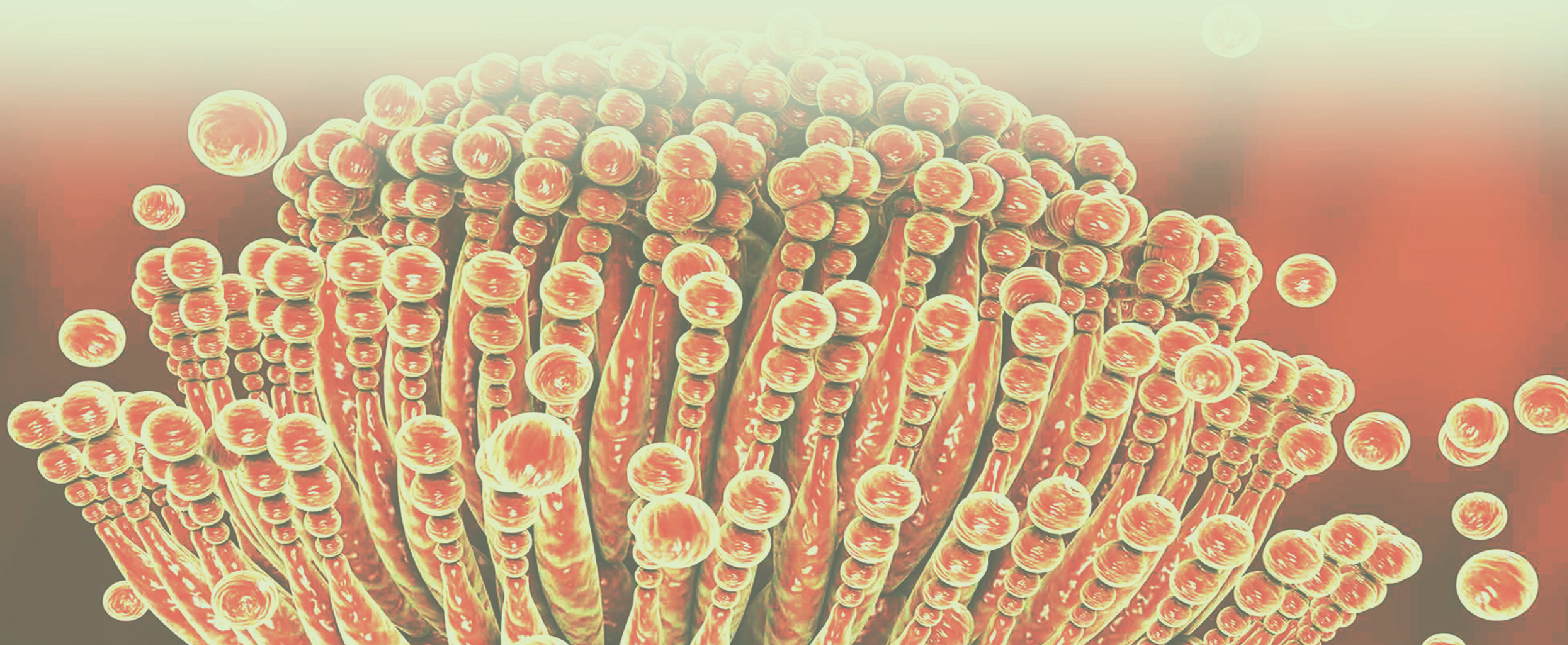




Guidance Note No.10/2018

# AFLATOXINS

**A KEY FOOD SAFETY CONCERN**



## AFLATOXINS-A KEY FOOD SAFETY CONCERN

### SUMMARY

Aflatoxins are a class of mycotoxins produced mainly by the fungi of *Aspergillus flavus* and *Aspergillus parasiticus* groups. The spores of these fungi are ubiquitous in nature and infect various agricultural commodities. Both pre-harvest contamination in standing crops and post-harvest contamination in stored food commodities may occur. Lack of knowledge and awareness on aflatoxin contamination among general public and farming communities may be one of the major reasons for prevalence of aflatoxicosis including liver cancers in humans and animals. Complete elimination of aflatoxins in agricultural products is difficult but efforts should be made to prevent their formation in food and feed.

This guidance note discusses the issues involved and outlines measures that could be undertaken by the stakeholders in assuring safe and wholesome food to consumers. Tips for consumers to identify and avoid consumption of aflatoxin contaminated foods are also provided.

