Aflatoxins, animal health and safety of animal source foods

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CGIAR Research Program on Nutrition and Health

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Overview

- Aflatoxins: introduction
- Livestock and fish exposure to aflatoxins
- Impacts of aflatoxins on animal health & production
- Aflatoxin transfer to animal source foods (ASF)
- Managing the risk of aflatoxins in animals & ASF
- Standards for feeds & ASF
- Policy recommendations

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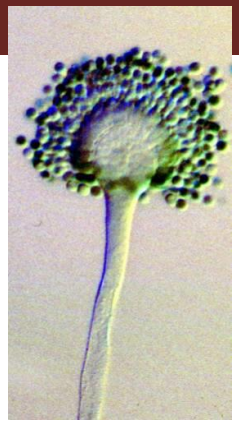
Mycotoxins



- Mycotoxins are toxins produced by fungi
  - 500 types; >200 found in foods
  - Aflatoxin is one of the most serious

- They cause acute and chronic illness in people and animals (including fish)

- Economic losses result from cost of human illness, loss of livestock production, exclusion from markets, cost of testing and risk mitigation

AFLATOXIN

A Fungal Toxin Infecting the Food Chain

Persistent high levels of aflatoxins—naturally occurring carcinogenic byproducts of common fungi on grains and other crops—pose significant health risks in many tropical developing countries.

Chronic exposure to aflatoxins leads to liver cancer and is estimated to cause as many as 26,000 deaths annually in sub-Saharan Africa. This infographic depicts the ways that aflatoxins persist throughout the food chain. Each level presents an opportunity to improve research and manage risks.

Susceptible Crops

Field crops infested with aflatoxin

Poor Storage

Toxins increase during storage

Animal Consumption

Animals and dairy are infected from contaminated feed

Impact on Dairy Production

Livestock produce less, loss of income and food

Human Consumption

Humans consume toxins in staple foods and dairy products

Impact on Human Health

Consumers experience liver cancer, poisoning

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Source: Tackling Aflatoxins: An Overview of Challenges and Solutions, Laurian Unnevehr and Delia Grace.

