence)
- Standards stricter for sensitive species and ages

- Standards stricter for low risk foods (suggests pragmatism > food safety)

	Range of aflatoxin limits ppb	Average aflatoxin limit ppb
Low risk feeds	5-50	20
Complementary/concentrates	5-30	23
Complete/combined/mixed	25-100	25
All feeds	20-100	29
Straight/cereal	20-200	82
Corn/cottonseed/peanut/copra	5-300	85

	Range of aflatoxins ppb	Average aflatoxin limits ppb
Tropical countries	0-300	54.5
Non tropical countries	1-200	26.3

- Standards stricter for non-tropical countries (suggests protectionism?)

Highly susceptible: oral LD50 (<1 mg per kg body weight)

Rabbits, ducks, cats, swine, rainbow trout

Moderately susceptible: oral LD50 (1-2 mg per kg body weight)

Dogs, horses, calves, turkeys, guinea pigs, sheep, baboon

Relatively resistant: oral LD50 (5-10 mg kg body weight)

Chickens, rats, macaque monkeys, mouse, hamsters



One teaspoon of aflatoxin is enough to kill 2,500 rabbits

Standards and policies

FDA limits

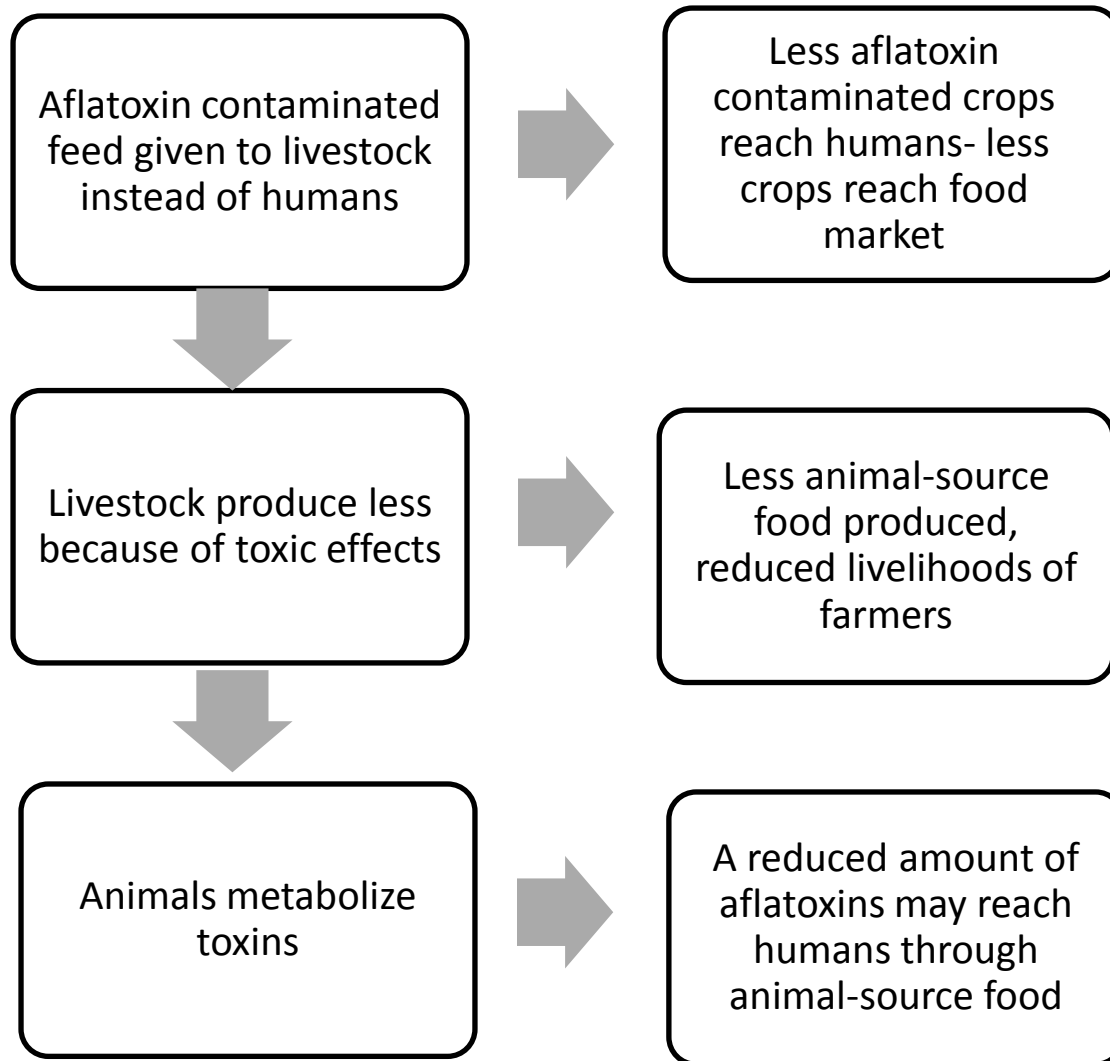
product or animal	total aflatoxin action level ($\mu\text{g/kg}$)
human food	20
milk	0.5
beef cattle	300
swine over 100 lbs	200
breeding beef cattle, swine, or mature poultry	100
immature animals	20
dairy animals	20

