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Kentucky Dairy Notes

November 2012

Mycotoxins and their Effects on Dairy Cattle

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Mycotoxins are naturally occurring compounds produced by fungi growing on plants in the field or during storage. Even though toxigenic molds may grow under a given set of environmental conditions, they do not always produce mycotoxins. However, under the right conditions, mycotoxins can be generated fairly rapidly in the field or in storage. Mold identification can provide a direction to test for potential mycotoxins but does not confirm the presence or identification of a mycotoxin. Most mycotoxins can remain stable for years in feeds, and many survive ensiling and food processing. They can be concentrated several-fold in cereal by-products and typically concentrate threefold in distillers or corn gluten coproducts.

Aflatoxins can occur before harvest on starchy cereal crops (corn, cottonseed, and peanuts) or after harvest on stored commodities. Strains of *Aspergillus flavus* mainly produce aflatoxin B1, which is considered the most toxic and carcinogenic (cancer-causing) of the aflatoxins. Aflatoxins are potent liver toxins (hepatotoxins), immunosuppressants, carcinogens, and mutagens, and can cause important public health problems. For these reasons, many governments regulate the allowable concentrations of aflatoxins in animal feeds, human foods, and fluid milk. The FDA limits the amount of aflatoxin that can be found in lactating dairy cow feed to 20 ppb and the aflatoxin metabolite M1 to 0.5 ppb in milk.

The clinical signs of aflatoxicosis are somewhat vague and become more pronounced at higher dietary levels (>500 ppb) and/or prolonged periods of time exposed to the contaminated feed. All animals are susceptible to aflatoxins, but the sensitivity varies between species. Young animals and monogastrics are more at risk for toxicosis. Signs in ruminants include:

1. Decreased performance-
   a. Reduced appetite, reduced feed efficiency, reduced weight gain
   b. Reduced milk production and potential for illegal milk residues
2. Signs of Liver Damage-
   a. Increased hepatic enzymes and bilirubin on serum chemistries
   b. Prolonged clotting times (hemorrhage/nosebleeds)
   c. Icterus (jaundice)
   d. Neurologic signs including depression, lethargy, ataxia (staggering), circling, recumbency
3. Reduced immune competence-
   a. Vaccine failure or poor antibiotic response
   b. Decreased cell-mediated immunity, cytokine production, and nonspecific humoral factors such as complement, interferon, and some bactericidal serum components.
4. Abortion
   a. May cross the placenta and cause damage to fetal tissue
5. Death

Aflatoxin M_1 is the major excretion product in urine and milk and can be monitored for exposure. Aflatoxin M_1 appears quickly in milk and excretion in milk varies with animal species, individual, lactation status, and number of milkings after exposure. The dietary threshold for cows to excrete aflatoxin in milk is approximately 15 ppb; lactating cows consuming a diet with 20 ppb or less excrete less than 0.1 ppb in milk (US Food and Drug Administration [FDA] action limit is 0.5 ppb in milk). Aflatoxin M1 becomes undetectable in milk 2-4 days after aflatoxin-contaminated feeds are removed from the diet.

Veterinarians and nutritionists need to consider multiple sources of aflatoxins in rations and evaluate commodity storage conditions on the farm. In one field case, young calves (300-450 lbs) fed corn, whole cottonseed, gin trash, molasses, and mineral for several months started to show clinical signs of depression, lethargy , ataxia, poor performance, respiratory disease with poor treatment response, and death. Aflatoxin B_1 was detected in multiple samples of cottonseed between 96 and 1700 ppb, in 2 samples of gin trash at 110 and 857 ppb, and corn at 14 ppb. In these instances it is important to sample the final as-fed ration to determine the total level of aflatoxin the animal is consuming. Extremely high levels of aflatoxin B1 (>1000 ppb) may cause sudden or acute neurologic signs such as circling, depression, staggering, recumbency and death due to severe liver and brain damage. Diagnosis is based on clinical signs, laboratory tests indicating liver abnormalites, and toxic levels of aflatoxin present in the ration. An enlarged, fibrous liver is generally found on necropsy.