Some species are more sensitive than others

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, Nile tilapia

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

Chickens, rats, mouse, hamsters, shrimp, honey bees

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

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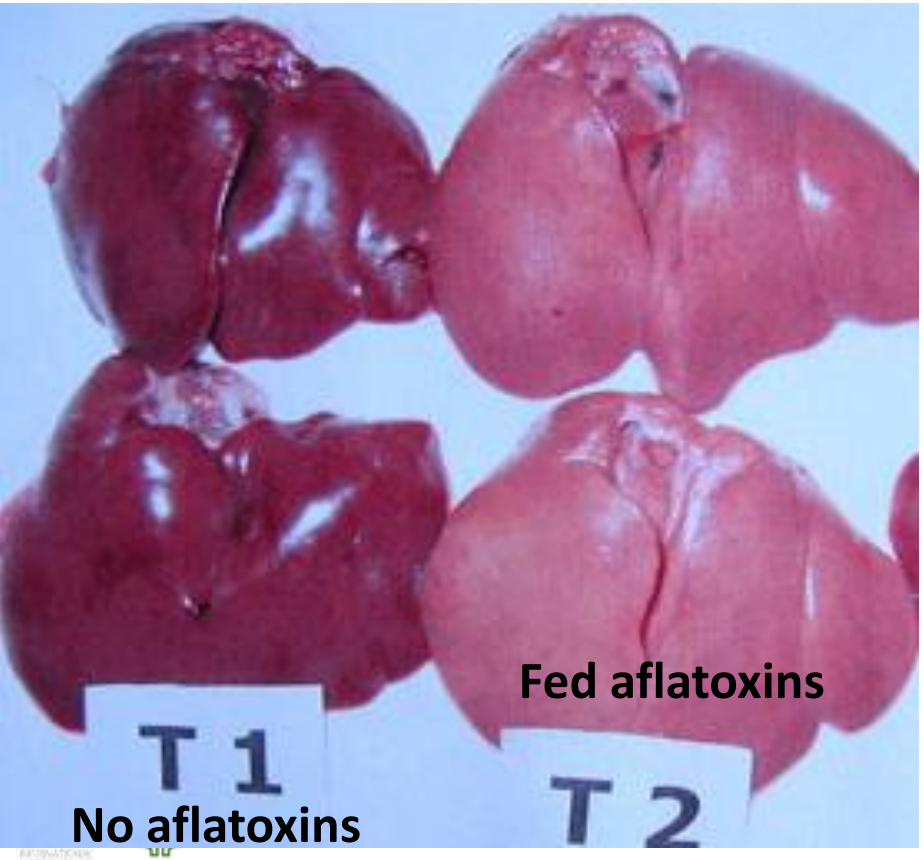
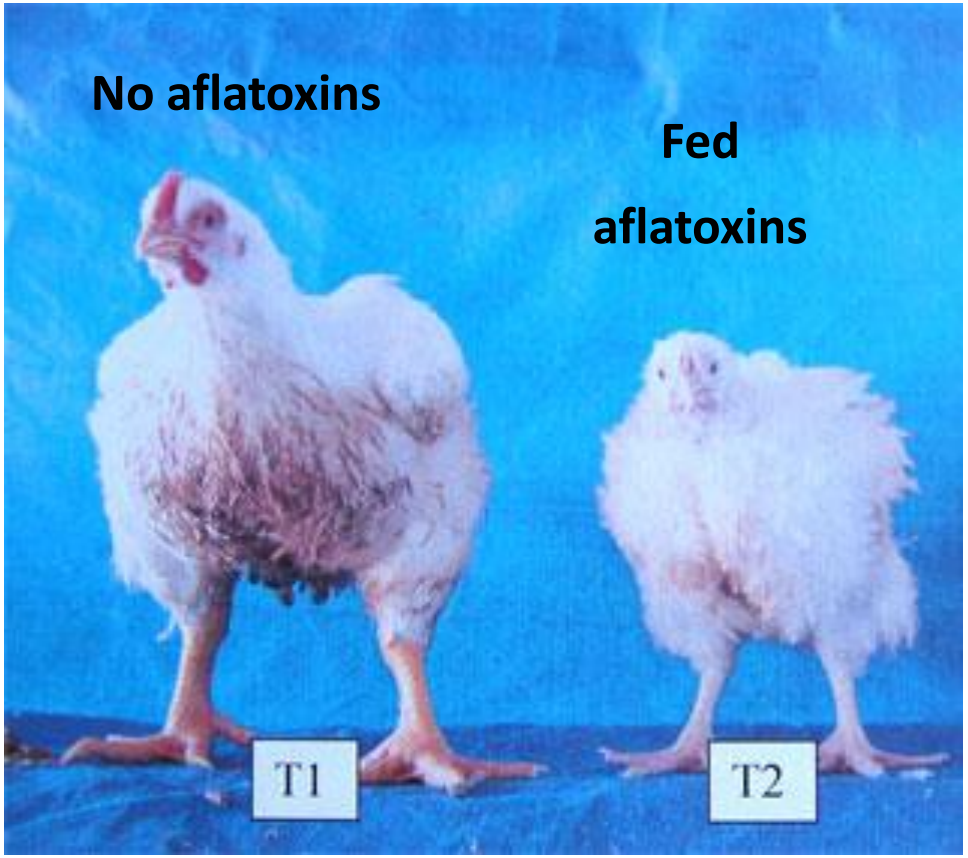
Some broilers were fed 3,000 ppb aflatoxin for 42 days (T2)
Others had a safe diet (T1)