### KEY TAKEAWAYS

- Aflatoxins are produced by toxigenic strains of *Aspergillus flavus* and *Aspergillus parasiticus* group of fungi.
- Aflatoxin contamination of foods poses a risk to human and livestock health.
- Produce dried at farm such as maize (corn), groundnuts (peanuts), cottonseed, spices, tree nuts and processed products such as milk and milk products, eggs, peanut butter etc. are the most likely to be contaminated with aflatoxins.
- Pre-harvest and post-harvest contamination in food value chain may lead to development of aflatoxins.
- Food Safety and Standards (Contaminants, Toxins and Residues) Regulation, 2011, has specified maximum limits of mycotoxins including aflatoxins in different food categories.
- Risk of aflatoxin contamination can be prevented and controlled by using mitigation strategies.
- Discarding mouldy, damped, shrivelled and discoloured foods minimizes the risk of aflatoxin exposure.
- Awareness of stakeholders and consumers on aflatoxin contamination, its deleterious effects and proper management of food and feed is needed.

## A. Introduction

Aflatoxins are a class of mycotoxins produced primarily by *Aspergillus flavus* and *Aspergillus parasiticus* group of fungi. The spores of these fungi grow on a suitable food substrate under favourable environmental conditions. Nearly 18 different types of aflatoxins have been identified and the major toxins are Aflatoxin B1 (AFB1), B2 (AFB2), G1 (AFG1), G2 (AFG2) and Aflatoxin M1 (AFM1). Both AFB1 and AFM1 are Group 1 carcinogens according to International Agency for Research in Cancer (IARC). Aflatoxins are especially problematic in dry and hot climatic conditions and their prevalence is aggravated in pre-harvest crops by conditions of drought, floods, delayed harvest, pest infestation, inadequate drying including improper postharvest handling and storage of crops and food.



*Micrograph of a head of Aspergillus flavus showing spores*

## B. Types of foods most likely to be contaminated

Agricultural crops such as maize (corn), groundnuts (peanuts), cottonseed, spices, tree nuts and processed products such as milk and milk products, eggs, peanut butter etc. are more likely to be contaminated with aflatoxins. Aflatoxin contamination in milk and dairy products is also a serious problem, as most of the human beings, particularly infants, are dependent on milk as a part of their diet. Contamination of milk with aflatoxin M1 might occur where mammals ingest aflatoxin B1 contaminated feed, metabolize it in their liver to the hydroxylated metabolite known as 'milk toxin' or aflatoxin M1, which is excreted in their urine and milk. Furthermore, it may subsequently also appear in milk products, such as curd, cheese, and milk powder. The molded and aflatoxin contaminated food commodities are shown below:-



Red whole chilly



Peanuts



**Cheese**



**Maize**

### **C. Impact of aflatoxins on consumer health**

Long-term or chronic exposure to aflatoxins has several health consequences including induction of liver cancer. Aflatoxin also has synergistic effects with Hepatitis B virus infection, and potential association with stunting and immunosuppression. Chronic exposure to even low levels of aflatoxin from consumption of contaminated commodities over a prolonged period increases the risk of liver cancer. It could also contribute up to 30% of all liver cancers globally.

### **D. How aflatoxins enter in food chain?**

Aflatoxin producing fungi are normally found on dead and decaying vegetation and infect agricultural crops. *Aspergillus* fungus can produce aflatoxins in food chain during pre-harvest, harvesting, handling, storage, processing and transportation. Droughts, high temperatures, low soil fertility, pest infestation affect plant growth and increase likelihood of fungal infection. Improper storage and delay in drying increases risks of mold growth and aflatoxin formation.

### **E. Regulatory status**

Regulations have been established in many countries for controlling aflatoxin contamination in food. Internationally, Codex Alimentarius Commission has set limits for mycotoxins including aflatoxins in foods under the “General standard for contaminants and toxins in food and feed (CXS 193-1995)” which serves as the reference standard for international trade in food.

**Provisions under Food Safety and Standards Act, 2006-** The maximum limits for mycotoxins including aflatoxins are prescribed under Food Safety and Standards (Contaminants, Toxins and Residues) Regulations, 2011 (FSSR). These Regulations are available on FSSAI website ([www.fssai.gov.in](http://www.fssai.gov.in)). The maximum limits of the aflatoxins in various food commodities as per FSSR are as per the table below:-

Name of the Mycotoxins	Article of the food	Limit µg/kg (max.) or parts per billion (ppb)
<b>Aflatoxins</b>	Cereal and Cereal products	15
	Pulses	15
	Nuts for further processing	15
	Ready to eat nuts	10
	Dried figs	10
	Oilseeds or Oil	15
	Oilseeds for further processing Ready to eat	10
	Spices	30
	Arecanut or Betelnut	15
<b>Aflatoxin M1</b>	Milk	0.5
<b>Ochratoxin A</b>	Wheat, rye, barley	20
<b>Patulin</b>	Apple juice and apple juice as a ingredient in other beverages	50
<b>Deoxynivalenol</b>	Wheat	1000

## **F. Test methods for determination of aflatoxins in food**

Various analytical methods are employed in analysis of aflatoxins in food. The analytical methods for aflatoxin determination include Thin layer chromatography (TLC), High performance liquid chromatography (HPLC), and enzyme-linked immunosorbent assay (ELISA). The detailed methodology for sample preparation, extraction, and analysis is provided in the Manual for methods of analysis of mycotoxins.

