

Aflatoxin Effect On Health



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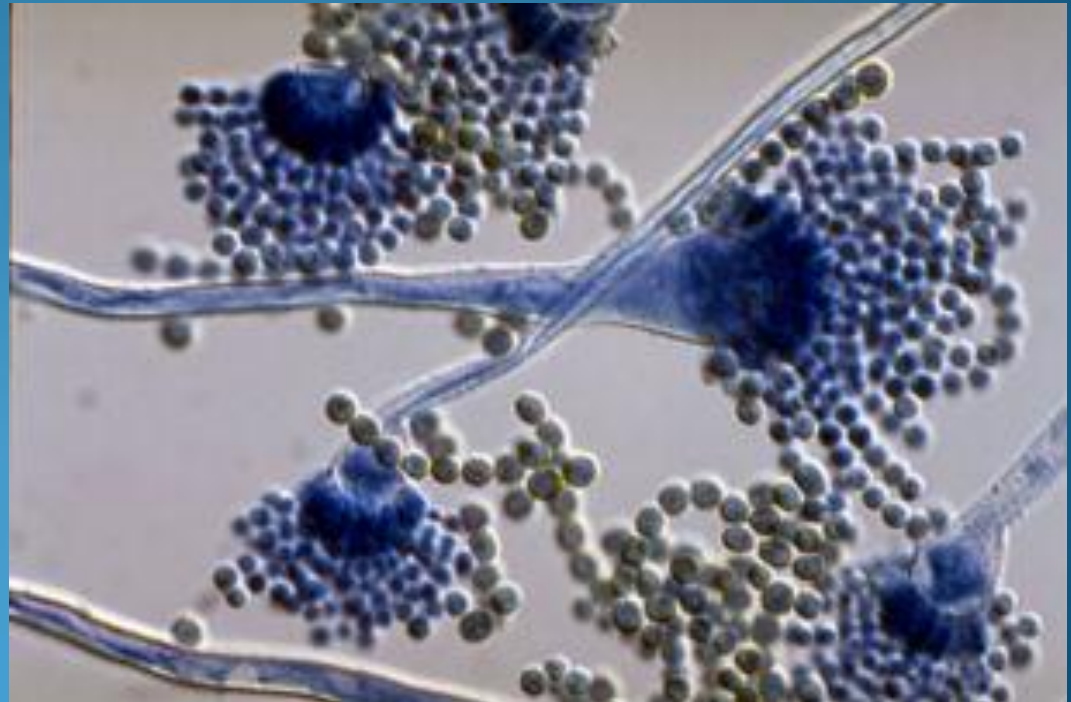
What is 'Toxin'



- A toxin (from Ancient Greek: *toxikon*) is a poisonous substance produced within living cells or organisms
- It simply means, it is a biologically produced poison.

Aflatoxins
are naturally occurring toxins that are
produced by species of a fungus called
Aspergillus

Types
Aspergillus flavus and
Aspergillus parasiticus



The Fungus - Aspergillus

- Survive temperatures ranging from 12°C to 48°C
- Survives on many organic nutrient sources like plant debris, tree leaves, decaying wood, animal fodder, cotton, compost piles, dead insects and animal carcasses, stored grains, and even immunocompromised humans and animals.
- At latitudes between 40°N and 40°S of the equator
- Contaminate 25% of crops worldwide

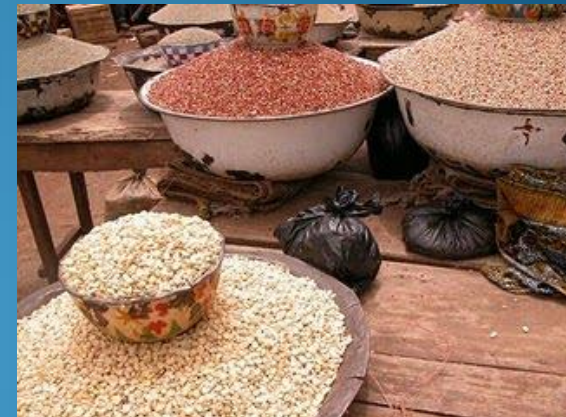
When Is The Toxin Produced

The toxins are produced as *secondary metabolites* by the fungi in temperatures range between 24 and 35°C, within many commodities whenever the moisture content exceeds 7% (10% with ventilation)



Aflatoxin Prone African Dietary Staples

- ❑ Maize
- ❑ Rice
- ❑ Corn
- ❑ Cassava
- ❑ Nuts
- ❑ Peanuts
- ❑ Chilies
- ❑ Spices