Birds fed aflatoxins were smaller and had enlarged, fatty livers



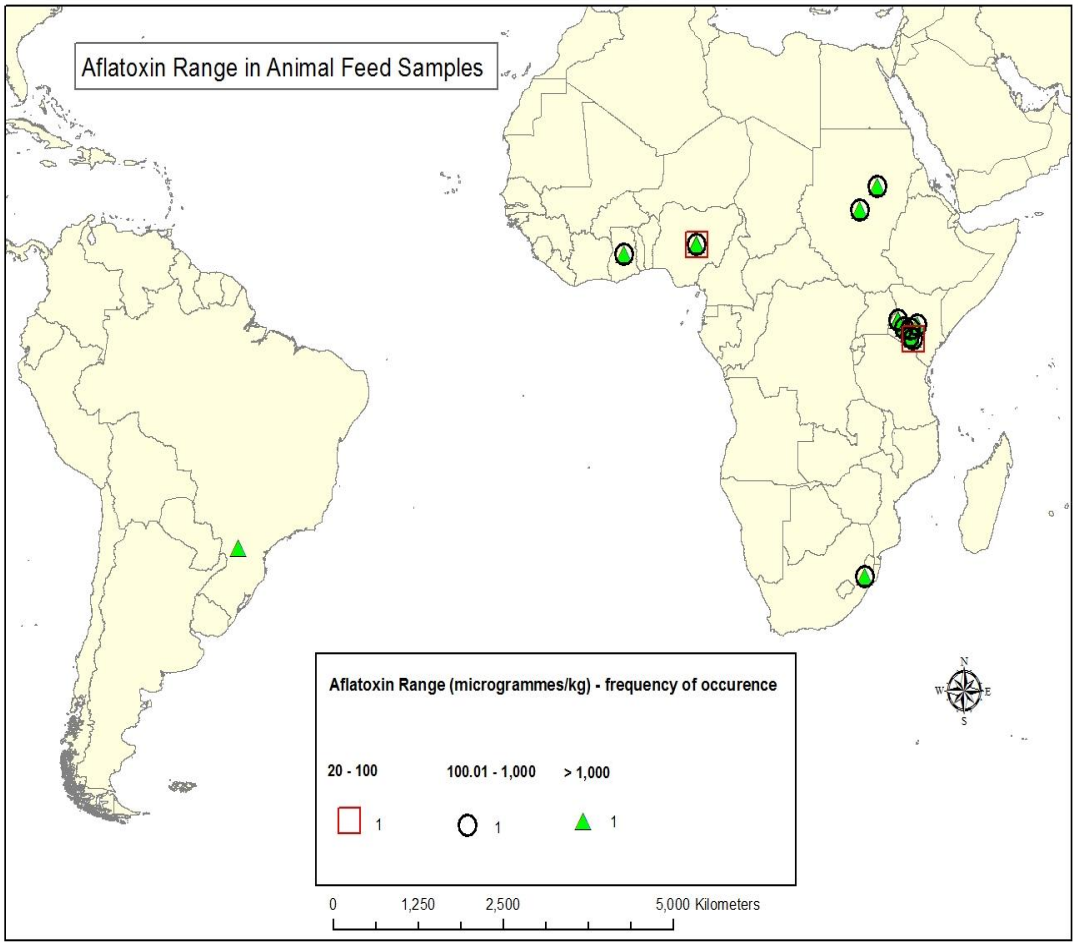


Range of impacts (review by ILRI)

