



LITCHFIELD ANALYTICAL SERVICES

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Feeds Forages Mycotoxins Soils Plant Tissues Manure Fertilizers Lime Water

Mycotoxin Sampling & Interpretation

Some molds or fungi growing on grains and forages may produce toxins called mycotoxins that are poisonous, mutagenic, teratogenic, or carcinogenic when consumed by humans or livestock. Feeds that contain mycotoxins reduce animal productivity and may even cause death.

Mycotoxins are usually associated with temperate regions. These molds can propagate in agricultural plants whenever environmental conditions are favorable. Such conditions include cool damp summers, late wet harvests, and poor storage after harvest, even at moisture levels as low as 16%. If mold growth has occurred, it is likely that one or more of the mycotoxins have been produced.

Mycotoxins may remain in food and feed long after the fungus that produced them has died. Therefore, toxins can be present at potentially dangerous levels in products that are not visibly moldy or do not show positive results on a mold count of the material.

It is important to test for mycotoxins as a means of maintaining high quality feed and grain as well as protecting your livestock investment.

Types of Analysis

Quantitative tests are available for Aflatoxin, Zearalenone, T-2 Toxin, and Vomitoxin. Prices may vary with the number of toxins requested and the number of samples analyzed. If you have any questions, please call. Our goal is to provide our customers with quality laboratory services at competitive rates.

Why Test for Mycotoxins

Mycotoxins can lower the nutritional value of feed by changing the vitamin and amino acid content. This reduces the energy derived from the feed, which leads to lower feed efficiency. Losses of freshness and palatability results in feed rejection and lower weight gain. Reproduction difficulties that result in a reduction in the number of pigs farrowed and reproductive damage caused to prepubertal gilts and mature sows can be very costly. The money spent on screening for mycotoxins is extremely minimal compared to the economic losses that will occur if mycotoxin growth is left unchecked.

In order to protect your investment we recommend a program of regularly screening your feed for mycotoxin contamination.

When to Test

Testing for mycotoxins should be considered when signs of potential effects on performance and health exist and cannot be readily explained. This is particularly important when moldy feeds are being fed or when marked changes in production or health have occurred among a relatively large portion of animals.

What to Sample

Sample all moldy and non-moldy feeds that are likely to contain mycotoxins. Since most feed ingredients might contain mycotoxins and not all moldy feeds have them, it is best to sample at least all major ingredients. Start by testing total mixed rations (TMRs) when these are used in feeding ruminants. Sample concentrate mixtures when they are used in conventional ruminant feeding or for single-stomached animals. If mycotoxins are found in the TMR or grain mixtures, ingredients within them should also be tested. Sample grain supplements and forages separately if fed conventionally.

How to Take Samples

It is important to take representative samples since mycotoxins are present in such small quantities and may only occur in isolated spots in a bin or silo. The mycotoxin content is not necessarily related to the amount of mold seen. Recommendations for sampling include:

- 1) Take 12 to 20 small sub-samples at periodic intervals from a moving stream of feed or sample cores from 12 to 20 bales of hay. . Probing is an acceptable method of sampling trucks or railroad cars if the grain has recently been blended. If more than several days have elapsed since blending, then this method of sampling is less reliable.
- 2) Mix the sub-samples well and prepare a one-pound composite sample from the mixture for submission to a laboratory. Force out excess air when sealing the sample bag.
- 3) Samples to be shipped must be kept refrigerated or should be dried to a moisture content of 12% to 13% and shipped

in a paper bag. Wet samples may mold when shipped at higher moisture levels.

- 4) Mark each sample bags with an indelible marker. Include the name of the person submitting it and a brief description (J. Adams-TMR-High Group). Identify the samples in a like manner on the sample mailer envelope. For each sample, note the specific mycotoxin or mycotoxins that you want screened. Indicate who should be billed for testing and the email address or fax number where the results should be sent.
- 5) Take or ship the sample to the laboratory for arrival on Tuesday through Thursday. This prevents samples from sitting in the mail over the weekend.

Advantages of Using Litchfield Analytical Services

We utilize the most modern laboratory methods available. Our staff is trained and experienced in testing grains and feeds, which will ensure you accurate and consistent results. Sample analysis will be completed within 24 hours of receipt of sample. Results can be reported by email or fax upon customer request.

Compare our turn-around time, the quality of the tests that you receive, and our very competitive rates. We are sure that you will want to place your mycotoxin analysis work in our experienced hands.

