How to handle Moldy Feed Problems

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Mold Toxins—Why Be Concerned With Moldy Feeds?

Some molds or fungi growing on grains and forages may produce toxins which can cause severe illness in animals. These toxins are called mycotoxins and the toxic or diseased state is termed a **mycotoxicosis.**

Feeds that contain mycotoxins can also diminish feed intake, consequently reducing animal productivity. Furthermore, some mycotoxins or their metabolic products may appear as residues in meat, milk and eggs and, if consumed by humans, could adversely affect human health. Mycotoxins are usually stable and remain active even after processing and cooking.

How Do I Know If Moldy Feeds Contain Mycotoxins?

It is sometimes very difficult to determine if a feed contains mycotoxins. The presence of a mold does not mean that the feed contains a mycotoxin and the absence of visible mold does not always mean that mycotoxins are not present. Chemical analysis is necessary to tell when feeds contain mycotoxins.

How Can I Detect A Mycotoxicosis?

The disease symptoms must first be shown to be related to the feed. Feed refusal by animals is the most common mycotoxin related complaint. Until the science of mycotoxin analysis is better developed, the producer should not force livestock to eat feed which they refuse. Decreased production or performance is also indicative but also common to other diseases. First, the problem must be shown to be related to the feed.

Remember, moldy grain can cause health problems that range from poor appetite to death. If the grain is suspected of being moldy, feed portions of it to one or more older animals first. These animals should then be watched closely for signs of poor eating and performance.

If you are concerned about mycotoxins in feed, or if you suspect mycotoxicosis in animals, contact your county agent or your veterinarian to learn how to take the feed sample and where to have it analyzed. Several state and private laboratories and the Animal Health Diagnostic Laboratory at Michigan State University can test for the presence of most mycotoxins. Make sure the sample is representative of the feed being fed. Mycotoxins do not occur uniformly throughout the moldy feed. Preferably, take two representative samples on different days. Samples must be kept refrigerated. Errors in detecting mycotoxins occur in sampling, not in analysis.

What Do I Do If Feeds Are Contaminated?

Measures to be taken if mycotoxins are present in feed depend upon the amount and type of toxin present. Mycotoxicoses are not contagious, nor does the condition respond to usual or antibiotic therapy. Usually, there is not much that can be done other than eliminating that particular feed from the ration. Highly contaminated feed should be discarded. For less toxic mycotoxins, small amounts of the contaminated feed may be fed. Feed contaminated with certain other toxins may be fed to species other than the one affected. For example, **Fusarium** toxins are not as harmful to dairy cattle as they are to swine and horses. However, animal health should be closely monitored when feeding contaminated feed. Research has shown that cows in good health and fed a balanced ration are not as adversely affected by ingesting mycotoxins as are improperly fed cows.

Symptoms Associated With Specific Mycotoxins *(see also Table 1)*

Aflatoxins—Aflatoxins are a group of closely related compounds produced by *Aspergillus* species. The name aflatoxin is derived from the fungus *Aspergillus flavus*. Aflatoxins, found in peanuts, corn, soybeans, wheat, barley and other feedstuffs, are most commonly found in the warm moist climate of the southeastern United States, and only occasionally in the north central, midwestern states.

Aflatoxins are potent cancer causing compounds. The Food and Drug Administration (FDA) does not allow grains with more than 20 parts per billion (ppb), nor milk with over 0.5 ppb to be sold. Cattle are somewhat more resistant to aflatoxin than other domestic animals, but aflatoxin in the diet may lead to residues in the milk, since 0.5 to 3% of dietary aflotoxin appears in the milk. There is no evidence of other tissue accumulation, except perhaps the liver.

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Table 1. Mycotoxins of Importance in Michigan.