The Manual for methods of analysis of mycotoxins is available on FSSAI website <https://www.fssai.gov.in>

## **G. Can we identify aflatoxin contaminated foods?**

Aflatoxins are colourless, odourless and tasteless chemicals which are invisible to naked eye. The mould growth responsible for its production may not only appear on the surface but also penetrate deep into food which may or may not be visible every time. However, the foods showing signs of mouldy growth and having musty flavour shall never be consumed.

## **H. Mitigation strategies for prevention and control of aflatoxins in food**

Prevention of aflatoxin formation in the supply chain is a challenge but the risk of contamination during food production and storage can be reduced using following mitigation strategies:-

## **(i) Pre-harvest measures**

Many of the pre-harvest measures currently available are based on Good Agricultural Practice (GAP), which typically include use of insect resistant crops, good tillage and weeding practices, appropriate use of fertilizers, good water management, especially irrigation, and crop rotation etc. Use of biocontrol agents which restrict the growth of aflatoxin producing fungi is considered to be one of the promising measures. This is achieved by introducing atoxigenic (i.e., do not produce aflatoxin) strains of fungi that displace the aflatoxin producers from the fungal communities.

## **(ii) Post-harvest measures**

Some of the post-harvest measures are as under:-

- Quickly dry the harvested commodities to adequate moisture levels by using appropriate drying technologies.
- Checking crop moisture using equipment such as moisture meters etc.
- Sorting and removal of the damaged, shrivelled, insect infested and mouldy grains.
- Storing bagged produce on pallets and away from the walls.
- Monitoring and surveillance of aflatoxins in food and feed.
- Highly contaminated crops or foods should be completely destroyed.

## **I. Advise to the Consumers**

Raising awareness on dangers of aflatoxins and disseminating relevant information to individuals is an important part of any intervention strategy. To reduce exposure to aflatoxins, the consumers are advised to:

- Consume well dried, clean and sorted food products free from mouldy growth.
- Discard mouldy, damped, shrivelled and discoloured foods.
- Promote dietary diversification with a view to reduce exposure to aflatoxin contamination.
- Avoid old and damaged bags used for storage as they may be infested with pests.
- Close containers tightly immediately after use and avoid unnecessary stockpiling.
- Examine food well before you buy it. Look at the stem areas on fresh produce, and avoid bruised produce.
- Avoid consumption of broken nuts as they are more likely to contain aflatoxins as compared to whole nuts. It is also advised not to consume bitter/ mouldy nuts
- If bread and top layer of pickles in a container show signs of mould growth, immediately discard the complete product.
- Buy foods which are properly packed and labelled bearing FSSAI Logo. Check “Best before date”, “Use by date” and “Expiry date” of products before consumption.

## **J. Advise to Processors/Manufacturers**

- Inspect produce and processing premises regularly. Do not process poor quality, mouldy, weevilled and shrivelled produce.
- Separate the raw material upon receipt, to prevent any cross-contamination during the storage, cleaning, washing, and processing stages.
- Inspect and sort the raw material prior to introduction into the processing line. The inspection may include visual inspection and removal of foreign material.
- Maintain clean and dry working environment.
- Use good quality processing equipments i.e. Stainless steel.
- Analyse microbiological and chemical parameters for raw and processed food products.

## **References:**

### **Related FSSAI Standards and other Regulations**

- Food Safety and Standards (Contaminants, Toxins and Residues) Regulations, 2011
- Manual for methods of analysis of mycotoxins, 2016

### **Other sources**

- General Standard for Contaminants and Toxins in Food and Feed (CODEX STAN 193-1995)
- Kumar, P., Mahato, D.K., Kamle, M., Mohanta, T.K., and Kang, S.G. (2017) 'Aflatoxins: A Global Concern for Food Safety, Human Health and Their Management', *Frontiers in Microbiology*, 7.
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- WHO (2018) Aflatoxins, Food Safety Digest, WORLD Health Organization, Geneva.
- Alfasafe Safer Food in Africa <https://aflasafe.com/aflatoxin/how-to-spot-aflatoxin/>