Interpretation of Mycotoxin Test Results

Always check the basis on which results are reported. Many laboratories report values on an as-received or as-fed basis and do not report dry matter (DM) levels in the samples to facilitate interpretation. Another problem in interpretation involves the units of measurement used to report the results. Further, the significance of the mycotoxin content of an individual feed in the diet depends upon how much is used in the ration and whether or not it or others may be present in other ration ingredients.

Moisture Correction

Usually mycotoxin results are reported on a 100% dry matter (DM) basis. Occasionally they are reported on an as-received or as-fed basis. These values must be corrected to a DM basis so that an appropriate inclusion rate can be calculated. As received or as-fed values may be converted to a DM basis as follows:

$$DM \text{ Value} = \text{As-Received Value} \div \%DM \text{ as a decimal.}$$

For example, a DON level of 1.0 ppm in whole plant corn silage containing 30% DM (70% moisture) is equivalent to $1 \text{ ppm DON} \div 0.30 \text{ DM} = 3.33 \text{ ppm DON}$ on a DM basis.

Unit of Measurement Correction

It is important to look closely at the unit of measurement given in the results for each test and employ the proper units when interpreting levels. Levels may be converted for interpretation purposes as follows:

$$\begin{aligned} 1000 \text{ parts per billion (ppb)} &= 1.0 \text{ part per million (ppm)} \\ &= 1.0 \text{ milligram per kilogram (mg/kg)} \end{aligned}$$

$$\begin{aligned} 1 \text{ part per billion (ppb)} &= 0.001 \text{ ppm} \\ &= 0.001 \text{ mg/kg} \end{aligned}$$

For example, 3300 ppb DON is only 3.3 ppm.

Mycotoxin Content of Total Ration Dry Matter (DM)

The mycotoxin level present in the total ration dry matter (TRDM) is the object of prime importance. Mycotoxin levels in an individual feed ingredient may be converted to TRDM values as follows:

$$TRDM \text{ Value} = DM \text{ Value} * \% \text{ of ration as a decimal.}$$

For example, if the corn silage containing 3.33 ppm DON on a DM basis is fed at a rate of 10% of the total dry matter in the ration, $3.33 \text{ ppm DON} * 0.10 \text{ of ration} = 0.33 \text{ ppm DON}$ in the TRDM. A guide for interpreting mycotoxin tests in livestock feeding is presented in **Table 1**.

Aflatoxin

Aflatoxin is a by-product of mold growth in a wide range of commodities. Two molds that are major producers of aflatoxin are *Aspergillus flavus* and *Aspergillus parasitiosus*. These mold species thrive on conditions such as high temperatures and moisture. Aflatoxin is one of the most potent carcinogens to which humans or animals can be exposed.

Effects of aflatoxin on livestock:

Swine

- Growth reduction.
- Reduced immunity.
- Coagulation problems.
- Liver damage, acute hepatitis.
- Increased mortality.
- Reduced feed efficiency.
- Lethargy.

Cattle

- Growth reduction.
- Reduced immunity.
- Liver damage.
- Increased mortality.
- Reduced feed efficiency.
- Lethargy.
- Reduced milk production.
- Aflatoxin in milk.
- Reduction in rumen motility.

Poultry

- Growth reduction.
- Reduced immunity.
- Liver damage.
- Increased mortality.
- Reduced feed efficiency.
- Lethargy.
- Reduced egg production.

- Reduced antibiotic efficacy
- Reduced skin pigmentation
- Anemia
- Reduced ability to metabolize fat, starch, & protein
- Coagulation problems

Horses

- Possible lack of muscular control.
- Excitability, circling.
- Tetany.
- Deaths from unspecified levels.

Fumonisin (B-1 Toxin)

Fumonisin is produced by the mold species *Fusarium verticillioides* and *Fusarium proliferatum*. This mycotoxin has its greatest effect on horses.

Effects of Fumonisin on livestock:

Horses

- Leukoencephalomalacia signs within 7 to 30 days include depression, uncoordination, weakness, blindness, head-pressing, and death from brain necrosis at levels of 8 to 10 ppm.

Swine

- Porcine pulmonary edema.
- Dyspnea, weakness, cyanosis, death.

Ochratoxin

Ochratoxins are produced primarily by *Penicillium verrucosum* and cause significant disease in animals, especially swine.