Toxin	*Fungus*	*Most Common Substrate*	*Species Usually Affected*	*Disease Produced/Clinical Signs*
Aflatoxin	*Aspergillus flavus*	cottonseed, corn, peanuts, sorghum	poultry, dog, swine, cattle sheep	Aflatoxicosis; acute syndrome: hemorrhage, edema, yellowish discoloration of body tissues; chronic syndrome: loss of appetite, reduced feed efficiency, "wasting"
Diacetoxy-scirpenol	*Fusarium tricinctum*	corn	cattle	diarrhea, reduced milk production, weight loss, possible skin necrosis, gangrene
Ergot alkaloids	*Claviceps purpurea*	rye and other cereal grains	swine, poultry, cattle	dry gangrene of extremities, diminished milk production in lactating sows, convulsions, ataxia, tremors
Ochratoxin (Citrinin)	*Aspergillus ochraceus* *Penicillium viridicatum*	barley, corn, wheat	swine, poultry horses, sheep	kidney and liver disease, reduced gain, reduced bone development, internal organ atrophy, death
Rubratoxin	*Aspergillus flavus* and others	grain and meal	growing chickens	Poultry Hemorrhagic Syndrome; depression, loss of appetite, no gain in weight, death, widespread internal hemorrhage
Slaframine	*Rhizoctonia leguminicola*	clover hay and pasture	sheep, cattle	Slobbering; excessive salivation, lacrimation, bloat, diarrhea, sometimes death; usually recover when removed from clover
Tricothecene (T-2 toxin)	*Fusarium tricinctum*	corn, hay	swine poultry, cattle	gastroenteritis, widespread hemorrhage, dehydration, hematopoietic depression
Vomitoxin	*Fusarium roseum* *Fusarium graminarium*	corn, wheat, barley	swine	vomiting and diarrhea; reduced growth, dehydration, followed by death
Zearalenone (F-2)	*Fusarium graminarium*	corn	swine	Vulvovaginitis; prolonged estrus, spontaneous estrus, vulval swelling, mammary enlargement, preputial enlargement, abortion
Toxin unknown "moldy corn poisoning"	*Fusarium monilliforme*	corn	horses, other	brain disease; opsithotonus (star-gazing), ataxia, incoordination, blindness, inability to eat, drooping of lower lip, coma, death

The effects of aflatoxin are more pronounced with lower quality feed, particularly lower protein levels. Younger animals are also more susceptible. Currently, the FDA allows 100 ppb in the diet of livestock and poultry—20 ppb for milking animals.

The acute syndrome is rare in the North Central U.S. and involves the short-term intake of a relatively large amount of the aflatoxin. It is characterized by hemorrhage, edema, and a yellowish discoloration of body tissues. The more commonly observed chronic syndrome involves reduced growth rates and feed efficiency or a wasting disease. The condition can be diagnosed by postmortem and microscopic examination of the liver and other tissues along with chemical analysis of the feed.

Ergotism—Ergot poisoning is caused by the fungus *Claviceps purpurea*. This fungus infects cereals (rye, oats, wheat, barley and other grasses). Rye is particularly susceptible. Ergot causes the constriction of blood vessels which causes dry gangrene of the extremities. Identification of these mycotoxins has been based primarily on clinical signs and lesions. Chemical analysis of the feed is generally disappointing because many different ergot toxins exist and only a few are readily identifiable. The ergot containing bodies are black and visible (similar to mouse feces) and can be readily identified in grains. Grains containing over 0.3% ergot sclerotia are restricted from trade. See MSU Extension Bulletin E-1430 for more information.

Fusarium Toxins—An estrogenic syndrome in swine is produced by zearalenone (F-2 toxin), a mycotoxin produced by *Fusarium roseum*, also called *Gibberella zeae*. These organisms are plant pathogens and cause scab of wheat, and stalk rot and ear rot in corn. Common symptoms include enlargement of the vulva, mammary gland or uterus in gilts one to four months old and enlargement of the prepuce in boars or barrows. Vaginal and perhaps rectal prolapses commonly follow. This condition is not uncommon in the North Central U.S. and can be diagnosed by the clinical signs and chemical analyses of the feed supply.