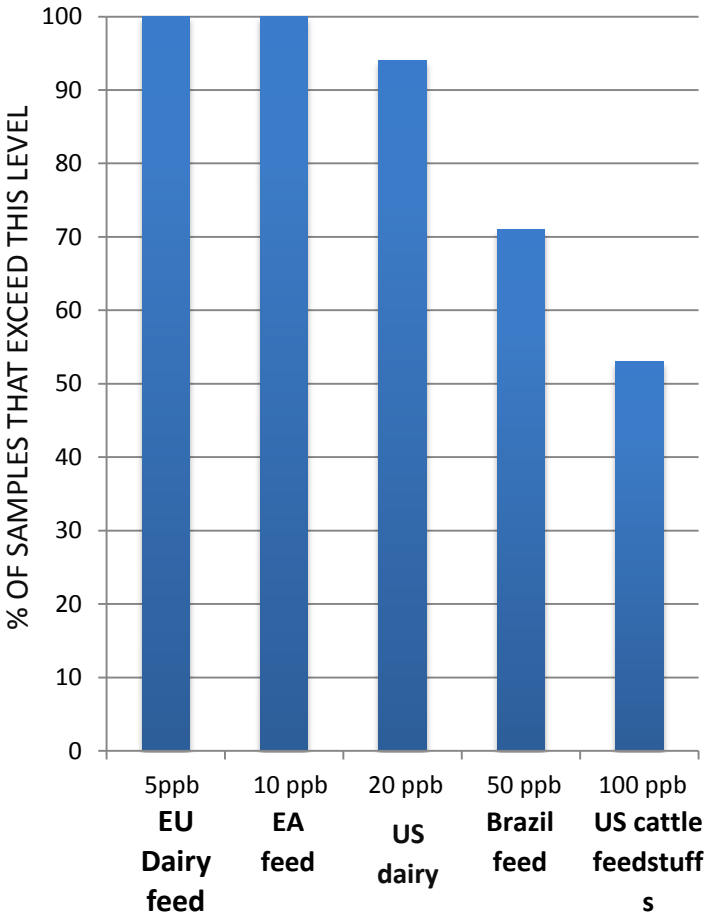
- In pigs, every extra 1,000 ppb in feed causes a 4% decrease in weight.
- In broilers, every extra 1,000 ppb in the feed, causes a 5% decrease in weight.
- Dietary levels of aflatoxin (in ppb) generally tolerated by livestock are higher than current standards.

  - **50,000 ppb: kills many animals**
  - **1,000 ppb: causes major impacts on production and immunity**
  - **500 ppb: causes significant impacts on production and immunity**
  - **100 ppb: generally tolerated by most animals, may be some ill effects**
  - **10 ppb: Current EAC standards**

Animal feeds in Africa have high aflatoxins-



Feed surveys in SS Africa with samples exceeding different standards (n=17):
100% exceed EU & East African (EA) standards
50% exceed US cattle feed standards



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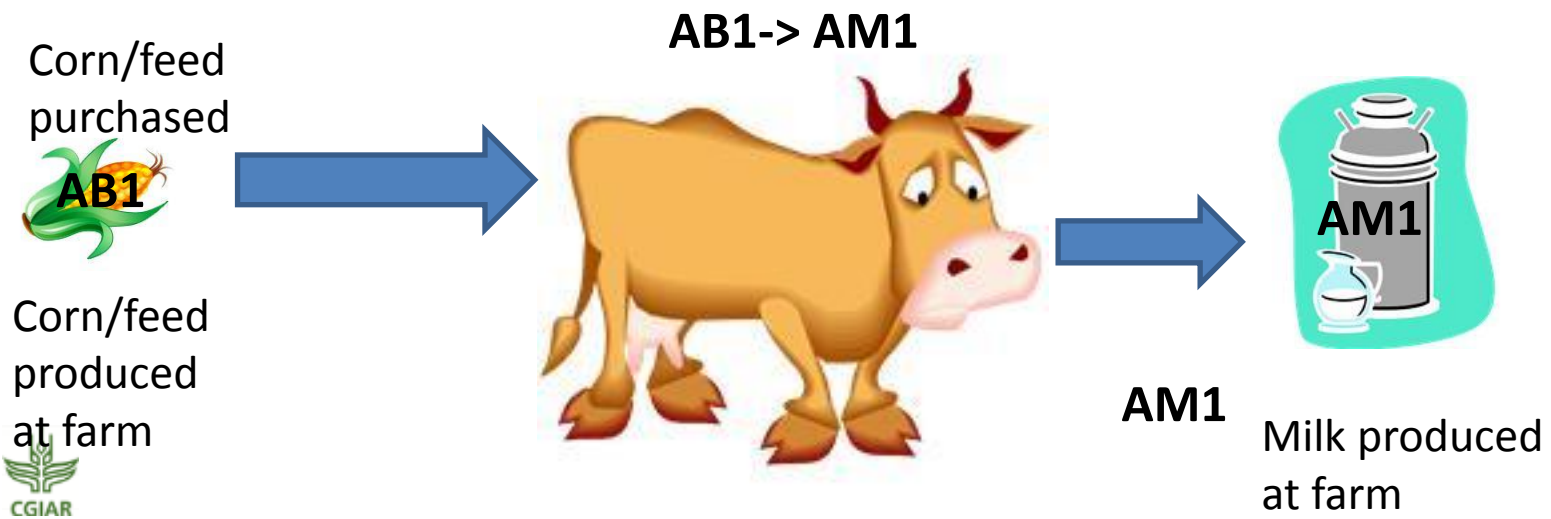
Aflatoxins can also transfer to animal products

