



Aflatoxin M1 in Milk

L. E. Chase¹, D. L. Brown¹, G. C. Bergstrom² and S.C. Murphy³

¹Department of Animal Science

²Department of Plant Pathology and Plant-Microbe Biology

³Department of Food Science

Cornell University

A number of dairy cooperatives and milk processors in the U.S. and New York are testing loads of milk for aflatoxin. This testing is the result of concerns of potentially higher aflatoxin content in feeds produced during the 2012 growing season. The hot, dry and drought conditions experienced in this growing season increase the chance for elevated feed aflatoxin levels. The following points may be helpful in better understanding this situation.

What are aflatoxins?

A number of molds and fungi produce toxic compounds collectively referred to as mycotoxins. Aflatoxins are forms of mycotoxins produced by specific molds (*Aspergillus flavus* and *Aspergillus parasiticus*) that under certain conditions can be found in animal feeds and human foods.

What are the animal health concerns?

Dairy cattle consuming feeds with high aflatoxin levels may show lower dry matter intake, decreased milk production, slower growth in heifers and decreased immunity. Lower immunity decreases the animal's ability to fight disease challenges.

What are the human health concerns?

Aflatoxins are best known for causing liver cancer and other liver damage in humans. These toxins also suppress the human immune system and interfere with the proper use of nutrients. For this reason, the maximum concentration of aflatoxin permitted in food consumed by humans in the U.S. is 20 ppb (parts per billion) except for milk for which the maximum is 0.5 ppb. These levels are set by the Food and Drug Administration (FDA).

Where do aflatoxins come from?

Aflatoxins are metabolites produced by fungi in feeds and foods. There are a number of forms produced in feeds. These include B₁, B₂, G₁ and G₂. Corn, peanuts and cottonseed are the

crops most likely to contain aflatoxins. In the Northeast, corn grain would be the most likely source. There could also be aflatoxin present in corn silage or corn processing byproduct feeds. Whole cottonseed imported from the southern states could also contain aflatoxin.

What growing conditions support aflatoxin production in feeds?

Preharvest aflatoxin of peanuts and corn is favored by high field temperature, prolonged drought conditions and high insect activity. Postharvest production of aflatoxin on stored grains and peanuts is favored by warm temperature and high humidity. The molds (*Aspergillus flavus* and *Aspergillus parasiticus*) that produce the toxin grow best at 14-30% moisture and 77° F. They don't grow well at less than 53° and greater than 106° F. Samples with no visible mold may still contain high levels of aflatoxin.

How does aflatoxin get in milk?

The aflatoxin in milk is the M₁ form. When dairy cows consume feed containing aflatoxin, some of the feed aflatoxin can be converted to the M₁ form and excreted in the milk. It appears that 1-3% of the feed aflatoxin consumed is excreted in the milk.

How fast does aflatoxin appear in milk after consuming feeds with high aflatoxin content?

Research indicates that increased levels of aflatoxin in milk can be detected within 12 – 24 hours of consuming feeds with high aflatoxin levels. When these feeds are removed from the ration, milk aflatoxin levels decrease within 1 – 4 days.

What are the regulatory guidelines for aflatoxin in animal feeds, human foods and milk?

Aflatoxins are the only mycotoxins currently regulated by FDA. They have set the following action levels:

Aflatoxin level , ppb (parts per billion)	Feed and species
0.5	Milk
20	Foods for human consumption
20	Feeds and feed ingredients intended for dairy animals, animal species or uses not listed below or if the intended use is not known
20	Feeds and feed ingredients intended for use in immature animals
100	Feeds and feed ingredients fed to breeding beef cattle, breeding swine or mature poultry
200	Corn and peanut products fed to finishing swine (<100 lbs. body weight)
300	Cottonseed meal intended for beef cattle, swine or poultry (regardless of age or breeding status)
300	Corn and peanut products intended for finishing beef cattle (feedlot cattle).

Feeds, foods or milk exceeding the above action levels cannot enter the animal or human food chains.

What levels of aflatoxin have been found in the 2012 crops?

Dairyland Labs in Wisconsin recently summarized their data for samples submitted between September and December 31, 2012. These samples are primarily from the Midwestern states. Overall, about 9 to 14% of the samples analyzed (corn silage, corn grain and distillers grain) contained > 20 ppb of aflatoxin. Informal discussions with forage testing labs, feed companies and the two ethanol plants operating in New York indicate they are finding little if any aflatoxin in corn grain grown in New York or the distiller's grain produced from local corn grain. . The same pattern seems to hold for locally produced corn silage. The risk of high milk aflatoxin levels appears to be very low if New York produced feeds are used in dairy rations.

Can feeds with high aflatoxin levels be blended with feeds containing lower aflatoxin levels?

FDA does not permit this unless a special exemption is applied for by a state. New York has decided not to request this exemption. Corn grain that has been blended cannot be used in dairy rations.

Can compounds be added to dairy rations to bind aflatoxin?

The research data on binding ability from trials are contradictory and very few of these trials have been done with dairy cattle. Some hydrated sodium calcium alumino-silicates do have some ability to bind aflatoxin. Other clay type compounds, bentonites and yeast cell glucomannans are believed to have some binding capacity. The research data is not conclusive since there are a large number of compounds available and only a few have been tested for binding capacity. **None of the compounds are approved by FDA to be added as mycotoxins binders in dairy rations.** Some of these compounds may be approved for use as anti-caking agents in foods and feeds.

What analytical tests are available?

Aflatoxin content in feeds and milk can be analyzed using a number of tests. These include "dipstick" or other tests that can be used on the farm. Some of these give a negative or positive answer at a specified aflatoxin level. Other tests may provide a quantitative answer. These tests usually require some preparation of the feed including grinding and mixing with a solvent. Samples can also be analyzed by commercial labs using ELISA (enzyme-linked immunosorbent assay), HPLC (high pressure liquid chromatography) or other techniques. Feeds can be sent to the Dairy One Forage Lab (www.dairyone.com, 800-486-3344) or Cumberland Valley Analytical Services (www.foragelab.com, 800-2822-522). Other labs may offer similar analyses.

FDA Resources Used:

Milk:

www.fda.gov/ICECI/ComplianceManuals/CompliancePolicyGuidanceManual/ucm074482.htm

Feed:

www.fda.gov/ICECI/ComplianceManuals/CompliancePolicyGuidanceManual/ucm074703.htm

Author Contact Information:

L. E. Chase – lec7@cornell.edu, 607-255-2196

D. L. Brown – dlb20@cornell.edu, 607-255-4407

G. C. Bergstrom – gcb3@cornell.edu, 607-255-7849

S. C. Murphy – scm4@cornell.edu, 607-255-2893

All material is protected by Section 107 of the 1976 copyright Law. Copyright is held by Cornell University. ©2013 Cornell University. Permission is hereby granted to reproduce this Fact Sheet for educational purposes as long as the source statements are left intact.

Cornell University and Cornell Cooperative Extension provide equal program and employment opportunity.