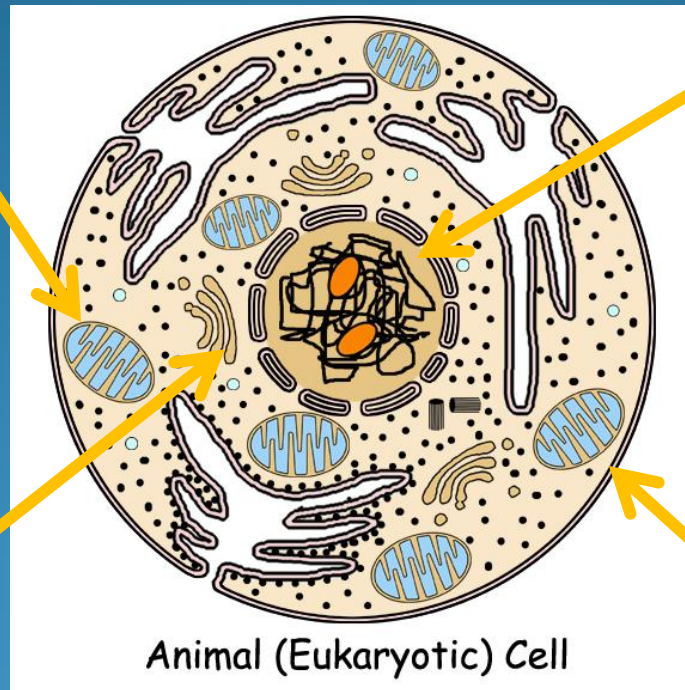
One form of the toxin
is also released
in milk



How Dose The Toxin Act?

**Apoptosis
(programed cell death)**

**Inhibits of nucleic acid
(DNA – RNA) synthesis**



**Decrease protein
synthesis**

**Effects membrane stability
leading cell damage**

How Dose The Toxin Act?

- Apoptosis → Cell death
- Inhibits of nucleic acid (DNA – RNA) synthesis → Mutation → Cancer
- Decrease protein synthesis → Stunting
- Effects membrane stability → cell damage

Aflatoxin Effect on Human Health

Organs/ Systems	Effects
Pathological changes	Liver, kidney, and spleen enlargement, fatty liver syndrome
Urinary System	Kidney inflammation leading to kidney failure
Digestive system	Decreased protein and fats digestion and absorptions, impaired carbohydrate breakdown, decreased motility, diarrhea

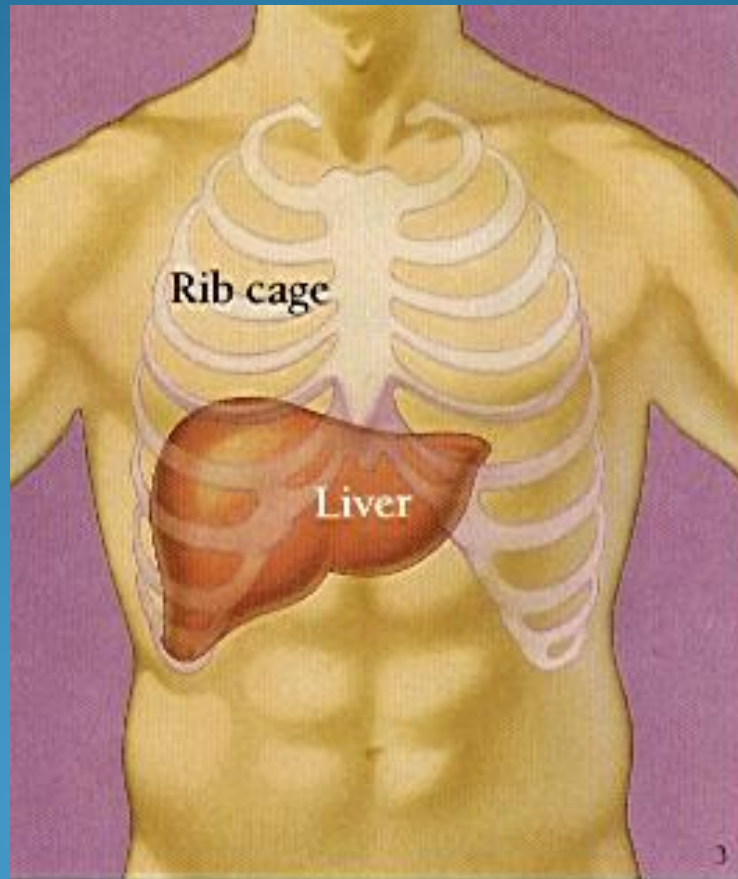
Aflatoxin Effect on Human Health

Organs/ Systems	Effects
Nervous system	Abnormal Behavior, depression
Reproductive System	Reduced sperm count and infertility; neonatal outcomes-low birth weight
Growth	Recent human research confirms that dietary Aflatoxin reduces the rate of growth

