

Aflatoxin toxicity in animals

and its control measures

Anup Kumar*, Deepak Upadhyay, K K Singh and Brijesh Kumar Mehta

ICAR–Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh 284 003

The occurrence of aflatoxins is influenced by certain environmental factors; hence the extent of contamination will vary with geographic location, agricultural and agronomic practices, and the susceptibility of commodities to fungal invasion during pre-harvest, storage, and/or processing periods. Aflatoxins have both acute and chronic toxicity in animals, produce quite different effects: acute liver damage, liver cirrhosis, induction of tumors and teratogenic and other genetic effects. The high toxicity and carcinogenicity of these compounds and their ability to cause various pathological conditions that led to widespread screening of foods and potentially contaminated with it. There are several ways to control aflatoxin contamination but it is very difficult to reduce when it spreads. So it is better to take preventive measures to minimize the spread.

Keywords: Aflatoxin, Aspergillus, Glycosuria, Mycotoxin

AFLATOXINS (AFs) are a difuranocoumarin group of secondary metabolites produced by polyketide pathway from *Aspergillus flavus*, *Aspergillus parasiticus* and the rare *Aspergillus nomius*. It mainly grows in warm and humid conditions. While a number of different types of AFs are synthesized in nature, four main naturally produced AFs are aflatoxin B1 (AFB1), aflatoxin B2 (AFB2), aflatoxin G1 (AFG1) and aflatoxin G2 (AFG2).

Factors responsible for aflatoxin contamination

AFs incidence in food-stuffs and feeds (Fig. 1) depends on various factors, such as the commodity, climatic conditions, agricultural practices, storage conditions and seasonal variances.

Mode of contamination of aflatoxin

Aflatoxin which are the secondary metabolites of the fungi *Aspergillus*, may either be transferred by taking

contaminated feeds by animals or through milk in the calves which are taking mothers milk as Fig. 2 shows the mode of contamination of aflatoxin to animals and humans.

Harmful effects of feeding AFs contaminated feed to animals

Feeding contaminated feed to animals may cause both acute and chronic toxicity and produce effects like acute liver damage, tumor induction, liver cirrhosis and