Feed refusal is suspected to be caused by several of a large group of mycotoxins called trichothecenes, some produced by the same fungi which produces zearalenone. These fungi are ubiquitous, produce many toxins and perhaps represent the greatest threat to animal health in this part of the country. Also, members of this group of fungi can grow and produce toxins at low temperatures and cause necrotic effect on tissues with which they come in contact. Seen most commonly in poultry, these mycotoxins can produce erosions and ulcers at the margins of the mouth and of the oral cavity. They have been most often associated with digestive tract inflammation, vomiting, oral ulcerations, diarrhea and intestinal hemorrhages. When exposure is severe, the blood producing organs may also be affected. Many trichothecenes have been identified, but few of these compounds have been associated with field cases. One of the trichothecenes, deoxynivalenol (vomitoxin), is known to produce profuse vomiting and/or feed refusal in animals, especially swine.

Slaframine—Slobbering is a mycotoxicosis caused by slaframine, produced by *Rhizoctonia* species growing on clovers, primarily red clover. This occurs particularly in wet years and is characterized by the sudden onset of profuse salivation. Watery eyes and excessive tearing, frequent urination, occasional bloat and loss of appetite may occur within hours after exposure to the contaminated clover. Recovery is usually rapid after the animals are removed from the contaminated pasture or hay, unless the ingestion of the material has been prolonged.

Other Toxins—An unknown toxin apparently produced by *Fusarium moniliforme* causes leukoencephalomalacia or "moldy corn poisoning," a terminal brain disease of horses. This condition is primarily associated with horses fed corn stalks during the winter or grain screenings anytime. The softening and necrosis of the white matter of the brain leads to blindness, inability to eat, drooping of the lower lip, coma and death. All symptoms are usually observed in one to five days. The only means of diagnosis for this condition is examination of the brain tissue, because a toxin has not been identified.

Ochratoxin and citrinin are two separate mycotoxins, produced by *Penicillium* and *Aspergillus* species, respectively, but both have been implicated as the cause of kidney disease and failure. The disease is well known in Denmark and has been described in the U.S. in swine and cattle. Lesions are typical, but not specific, and diagnosis depends on chemical analysis of the feed. Ochratoxin has been blamed for abortion in dairy cattle, but this has not been supported by experimental evidence. A diet level of 20 ppb is the maximum allowed by the FDA.

When Does Mold Infestation Occur?

Mold growth can occur in the field or in storage. Field infestation by molds is most common in crops under stressful conditions, especially grains heavily damaged by insects. A wet harvest season may allow common *Fusarium* species to invade kernels while grains are growing in the field. Such grain may contain mycotoxins when harvested. Lengthening exposure of mature crops to wet weather increases kernel deterioration and the possibility of mold growth and toxin production.

Many molds produce toxins in storage. The critical factors regulating mold growth in storage are 1) moisture, 2) temperature, 3) level of acidity (pH) and 4) presence of air (oxygen). Some molds may grow rapidly without producing toxins; at other times they produce toxins regardless of growth rate. Toxin producing molds need 14-24% moisture, more than 70% relative humidity, oxygen, a carbohydrate source (which is supplied by damaged grain) and a temperature range conducive to growth and toxin production.

Generally, grains and soybeans are considered safe for long term storage when the moisture content is 13% or less. Moisture levels even slightly above this allow molds to grow. Although some molds can grow at temperatures slightly above freezing, most grow best in warm environments. Molds do not grow well in anaerobic acid environments (low pH), such as in good silage. However, molds will grow in silage exposed to air.

Low moisture is the critical factor preventing mold growth in grain stored in bins or cribs. For grains stored in silos, the moisture level, amount of oxygen and acidity are all critical factors that need to be controlled.

Storing Grains in Bins or Cribs

- Most corn in the U.S. is field-shelled with moisture content too high for safe storage, and extremely perishable unless dried. Improper drying may allow for mold development. For example, if the grain is dried too slowly, it may mold before it has sufficiently dried.
- Leaks in storage facilities may enable rain or snow to increase the moisture content and allow "pockets" of mold to grow when temperature becomes desirable. Leaks also allow oxygen to enter.
- Temperature gradients are common in grain bins, and produce moisture migration toward the cooler region. Mold growth may develop in these moist spots. Temperature inside storage bins should be monitored

frequently. Such storage facilities should have fans installed for aeration and temperature control.