Effects of Ochratoxin on livestock:

Swine

- Kidney and sometimes liver damage.
- Increased urine production and water intake.
- Reduced feed intake.
- Weight loss.
- Abortions and delayed sexual maturity.
- Total feed refusal at 5.0 ppm in TRDM.
- Sometimes death at 1.0 - 2.7 ppm in TRDM.

Cattle

- Kidney involvement.
- Reduced feed intake and performance.
- Hunched stance in calves, possibly others.

Poultry

- Ochratoxin is the most harmful of mycotoxins for poultry.

T-2 Toxin

T-2 Toxin is produced by the mold species *Fusarium tricinctum*. This mycotoxin has its greatest effect on swine and poultry but it also effects dairy cattle, dogs and horses. In the most severe cases, T-2 toxin will cause death.

Effects of T-2 Toxin on livestock:

Swine

- Digestive disorders.
- Increased mortality.
- Reduced feed efficiency.
- Reduced growth.
- Bloody diarrhea.
- Reduced milk production.
- Hemorrhaging lesions of internal organs.
- Depressed immune system.
- Coagulation problems.
- Skin lesions.
- Feed refusal.
- Infertility.
- Vomiting.

Cattle

- Digestive disorders.
- Increased mortality.
- Reduced feed efficiency.
- Reduced growth.
- Reduced milk production.
- Hemorrhaging lesions of internal organs.
- Depressed immune system.
- Coagulation problems.
- Skin lesions.
- Feed refusal.
- Infertility.
- Vomiting.
- High somatic cell counts.
- Hemorrhage @ 1.0 – 2.0 ppm in TRDM.
- Reduced dry matter intake.
- Ketosis.
- Displaced abomasum.

Poultry

- Digestive disorders.
- Increased mortality.
- Bloody diarrhea.
- Reduced egg production.
- Hemorrhaging lesions of internal organs.
- Depressed immune system.
- Coagulation problems.
- Oral lesions.
- Dehydration.
- Hemorrhaging - stomach, intestines, lungs & kidneys.
- Hysteroid seizures.
- Impaired righting response.
- Reduced hatch rate.
- Poor feathering of growing birds.
- Lower feed consumption.

Vomitoxin (DON)

Vomitoxin or Deoxyvalenol (DON) is produced by the mold species *Fusarium graminearum* and *Fusarium roseum*. These are the same species that produce Zearalenone. So if vomitoxin is present, it may be a signal that Zearalenone is also present.

Vomitoxin can cause vomiting, feed refusal, immune suppression, diarrhea, and weight loss. Swine are extremely sensitive to Vomitoxin.

Effects of Vomitoxin on livestock:

Swine

- Reduced reproductive performance
- Increased mortality
- Reduced feed efficiency
- Diarrhea
- Reduced growth.
- Vomiting
- Reduced milk production
- Neural disturbances.
- Increase susceptibility to disease.
- Coagulation problems.
- Weight loss.
- Infertility.

Cattle

- Increased mortality.
- Reduced feed efficiency.
- Diarrhea.
- Reduced growth.
- Vomiting.
- Reduced milk production.
- Neural disturbances.
- Increased susceptibility to disease.
- Coagulation problems.
- High somatic cell counts.
- Reduced dry matter intake.
- Ketosis.
- Displaced abomasum.

Poultry

- Reduced reproductive performance
- Increased mortality
- Reduced feed efficiency
- Diarrhea
- Reduced growth.
- Vomiting
- Reduced egg production
- Reduced hatch rate.
- Neural disturbances.
- Depressed immune system.
- Coagulation problems.
- Oral lesions.
- Digestive disorders.
- Dehydration.
- Hemorrhaging - stomach., intestines, lungs & kidneys.
- Hysteroid seizures.
- Impaired righting response.
- Poor feathering of growing birds.
- Lower feed consumption.

Zearalenone (F-2)

Zearalenone is primarily produced by the molds *Fusarium graminearum*, and *Fusarium roseum*, which also commonly produce Vomitoxin. Hence, if Zearalenone is detected, there is a high probability that

Vomitoxin is also present. Zearalenone is most commonly found in wheat, corn, sorghum, barley and oats. Swine are predominantly affected by Zearalenone.