Fig. 1. Aflatoxin contaminated peanut and maize seeds

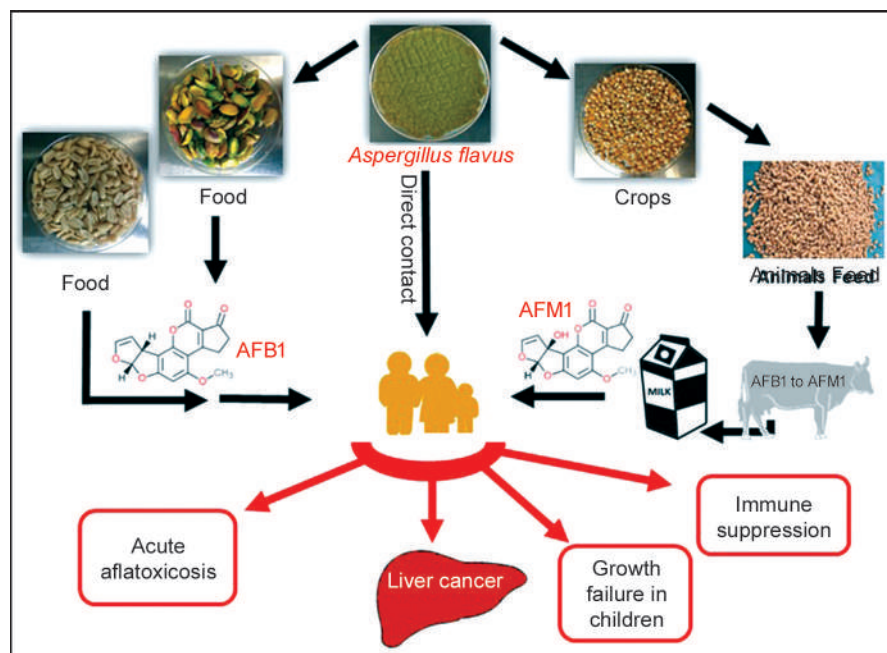


Fig. 2. Mode of contamination of aflatoxin

teratogenic effects. Disease that is caused by aflatoxin toxicity in animals is called aflatoxicosis which is mainly a hepatic disease. Susceptibility of animals to aflatoxin toxicity may varied and it depends on species, sex, age and nutrition. Toxicity in the animals may cause decreased milk and egg production, and immunity suppression that leads to recurrent infection.

Symptoms of aflatoxin toxicity

Animals of all age groups are prone to aflatoxin toxicity but younger ones are most susceptible. Clinical signs of Aflatoxin toxicity include gastrointestinal dysfunction, reduced reproductivity, reduced feed utilization efficiency, anemia and jaundice. There is a significant reduction of production of milk when animals are fed with AF contaminated feeds. Nursing animals, which are fed with milk can be affected by AFM1 which is a metabolite of AFB1 that are excreted in milk of dairy cattle.

As a result of acute toxicity, calves suffer with a disease that features blindness, circling and falling down, twitching of ears and grinding of teeth. Spasm of the rectum is also observed in most of the cases. Within two days of onset of severe clinical signs, death of calves occurs. Post mortem findings revealed pale, firm

and fibrosed liver. Kidneys become yellow and surrounded by wet fat.

Other pathological symptoms that appears in cattle are blood coagulation defects which may involve impairment of prothrombin, factors VII and X and possibly factor IX. Even a single dose of aflatoxin can increase plasma enzymes (aspartate aminotransferase, lactate dehydrogenase, glutamate dehydrogenase, gamma-glutamyltransferase and alkaline phosphatase) and bilirubin, probably reflecting liver damage. Other abnormal clinical findings are

proteinuria, ketouria, glycosuria and hematuria.

The induction of cancer by aflatoxins has been extensively studied. Aflatoxin B1, aflatoxin M1, and aflatoxin G1 have been shown to cause various types of cancer in different animal species. However, only aflatoxin B1 is considered as having produced sufficient evidence of carcinogenicity in experimental animals to be identified as a carcinogen.

Thus seeing these effects on animals, United states-Food and Drug Organization (US-FDA) has developed permissible maximum limits for aflatoxin contamination in various animal feeds (Table 1).

Methods to prevent aflatoxin toxicity

The prevention of mycotoxins in our environment is a big task. In general, prevention of the contamination of fungi and their mycotoxins in agricultural commodities can be divided into these following three levels.

Primary prevention

Prevention of mycotoxin contamination must be carried out initially before contamination. The prevention level is one of the most important and effective plan for reducing growth of fungus and production of mycotoxin. These are some of the practices that are recommended for keeping the

Table 1. Maximum permissible limits of aflatoxin in various animal feeds fixed by US-FDA

Intended use	Animal food and Ingredient	Action level (ng/Kg)
Finishing (i.e. feedlot), beef cattle	Corn and peanut products	300
Beef cattle, swine or poultry (regardless of age or breeding status)	Cotton seed meal	300
Finishing swine of 100 pounds or greater	Corn and peanut products	100
Breeding beef cattle, breeding swine or mature poultry	Corn and peanut products	100
Immature animals*	Corn, peanut products, cotton seed meal and other food ingredients	20
Pets (dogs, cats, rabbits etc.) of all ages	Corn, peanut products, cotton seed meal and other food ingredients and complete pet food	20
Dairy animals and other animal species (including wildlife) or other uses not specified in this table	Corn, peanut products, cotton seed meal, and other animal food and food ingredients	20

*Chickens and ducks less than 8 weeks of age; turkeys less than 12 weeks of age; goats, sheep, and pigs less than 4 month of age; cattle and equine less than 6 months of age.

condition unfavourable for any growth of fungi and mycotoxin production. These include:

- Development of fungal resistant varieties of growing plants;
- Control of field infection by fungi in planting crops;
- Making schedule for suitable pre-harvest, harvest and post-harvest measures;
- Lowering moisture content of plant seeds, after post harvesting and during storage;
- Store commodities at low temperature whenever possible;
- Using fungicides and preservatives against fungal growth; and
- Control insect infestation in stored bulk grains with approved insecticides.