No specific treatment is available for aflatoxicosis beyond quickly removing the contaminated feed and replacing with an uncontaminated feed. Providing optimum dietary protein, vitamins, and trace elements may aid recovery, although some affected animals may not recover. Numerous products such as bentonite are marketed to sequester or bind mycotoxins and reduce absorption from an animal's gastrointestinal tract, although in the United States these agents can only be sold as anticaking or free-flow agents. The FDA has not licensed any product for use as a mycotoxin binder in animal feeds and extra-label use of feed additives is prohibited.

Other mycotoxins of concern in cattle are those produced by the *Fusarium* species of mold and include deoxynivalenol (DON or "vomitoxin"), zearalanone, and fumonisins. Ruminants are generally resistant to many of the negative effects of these mycotoxins because of their ability to degrade these compounds with the bacteria and protozoa found within the rumen. However, in large enough quantities, deleterious effects may occur. DON or "vomitoxin" is restricted by the FDA to 5 ppm or less in the final ration of dairy cattle over 4 months of age and 10 ppm in the grain (5 ppm in the finished feed) in beef cattle over 4 months of age. The primary clinical sign with DON is feed refusal but a drop in milk production, diarrhea, and immune system alterations may be noted. Zearalanone is associated with hyperestrogenism, udder development, enlarged genitalia and infertility although the effects in cattle are not fully understood. Mature cows appear to be more resistant to zearalanone toxicosis than heifers in research trials. No FDA guidelines have been established for tolerable zearalenone concentrations in finished feed for ruminants. The University of Missouri at Columbia and North Dakota State University suggest limiting the level of zearalenone to <2-4 ppm in dairy cows and <5-10 ppm in beef cattle. Fumonisin B1 and B2 are mycotoxins cattle are more tolerant of than many other species. The FDA does have established tolerance levels of fumonisin in finished feeds of 30 ppm for ruminants over 3 months old and fed for slaughter, 15 ppm in ruminant breeding stock including lactating dairy cows, and 5 ppm for ruminants less than 3 months of age. Feeding large quantities has resulted in decreased feed intake, decreased milk production, and some mild liver lesions.

It is important when dealing with stressed feed ingredients to measure the concentration of mycotoxins present and to know the nutritional value of the feed. However, bear in mind when sampling feeds that human exposure to high levels of mycotoxins - aflatoxin in particular – in grains and other crops can result in serious health problems. Any potentially contaminated grains or feeds should be handled with great care. Farmers, mill operators and others who routinely handle potentially contaminated feeds should always use protective gear such as gloves, dust masks, and coveralls. Once the feed is tested, producers then need to:

1. Keep the mycotoxin level as low as possible;
2. Keep the mycotoxin level under the regulatory action level for the given species and stage of production as aflatoxin residues can occur in multiple animal products from animals exposed to excessive amounts. Residues are especially important in milk and organ tissues, but can also be present in meat.
3. Compensate for differences in individual animals, sampling technique and "hot spots" by targeting total mycotoxin intake at less than the action or guidance level;
4. Remember if multiple mycotoxins are present in a feed, their adverse effects may be additive.

For the most up-to-date information regarding aflatoxins and other mycotoxins in corn, visit the UK website http://www.uky.edu/Ag/GrainCrops/corn_mycotoxins2012.html for a comprehensive collection of bulletins compiled by the experts. A link to the mycotoxin page can be found at www.askukyvet.com under "Alerts".

For Further Reading on Aflatoxins check out last month's article.

Common Questions Regarding Aflatoxin in Corn Grain and Silage

Aflatoxin is a concern to many Kentucky dairy farmers due to the drought conditions this summer. Some of the common questions are listed in this article to help farmers decide if they may have an issue with aflatoxins.

