



Aflatoxin fact sheet

“Mycotoxins” are poisonous compounds or toxins that may be produced by various fungi. More than four hundred mycotoxins have been identified, but only a small number affect agricultural activities.

“Aflatoxin” refers to the mycotoxins produced by some strains of the *Aspergillus* fungus. Scientists discovered in 1961 that a previously unidentified ailment called “Turkey X disease” was actually caused by the *Aspergillus flavus* toxins found in peanut meal.

They coined the word “aflatoxin” from the cause of the disease (*A. flavus* toxin → “a-fla-toxin”).

A. What is “aflatoxin”?

1. Are group of mycotoxins produced by some *Aspergillus* fungus strains

- a. Includes species: *Aspergillus flavus*, *Aspergillus parasiticus*, *Aspergillus nomius*
- b. Four most common aflatoxins identified as B₁, B₂, G₁, and G₂

2. Considered potent human carcinogens (cancer-causing agents)

- a. Aflatoxin occurs naturally
- b. Known as “unavoidable contaminants”
- c. Cannot be completely eliminated from feedstuffs or food
- d. Consuming small amounts over lifetime presents little risk to health

3. Aflatoxin B₁

- a. Produced by *Aspergillus flavus*
 - i. Mold that grows on oil-rich grains
 - ii. Especially corn, peanuts and cottonseed
- b. Most potent of aflatoxin group (B₁, B₂, G₁, G₂)
 - i. Can affect cattle, poultry, and humans
- c. When animals consume feed containing aflatoxin B₁
 - i. First, metabolized to aflatoxin M₁ in the liver
 - ii. Then, excreted in the bile, urine, and milk
 - iii. Aflatoxin M₁ concentrations in milk usually 1.7% of B₁ concentrations of ingested feed

B. Aflatoxin “action levels”

1. Levels set by U.S. Food and Drug Administration (FDA)

- a. “Action levels and tolerances represent limits at or above which FDA will take legal action to remove products from the market.”
- b. Depends on commodity and animal type (see Table 1)

Table 1. FDA action levels for aflatoxin in grains and grain products

CORN and CORN PRODUCTS intended for:	Action level (µg/kg or ppb)
Beef cattle, finishing (i.e., feedlot)	300
Beef cattle, breeding animals	100
Dairy animals	20
Swine, finishing (100 lb. or greater)	200
Swine, breeding animals	100
Immature animals	20
Poultry, mature	100
Animal species not specified above	20
COTTONSEED MEAL intended for:	Action level (µg/kg or ppb)
Beef cattle (regardless of age or breeding status)	300
Dairy animals	20
Swine (regardless of age or breeding status)	300
Poultry (regardless of age or breeding status)	300
Animal species not specified above	20
PEANUTS and PEANUT PRODUCTS intended for:	Action level (µg/kg or ppb)
Beef cattle, finishing (i.e., feedlot)	300
Beef cattle, breeding animals	100
Dairy animals	20
Swine, finishing (100 lb. or greater)	200
Swine, breeding animals	100
Immature animals	20
Poultry, mature	100
Animal species not specified above	20
OTHER FEEDS and FEED INGREDIENTS intended for:	Action level (µg/kg or ppb)
Dairy animals	20
Immature animals	20
Animal species not specified above	20

Reference: FDA Guidance for Industry: Action Levels for Poisonous or Deleterious Substances in Human Food and Animal Feed, August 2000
<http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/ChemicalContaminantsMetalsNaturalToxinsPesticides/ucm077969.htm#afla>

2. Upper limit of 20 ppb (parts per billion) set for food products

- a. Equivalent to one kernel of corn in 625 bushels
- b. Milk has aflatoxin M₁ action level of 0.5 ppb

3. Action level of 20 ppb for feed products intended for dairy rations

- a. Concentration of individual ingredients must not exceed 20 ppb
- b. Even if blended ration has 20 ppb or less

4. Deliberate blending to dilute toxin levels is illegal

C. *Aspergillus* ear rot

1. Gray-green, yellow-green, olive-green powdery mold.

- a. Usually develops around injuries
- b. Associated with damaged kernels

2. Most common in hot dry years

- a. Can grow at temperatures from 45 to 120°; moisture from 15% to 30%.
 - i. Can grow at higher or lower temperatures o moisture levels and not produce aflatoxin

D. Conditions favoring aflatoxin production

1. Just because visible molds are present, aflatoxin may or may not be present

- a. *A. flavus* can grow and produce aflatoxin in almost any organic substrate if conditions are right
- b. Factors that initiate aflatoxin formation are not well understood



Figure 1. *Aspergillus* ear rot of corn
(after cornmytoxins.com)