- **If animals eat feed with aflatoxins some is metabolised and transferred to the milk, eggs, meat or offal.**
- **Milk and traditionally dried/smoked foods have highest levels of aflatoxin and so should be given highest attention.**
- **Withholding aflatoxin-contaminated feed from livestock for 3-4 weeks before slaughter may be enough to clear toxins from muscle and organ meat.**



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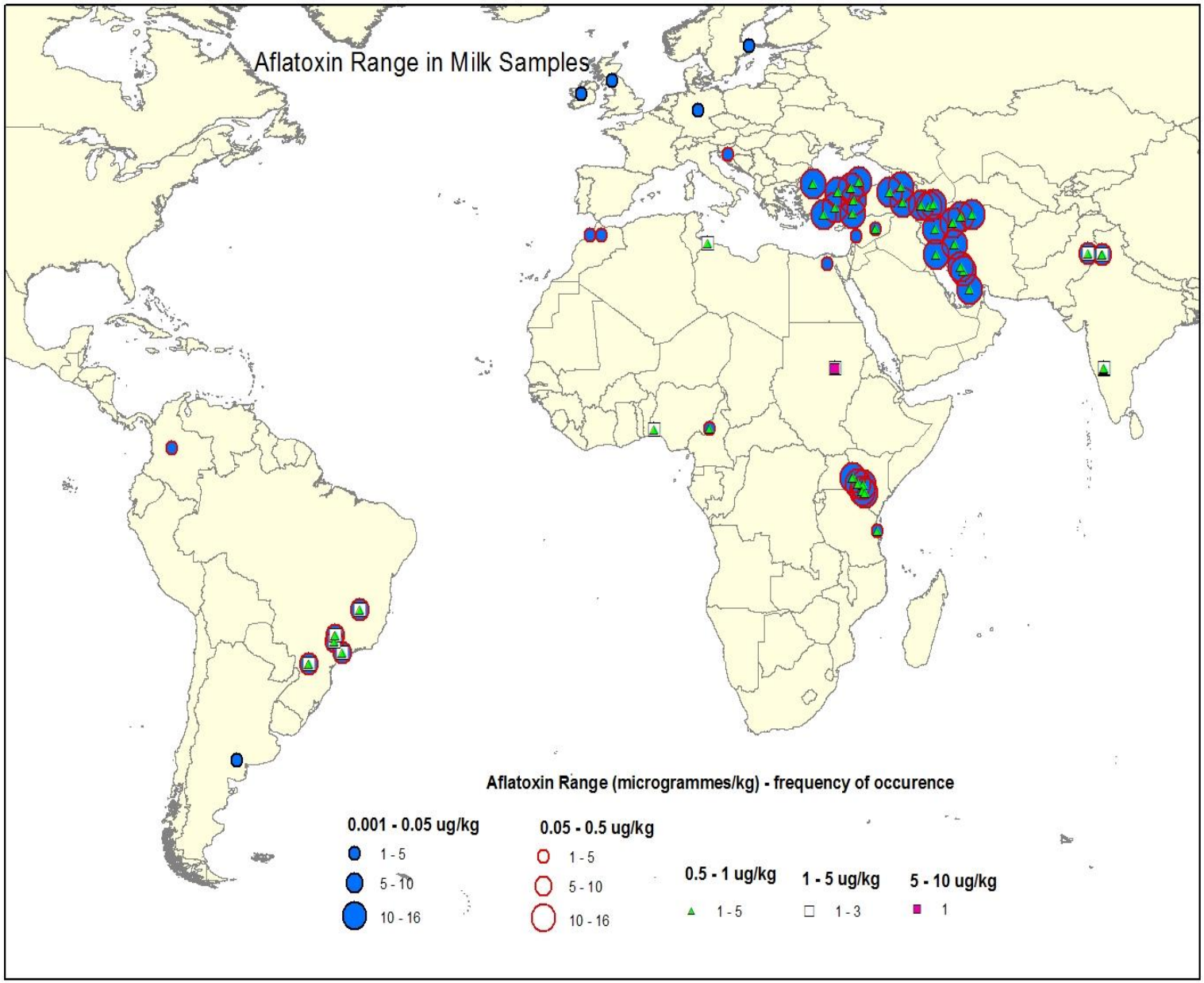
Results of studies testing aflatoxins in milk