Cow Nutrition and Crop Nutrient Management

Bill Weiss, Department of Animal Sciences,The Ohio State University

Dairy cows must follow the law of conservation of mass. What this means is that everything that goes into a cow must eventually come out. Nutrients consumed by a cow are secreted in milk, excreted in manure, or retained in the body (either in the cow or in her developing fetus). The nutrients secreted in milk are shipped off the farm several times each week, and most of the nutrients in the cow or her calf eventually leave the farm as a bull calf or a culled dairy cow. The excreted nutrients, although not as valuable as the nutrients in milk have substantial value as fertilizer. The most important nutrients when we consider both the cow and the crops are nitrogen (in nutrition, we call this crude protein), potassium, and phosphorus.

Please check this link first if you are interested in organic or specialty dairy production.

Manure Nutrients

Based on the average milk yield in the U.S., an average lactating Holstein cow eats about 48 lbs./day of dry matter. Survey data on the nutrient composition of an average diet are not available (surveys generally provide data from high-producing herds), but assuming an average cow is fed to her approximate nutrient requirements (plus a little extra), a typical diet probably has about 16% crude protein (2.6% N), 0.38% P, and about 1.2% K. These concentrations will vary greatly from farm to farm, and actual farm data should be used when determining manure application rates.

Nitrogen

About 25% to 30% of the N consumed by a cow is secreted in milk. Using the above assumptions, an average cow will excrete about 0.9 lbs./day of N in manure. Excretion of manure N increases linearly as N (i.e., protein) intake increases; the amount of N excreted per day could easily vary by +/- 25% (0.67 to 1.3 lbs./day) across herds because of diet composition, feed intake, and milk production and composition. Form of dietary protein affects the route of excretion (feces or urine) much more than it affects the amount of N excreted. Substantial losses of N from manure can occur during its handling, storage, and field application, which means that the amount of N in manure that is applied to crops is usually much less than what is excreted by the cow.

Phosphorus

If P is fed close to requirements, about 70% of the P consumed is excreted in manure, which means that the average cow will excrete about 0.13 lbs./day of P. As P intake increases, the amount of P excreted in manure increases linearly.

Potassium

Depending on the concentration of K in the diet, 70% to 80% of the K consumed by a cow is excreted in manure. Based on the assumptions above, the average cow would excrete about 0.4 lbs./day of K. As with all other nutrients, as intake of K increases, manure excretion increases.

Based on these assumptions, the average cow excretes manure with a P:K:N ratio of about **1 unit of P to 3.1 units of K to 6.9 units of N**. Because of substantial losses of N, the concentration of N relative to P is much lower in manure when applied to crops (discussed below).

Crop Needs

The fertilizer needs of crops depend on the crop, yield potential, soil characteristics, and the crop grown on the soil the previous year. Fertilizer recommendations are given as lbs./acre, but that value can vary greatly depending on yield potential, soil, crop, etc. However, the ratio of P:K:N (as actual P, K, and N, not P_2O_5 or potash) is more similar across yield potential and crops, and ratios can be used to determine proper application rates for manure (see example below). For corn grain, an average recommendation for P:K:N fertilization is 1:5:6 (for every 1 unit of P, you need to apply 5 units of K and 6 units of N). If the corn followed alfalfa, then only 3 or 4 units of N are needed per unit of P. For corn silage, the ratio is 1:6:5, and for wheat, it is about 1:7:4. If the crop is a legume such as soybeans or alfalfa, then very little, if any, N fertilizer is recommended. Nutrients applied in different ratios than those above will cause buildup of soil nutrients. In some cases, this is a good thing (for example, soil with low P will benefit from some P accumulation), but if soil is already adequate in the nutrient, additional buildup can cause environmental problems and eventually crop issues. Assuming no loss of N during manure storage (which will **NOT** happen), manure from a typical lactating cow has a P:N ratio that is reasonably close to the needs for non-legume plants. Manure is low in K relative to P and N (fresh manure), which means supplemental K fertilizer will often be needed.