2. *A. flavus* grows most rapidly when:

- a. Temperatures are between 80° and 100°F
- b. Relative humidity is greater than 80% to 85%
 - i. Equivalent to:
 - 1) 16% to 18% grain moisture in corn
 - 2) 8% to 10% grain moisture in peanuts.
- c. Stress factors encourage mold growth and aflatoxin production
 - i. Prolonged drought

- ii. Close planting
- iii. Weed competition
- iv. Low soil fertility
- d. Insect damage
 - i. Insects carry and transmit spores
 - ii. Can infect living plant tissue or damaged kernels

3. Aflatoxin contamination

- a. Affects corn, peanuts, and cottonseed
 - i. Corn probably commodity of greatest concern
- b. Corn grown in warm, humid climates likely to have perennial aflatoxin contamination.
 - i. Southern US weather clearly promotes aflatoxin formation more often than Corn Belt weather
- c. Becomes a concern in stored corn
 - i. When grain temperatures exceeding 77°F
 - ii. When grain moisture greater than 16%.
 - iii. Can appear within 24 to 36 hours after storage
 - iv. Can start forming after six to eight hours in wet corn stored in trucks or holding bins
 - v. Inhibited with grain moisture contents less than 12% to 13%; grain temperatures below 55°F
- d. Concentration never decreases in storage; increases or stays the same

E. Aflatoxin effects

1. Effect on animal health may be acute or chronic

- a. Aflatoxin poisoning called "*aflatoxicosis*"
- b. Acute: death can occur if livestock consume high doses of aflatoxin
- c. Chronic: more subtle health problems
 - i. Are most common
 - ii. Can result from sub-lethal doses of aflatoxin
 - iii. Reproduction in swine not primarily affected
- d. Liver is primary target
 - i. Abnormal blood clotting, hemorrhaging
 - ii. Reduced immune response
 - iii. Degeneration of liver

2. Chronic symptoms:

- a. Reduced growth rate, gains
- b. Lower milk production
- c. Decreased appetite
- d. Reduced feed efficiency
- e. Poorer carcass quality
- f. Lower disease resistance, vaccine immunity

3. Example: aflatoxin levels over 100 ppb

- a. May not be fatal to dairy cattle
- b. Can affect kidney function and overall performance

4. Livestock types affected differently

- a. Dairy and beef cattle are more susceptible to aflatoxicosis than sheep.
- b. Young animals are more susceptible than mature animals
- c. Pregnant and growing animals are less susceptible than young animals but more susceptible than mature animals

F. Sampling for aflatoxin

1. Survey fields before harvest

- From dent through to harvest, check five to ten field locations
- Target areas with plants that appear most stressed.
- Peel back the husks of 10 ears at each location and inspect for mold

2. Olive-green powdery mold is characteristic of *Aspergillus* ear rot and potential aflatoxin problems

- If more than 10% of corn ears in a field have more than 10% to 20% mold – harvest ASAP

3. Accurate sampling is difficult

- Contamination can vary widely within a field or a storage facility
- Often “kernel-by-kernel” situation
 - e.g., a few kernels have very high levels (several thousand times the average); most have none
 - Aflatoxin in storage bin may only be found in clumps of grain held together by mold growth
 - May have been mixed throughout grain mass during transfer

4. Suggested sampling procedures

- Standing grain: Collect 25 ears or heads at random throughout the field
- Grain cart/truck: Take multiple probes for a composite 10 lb. sample
- Moving grain stream: Take a composite 10-lb sample consisting of 12 to 20 subsamples from the grain stream
- Silage: Collect 8 to 12 subsamples to form a 2-quart to 3-quart sample during harvest or from storage
- Keep samples cool, but do not freeze
- Ship promptly, early in the week, to avoid weekend delays

G. Interpreting laboratory results

1. Several methods available

- Have different applications
- Screening vs. quantitative (*see Table*)

2. Interpretation depends on commodity and animal type (*see Table 1*)

- Data may be \pm 25% to 40% of reported value due to typical sampling and analytical error
- Official grain inspection certificate
 - Not everyone can or should always have their grain officially inspected
- Certificate can only be issued by partners of official system FGIS system field offices and State and local agencies authorized by FGIS

Method	Type	Comments
Black-light ultraviolet)	Screening	For aflatoxin only 40% to 60% false positives
Immunoassay test kits	Screening	Several mycotoxins available Gives yes or no answer
Immunoassay with reader	Quantitative	Several mycotoxins available Used by Federal Grain Inspection Service (FGIS)
Chromatography	Quantitative	Laboratory confirmation Can test all mycotoxins

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