Aflatoxin Effect on Human Health

Organs/Systems	Effects
Gene and Gene Expression	Teratogenic effect (birth defect)
Gene and Gene Suppression	Carcinogenic effect—higher incidence of cancer
Immunosuppression	Decreased resistance and susceptibility to, HIV, TB, and other opportunistic infections

The Principal Target Organ For Aflatoxins Is The Liver.



Aflatoxicosis

**Aflatoxicosis is the poisoning that
results from ingesting
aflatoxins**

Aflatoxicosis

Is Exposure related

- 1) large doses lead to acute illness and death, usually through liver cirrhosis;
- 2) Chronic low doses have nutritional and immunologic consequences; and
- 3) All doses have a cumulative effect on the risk of cancer

An iceberg floating in a dark blue ocean under a cloudy sky. The small tip of the iceberg is above the water, while the much larger, jagged mass is submerged below the surface. The text 'Acute Aflatoxicosis' is written in red on the visible tip, and 'Chronic Aflatoxin Exposure' is written in yellow on the submerged part.

Acute Aflatoxicosis

**Chronic Aflatoxin
Exposure**

Acute Aflatoxicosis

- Acute poisoning is characterized by an acute hepatotoxic disease that manifests itself with
 - Depression
 - Anorexia
 - Jaundice
 - Hemorrhages
 - Edema of the lower extremities
 - Abdominal pain and vomiting

Adult humans usually have a high tolerance of aflatoxin, and, in the reported acute poisonings, it is usually the children who die

Chronic Exposure

- **4.5 billion people worldwide are at risk**
 - Liver cancer: causative role in 5 – 28% of liver cancer cases
 - Impaired immune function
 - Childhood stunting
 - Possible neural tube defects

Both acute and chronic aflatoxin exposures are preventable

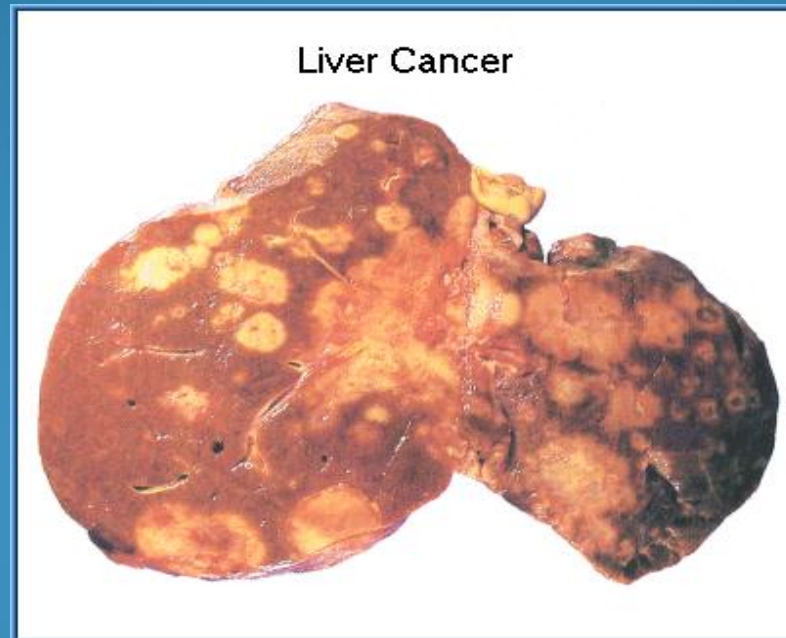
Aflatoxin and Cancer

Aflatoxin (B₁) is regarded as a

class I carcinogen

by the World Health Organization

**As per one estimate, 40% of the
hepatocellular carcinoma
(liver cancer)
in Africa
can be attributed to aflatoxin**



Aflatoxin: Hepatitis B and Cancer

Hepatitis B virus (HBV) infection contributes to liver damage that is potentiated by chronic AF exposure leading to cancer

- The presence of the virus may interfere with AF metabolism and detoxification process
- Predisposition of HBV-infected hepatocytes to aflatoxin induced DNA damage;
- Viral replication and chronic inflammation in liver cell, may contribute to the mutation potentiated by AF

Aflatoxin and HIV

- ❑ HIV increases the toxic effect of Aflatoxin (AF) by decreasing the levels of anti-oxidant nutrients that helps detoxify AF in the body
- ❑ For HIV virus to penetrate a cell it has to overcome the barrier of cell membrane & secretory IgA. AF reduces the level of secretory IgA thereby easing one of the barriers.
- ❑ In a large number of HIV cases there is a co-infection of HBV causing liver damages thereby potentiating the effects of AF

Aflatoxin Effect On Feotal Growth

Several Studies demonstrated effects of prenatal AF exposure.