Effects of Zearalenone on livestock:

Swine

- Reduced reproductive performance.
- Increased mortality.
- Reduced feed efficiency.
- Reduced growth.
- Hyperestrogenic syndrome.
- Prolapsed uterus or rectum.
- Enlarged nipples or mammary glands.
- Vulvovaginitis.
- Enlarged prepuce.
- Reduced milk production.
- Depressed immune system.
- Coagulation problems.
- Reduced testicular size & lower libido.
- Abortions.
- Stillborn pigs.
- Anestrus.
- Reduced litter size.
- Pseudopregnancy.

Cattle

- Reduced reproductive performance.
- Increased mortality.
- Reduced feed efficiency.
- Reduced growth.
- Hyperestrogenic syndrome.
- Swelling of female reproductive organs.
- Enlarged nipples or mammary glands.
- Reduced milk production.
- Depressed immune system.
- Coagulation problems.
- Irregular heats and infertility @ 4 – 7 ppm in TRDM.
- No abortions noted in most cases.

Poultry

- Reduced reproductive performance.
- Increased mortality.
- Depressed immune system.
- Coagulation problems.

Sources

“Mold & Mycotoxin Problems in Livestock Feeding,” Adams, Kephart, Ishler, Hutchinson, & Roth, Penn State University DAS 93-21.

“Molds and Mycotoxins,” B. Tarr, Cattle Nutrition Specialist, Ontario Ministry of Agriculture, Food & Rural Affairs.

“Mycotoxins in Feed Grain,” Office of Indiana State Chemist, Purdue University, 1996.

“Mycotoxins,” Council for Agricultural Science and Technology, Task Force Report #139, January 2003.

Valuable Information on Managing Feeds Containing Mycotoxins

Table 1. Guidelines for interpretation of mycotoxin tests in livestock feeds

<u>Mycotoxin</u>	<u>Concern Level</u>	<u>Potentially Harmful TRDM Levels</u>				
		<u>Dairy</u>	<u>Beef</u>	<u>Swine</u>	<u>Poultry</u>	<u>Horses</u>
Aflatoxin	20 ppb	20-132 ppb	20-132 ppb	20-102 ppb	20-102 ppb	20-50 ppb
Fumonisin	1.1 ppm	6.7-11.1 ppm	1.9-5.0 ppm	10.0 ppm	6.7-11.1 ppm	2.0-5.0 ppm
Ochratoxin	0.25 ppm	5.0-9.0 ppm	5.0-9.0 ppm	0.7-1.5 ppm	0.25-1.5 ppm	0.7-1.5 ppm
T-2 Toxin	100 ppb	100-250 ppb	150-500 ppb	100-300 ppb	100-300 ppb	150-1500 ppb
Vomitoxin	0.56 ppm	1.5-2.0 ppm	2.5-6.0 ppm	0.6-1.0 ppm	1.0-5.0 ppm	0.56-1.0 ppm
Zearalenone	100 ppb	300-1000 ppb	1000-6000 ppb	600-3900 ppb	600-3900 ppb	100-3900 ppb

- **A Negative Test** with no symptoms in animals suggests that a mycotoxin problem is highly unlikely. However, a negative test in the presence of symptoms possibly related to mycotoxins indicates the need for further inspection of feeds, further testing of suspected and other feeds in the diet, and a continued search for other causative factors. If drastic or pronounced effects are present, suspected feeds should be discontinued or fed in limited amounts at least temporarily. Additional mycotoxin and possibly other tests should be performed on the ration, blood, and feces in an attempt to find other causative factors.
 - **Concern Level** indicates possible favorable conditions for mycotoxins and probable need for further testing of all feeds or the TMR. In the absence of symptoms, feeds with a mycotoxin content ranging from the concern level to the lower potentially harmful level should be closely inspected, re-sampled, and re-tested since these levels indicate that conditions favoring mycotoxin production were present. In the presence of moderate effects on performance, re-sample and test the feeds as well as reduce intake of positive-testing feeds. In the presence of pronounced or drastic reductions in performance, discontinue the feed at least temporarily at the concern level.
 - **Potentially Harmful** indicates probable involvement in performance effects or acute clinical symptoms. Discontinue feeding at least temporarily in the presence of either type of symptoms. Feeds with mycotoxins at potentially harmful levels or higher should be fed at restricted levels in the absence of performance effects and discontinued at least temporarily if positive at concern levels in the presence of otherwise unexplained performance problems.
 - **TRDM** = total ration dry matter.
- * See the text for important details on aflatoxins. A diet with 20-40 ppb in aflatoxin should not be fed to dairy cows to keep milk values under FDA actionary levels and to avoid health or performance effects in young animals fed milk.