• Inclusion of trash (husks, chaff, etc.) in the grain enhances mold development.

• Inspect grain when stored. Insects or mechanical handling may damage grain, thereby enhancing mold infestation.

• A unique problem with some *Fusarium* molds is that they can develop in ear corn stored in cribs during weather conditions such as "Indian Summer," when days are warm and nights are cool. The mold grows during warm humid days, but produces the toxin during cool nights. Keep feed as dry as possible to help avoid this problem.

High Moisture Grains

• High moisture grains such as corn (25-36% moisture) can be stored under airtight conditions in an oxygen limiting silo or treated with organic acids such as propionic acid to lower the pH (see Table 2). Length of satisfactory storage varies with moisture content and amount of acid used.

• Airtight storage structures should be checked at least every other year to determine that they are airtight.

Table 2. Propionic acid required for preventing mold growth in high moisture grain.

Moisture Content,	Propionic Acid Required	
%	%	lb/ton
Up to 22	1.1	22
24	1.2	24
26	1.3	26
28	1.4	28
30	1.5	30
Over 30	2.0	40

Use only liquid that is over 70% propionic acid.

Mold Problems in Ensiled Feeds

Proper ensiling techniques and exclusion of air are of the utmost importance for ensiling high moisture grains in upright silos or bunkers. The following guidelines will help:

• Harvest the crop promptly when it is ready. The corn kernel is mature when the "black line" is formed.

• **Store in a facility compatible with daily feed utilization.** This will minimize surface spoilage during feeding. Feed at least 2" per day during the winter and 3 to 5" per day during summer from upright silos. If feeding from bunker, try to have the bunker empty before warm months when excessive spoilage is likely to occur. Another alternative is to grind and treat grains with propionic acid as they enter the bunker, and then cover with plastic.

• Ensile at a moisture content between 32 and 36% for ear corn and 28 to 32% for shelled corn. Never ensile high moisture corn under 25% moisture. Use a "Koster" moisture tester for accurately determining water content of corn, other grains and forages.

• Eliminate trash (husks, stalks, etc.) from the ensiled material.

• Whole grains can be ensiled in airtight silos. However, grinding as ensiled will produce better packing which is important in top-unloading upright silos. Chop, grind or roll kernels to the appropriate size. Grain should be cracked into 6 to 8 pieces. If cob is included with corn, both the corn and the cob should be as uniform in particle size as possible. Avoid cob particles larger than ½" or grinding the grain into flour. See Extension Bulletin E-1030.

• Distribute material in the silo evenly to prevent lighter material from floating to the edge.

• Fill the silo rapidly. The more material that can be ensiled per day, the better preserved the grain will be.

• Treat the last few feet (5' to 10' in a conventional silo; 2' of a bunker silo) with propionic acid to minimize surface spoilage. Make sure it is 70-100% propionic acid applied at the recommended rate. (See Table 2). Alternately, the top ⅙ of the silo can be filled with grains having a higher moisture content to enhance packing and oxygen exclusion.

Summary of Practices to Avoid Mold Problems

1. Minimize insect damage to growing crops and grains in storage. Take appropriate control measures when necessary.
2. Take extra precautions when storing weather-stressed or insect-damaged crops to minimize mold growth in storage.
3. Harvest crops on time. Do not leave mature crops in the field any longer than necessary.
4. Store feeds properly. Dry grains to the appropriate moisture level (13%) or treat with propionic acid. Follow recommended ensiling practices.
5. Inspect grains regularly for excessive temperature, mold growth and insect damage.
6. Feed out of silos at a rate which will minimize surface spoilage and mold growth.

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Issued in furtherance of cooperative extension work in agriculture and home economics, acts of May 8, and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Gordon E. Guyer, Director, Cooperative Extension Service, Michigan State University, E. Lansing, MI 48824.

1P-5M-1:83-UP-KMF, Price 20 cents. Single copy free to Michigan residents.

O-14071