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

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 cost 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 cost 2% of the total value of the corn used.

- The value of maize in East Africa was $3.4 billion USD in 2012.
- The cost of regulating aflatoxins would be at least $68 million USD

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National regulations on aflatoxins in livestock and fish feeds: STANDARDS VARY A LOT AND ARE NOT EVIDENCE BASED

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
- Standards stricter for sensitive species and ages

- Standards stricter for low risk foods

	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

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Managing aflatoxins in animal feeds

Management of aflatoxins in animal feeds requires:

- **Good practices at producer, processor and retail level**
- **Appropriate, risk-based legislation and regulations**
- **Monitoring of aflatoxins in feeds and foods**
- **Appropriate management of contaminated feeds**

The best approach is to prevent cereals becoming contaminated, but methods are also needed to deal with contaminated feeds

How important are aflatoxins to the livestock sector?

- **If not controlled, at levels present in poor countries, aflatoxins may reduce productivity of intensive poultry/pig production by 5%.**
- **Impact on extensive ruminants, pigs and poultry productivity probably less than 1% (but very little evidence on this).**
- **Probably most feed manufacturers add binders; around 2/3 of these binders probably don't work.**
- **Cost of aflatoxin regulation and control is probably around 2% of the value of animal feed: strong incentive for feed makers and industrial farmers to control aflatoxins.**
- **Effective government regulation difficult in many developing countries.**

How important are aflatoxins in animal source foods?

- **Probably not important in fresh meat, fish and eggs.**

- **Possibly important in traditionally processed fish and milk due to post-harvest colonization by molds. But in this case, maize and groundnuts likely to be a much more important cause of human exposure. And intake is often low.**

- **Likely important in dairy in countries where milk consumption is high especially as milk often targeted to most vulnerable infants. Risk assessment is needed to understand the importance: ILRI is conducting a RA for milk in Kenya.**

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What should we do?

- High-risk feeds (g'nut, cottonseed, maize), high risk livestock (pigs, poultry dairy) and high risk ASF (milk, traditionally dried) require more attention.

- Current feed standards not based on evidence: not suited to the developing country context. Feed standards should be reviewed based on quantitative economic and risk assessments.

- Self-regulation and co-regulation are good approaches for livestock and fish feed regulation as few risks to human health and most of the costs born by industry or farmers.

- Blending and binders are simple ways to direct contaminated grains away from people to safer use in animal feeds and should be supported by policy, codes of practice and self/co regulation.

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