Secondary prevention

If the invasion of some fungi begins in commodities at early phase, this level of prevention will then be required. The existing toxigenic-fungi should be eliminated or its growth should be stopped to prevent further deterioration and mycotoxin contamination. Several measures are

suggested as follows:

- Stop growth of infested fungi by re-drying the products;
- Removal of contaminated seeds;
- Inactivation or detoxification of mycotoxins contaminated; and
- Protect stored products from any conditions which favour continuing fungal growth.

Tertiary prevention

Once the products are heavily infested by toxic fungi, primary and secondary preventions would not be then feasible, since it will be quite late to completely stop toxic fungi and reduce their toxin formation. However, some measures should be done to prevent the transfer of fungi and their health hazards toxins highly contaminated in products into our daily foods and environment. For example, peanut oil extracted from poor-graded peanut seeds always contains very high levels of aflatoxins and the oil-soluble toxin has to be eliminated by absorption and alkalization during oil refining process. Only a few practices are recommended:

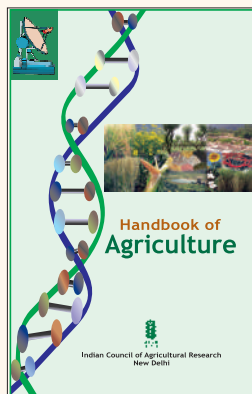
- Complete destruction of the contaminated products; and
- Detoxification or destruction of mycotoxins to the minimal level.

Economic impact of aflatoxins

Aflatoxin contamination of feed causes direct economic impact due to cost involved in loss of volume of feed (grains/oil seed cakes). Further contaminated feed cause significant economic and trade problems at almost every marketing stage, from the producer to the consumer. Many disease outbreaks have been caused due to aflatoxin toxicity resulting into death of animal. Further chronic toxicity results in loss in term of reduced production and fertility. The high toxicity and carcinogenicity of these compounds and their ability to cause various pathological conditions has led to widespread screening of foods and feeds potentially contaminated with them.

Corresponding author e-mail:
Anup.kumar1@icar.gov.in

Handbook of Agriculture



The Handbook of Agriculture is one of the most popular publication of the ICAR with a wider readership. The present edition presents science-led developments in Indian agriculture, the ongoing research efforts at the national level and with some ideas on the shape of future agriculture. While information in some chapters such as Soil and water, Land utilization, field and forage crops has been updated with latest developments, many new topics such as the Environment, agrobiodiversity, Resource conservation technologies, IPM, Pesticides residues, Seed production technologies, Energy in agriculture, informatics, Biotechnology, Intellectual Property Rights, Agricultural marketing and trading and Indigenous Technical Knowledge have been included in the present edition. For those who take intelligent interest in agriculture – and their number is increasing fast – the present edition would serve as a useful book.

TECHNICAL SPECIFICATIONS

Size : Royal Octavo (16 cm x 24 cm) • No. of pages : i-xii + 1618 • Price : Rs 1500 • Postage : Rs 100
ISBN No. : 978-81-7164-096-6

For obtaining copies:

Business Manager

Directorate of Knowledge Management in Agriculture
Indian Council of Agricultural Research
Krishi Anusandhan Bhavan-I,
Pusa, New Delhi 110 012
Tel : 011-25843657, Fax 09-11-25841282;
E-mail : bmicar@icar.org.in