Ref: Wu. VOL. 38, NO. 15, 2004 / ENVIRONMENTAL SCIENCE & TECHNOLOGY



Aflatoxin standards for feeds and feed materials should be based on tolerable ranges plus a margin of safety. Generally tolerable ranges are: ≤ 50 ppb in young poultry, ≤ 100 in adult poultry, ≤ 50 in weaner pigs, ≤ 200 in finishing pigs, < 100 in calves, < 300 in cattle and < 100 in Nile tilapia.

Feeding livestock contaminated feed



Standards for Anti-Mycotoxin Additives (AMAs) in Feeds

Clays (aluminosilicates)

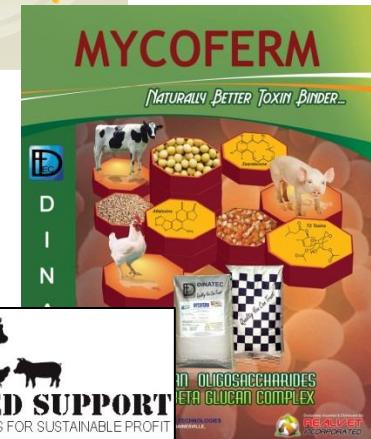
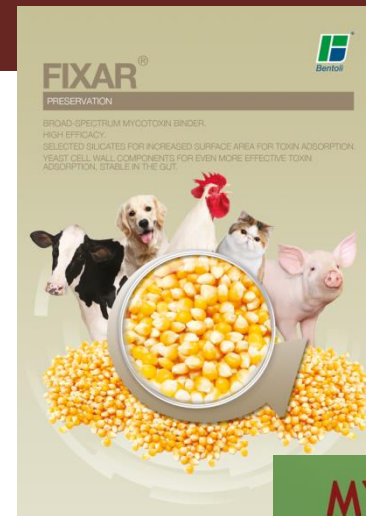
- Most effective binder but different clays vary in effectiveness

Yeast/bacterial cell wall extracts

- Provide other useful nutrients, but evidence on effectiveness is mixed

Other binders

- Some are promising but less evidence of effectiveness
- *Over 100 companies offering AMAs*
- *In the Brazilian market, where approximately 100 AMAs for poultry and swine were evaluated, only about 30% were effective*



Need of revising feed standards?

- ❑ High levels of aflatoxins, need of alternative use for contaminated foods, and implications for food security and livelihoods would support feed standards that are less rather than more strict.
- ❑ Need for approving safe and suitable AMAs for livestock and fish feeds.
- ❑ Livestock revolution with rapidly growing pig, poultry and aquaculture sectors plus the availability of effective mycotoxin binders offers a pathway to take contaminated grains away from human consumption and safely use to produce much needed, highly nutritious animal source foods

How can it be financed?

1. Farmers pay: if crops of other desirable characteristics (drought resistance) or premium market. Afla-safe example of premium market with contracted buyers.
2. Buyers pay: Importers, large programs (World Food) require aflatoxin safe. Scope for processors, manufacturers to also demand (and pay for) safer foods
3. Consumers pay: Premium markets. Aflatoxin-free certified dog food on the market in Kenya. Experiments indicate consumers WTP for safe maize and milk
4. Projects support: much of the GAP and bio-control is supported by development actors

Who are the stakeholders?

Multi-stakeholder approaches

PACA (Partnership for aflatoxin control in Africa)
– success in bringing stakeholders together
(public health under-represented)



Take home message

- Effective ways to reduce aflatoxin exist, but incentives are lacking in poor countries for widespread adoption
- Research on full health impacts and ways to finance aflatoxin mitigating practices a priority
- Livestock feed sector + binders an attractive mechanism to suck contaminated grain out of human food chain
- Potential for aflatoxin regulation to cause harm (burden on agricultural sector, concentrating contaminated among poorest)

Conclusions

There is no silver bullet to eradicate aflatoxins

-A battery of interventions to provide safer food in a world full of food safety hazards!



Acknowledgements

The ILRI work is financed by the Ministry of Foreign Affairs, Finland

It is implemented in a partnership with the International Food Policy Research Institute (IFPRI), MTT Finland, Biosciences in eastern and central Africa (BecA)

It contributes to the CGIAR Research Program on Agriculture for Nutrition and Health, led by IFPRI



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