These results demonstrate trans-placental transfer and concentration of AF by the feto-placental unit

The presence of AF in cord blood is consistent with activation of AFB₁ to its reactive form in fetal liver confirming the potential for toxic and mutagenic effects, as a result of transplacental exposure.

Aflatoxin Effect On Fetal – Neonatal Growth

**High maternal AF strongly relates to a lower
weight-for-age in infants**

**High maternal AF also significantly relates
to lower
height-for-age in the infant**

One study has demonstrated :

A reduction of maternal AF from 110 pg/mg to 10 pg/mg
would lead to a 0.8-kg increase in weight and 2-cm
increase in height within the first year of life.

Aflatoxin Effect On Feotal Growth

In one study on 125 primigravidae in rural Kenya showed

- Detection in maternal blood : 53 %
- Detection in cord blood : 37 %
(However no direct correlation was established between the levels in maternal and cord blood)
- The mean birth weights of females born to aflatoxin positive mothers was significantly lower (255 g) than those born to aflatoxin free mothers.
- The frequency of detection was significantly higher in maternal and cord bloods during the 'wet' than 'dry' months.

Aflatoxin & Breast Feeding

It has been demonstrated that where the lactating mother is exposed to aflatoxin, the breast milk is also contaminated with aflatoxins, though at FAR LOWER levels than are found in solid foods.

It is found that exclusive breast feeding and continued partial breast feeding can reduce the AF Exposure

Early weaning can contribute to higher exposure to AF and growth faltering

Aflatoxin & Stunting

It has been demonstrated that Chronic AF exposure at high levels during infancy was associated with growth faltering.

There are 3 biologically plausible pathways through which AF may affect growth:

1. zinc deficiency,
2. inhibition of protein synthesis leading to impaired metabolism,
3. Enterocyte damage – change in intestinal lining architecture

Animal Health and Aflatoxin

- ❑ Animals have similar (& potentiated) pathological effect as found in Humans
- ❑ In general animals have greater pathological effect at lower concentrations
- ❑ In animals, the affects of aflatoxin on the liver is greater at a much lower concentration than that for humans



Impacts of Aflatoxin on Livestock and Livestock Products

Direct Impacts on Animals:

- ☐ Acute Toxicity
- ☐ Reduced growth rates and weight
- ☐ Immunosuppression at low doses

Product Contamination:

- ☐ Meat
- ☐ Dairy, eggs, and cheese
- ☐ Farm fish
- ☐ Organ meats

Diagnosis

The diagnosis of aflatoxicosis is often difficult because of

- Variation in clinical signs,
- Gross pathological conditions
- Presence of infectious diseases due to the suppression of the immune system.
- No consistent diagnostic changes in hematocrit, hemoglobin, and differential cell counts

Treatment

- The source should be eliminated immediately.
- Levels of protein and vitamins A,D,E,K and B should be increased.
- Secondary infections must receive immediate attention and treatment.
- Good management practices to alleviate stress
- Address specific system diseases

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PREVENTION

- Remove the sources
- Promotes better agricultural and storage techniques
- Have good resources for testing and early diagnosis
- Strict food quality standards
- General awareness and personal protection.
- Better livestock feeding & management

Permissible Limits

United States Food and Drug Administration

Parts Per Billion	Criterion
20	<ul style="list-style-type: none">• Food for human consumption• Feed corn, grains, and cottonseed meal for immature animals
100	<ul style="list-style-type: none">• Feed corn and grains for breeding beef cattle, breeding swine, or mature poultry
200	<ul style="list-style-type: none">• Feed corn and grains intended for finishing swine of 100 pounds or greater
300	<ul style="list-style-type: none">• Feed corns and grains and for finishing (feedlot) beef cattle

Aflatoxin Abatement Measures

*Protection is Required throughout the value chain
from “field to fork”*

1. Pre-harvest

- Bio Control
- Improved Plant Varieties
- Integrated Pest Management

2. Post-harvest

- Post-Harvest Handling
- Improved Storage
- Quality Assurance of the Food Chain

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THANKS