The Problems

1. The main issue with manure nutrients is the imbalance between amounts of P and N provided by manure relative to crop needs. If a fertilizer, such as manure, has a lower P:N ratio than required by the crop, it should be applied to the soil to meet the crop's P requirement. If applied to meet the N requirement of the crop, excess P will be applied, which will cause an accumulation of P in the soil. If the soil is deficient in P, this is a good practice, but once the soil is adequate, P should be applied to equal crop removal rates.
2. Manure usually contains much more P than needed relative to N even though typical fresh manure should have an P:N ratio close to what is needed by crops. The reason manure usually has a much lower P:N ratio than desired is because excess P is fed and too much N is lost during manure handling and storage. Increasing intake of P causes a linear increase in P excretion. Therefore, if all else is equal, increasing the concentration of P in the diet from 0.38% to 0.5% would reduce the P:N ratio in manure from about from 1:7 to about 1:5. There is no nutritional or economic reason to supplement diets to increase dietary P above about 0.38%. However, diets based heavily on by-products, such as distillers grains, often contain 0.45% to 0.5% P without any P supplementation. This concentration of P is perfectly safe to the cow, and the diets are often less expensive than conventional diets. The potential savings in feed costs have to be adjusted to cover any increased cost in manure application (e.g., having to spread manure over more acres to maintain P balance).
3. However, the primary cause of the low P:N ratio of manure compared to plant needs is loss of N during manure handling, storage, and crop application. On average, 20% to 40% of the N in manure is lost as volatile ammonia. Injecting manure into soil rather than broadcasting it can cut that loss substantially, and proper manure storage and handling will also reduce losses. Nutritionally, we can reduce loss of ammonia by reducing the amount of N excreted in urine. In the short term (days), loss of N from manure comes mainly from urinary urea that is converted to ammonia that then is lost into the atmosphere. To minimize urinary N (without adversely affecting milk yield), diets should be formulated for metabolizable protein, not crude protein. Diets should contain adequate but not excessive concentrations of rumen degradable protein and rumen undegradable protein (both contribute to urinary N). Formulating diets for specific amino acids can reduce urinary N if that allows for a lower protein diet to be fed without reducing milk yield. The concentration of milk urea nitrogen (MUN) is strongly correlated with urinary N, so keeping MUN in the acceptable range of 10 to 14 mg/dl will improve the fertilizer value of manure by reducing the loss of N and increasing the P:N ratio.

Example

In this example, the farm is growing corn silage with an expected yield of 20 tons/acre (7 tons of dry matter), the crop grown the previous year was wheat, and the farm has average soil characteristics (soil P, K, cation exchange capacity, etc.). The standard N, P, and K fertilizer recommendations would be about 28 lbs. P (65 lbs. of P_2O_5), 170 lbs. of K (200 lbs. of K_2O), and 140 lbs. of N/acre. If manure had a P:K:N ratio of 1 to 3.1 to 3.5 (assuming half the N in manure is lost) and you applied manure to meet the P requirement of the crop (28 lbs.), you would apply only 87 lbs. of K (28 x 3.1) and 98 lbs. of N, both of which are well below the requirements of the crop. This means additional K and N fertilizer would be needed. If you applied that same manure but at a rate to meet the K needs of the crop (i.e., 170 lbs.), then 54 lbs. of P (170/3.1) and about 190 lbs. of N (170 x (3.5/3.1) would be applied per acre. Over time, this would result in substantial soil buildup of P.

Bottom Line

Feeding adequate but not excessive amounts of N (protein) and P to dairy cows will result in manure that is closest to what most crops require. Preventing loss of manure N by proper manure handling, storage, and soil application and by feeding the correct forms and amounts of protein will improve the fertilizer value of the manure. Maintaining MUN in the acceptable range not only can reduce feed costs, it can also improve the fertilizer value of the manure.

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Webinar: Diagnosing Problems in Nutrition Programs Through Records
Date: November 19, 2012, 12:00-1:00 PM Central Time **Speaker:** Dr. Greg Bethard

There are numerous points in a nutrition program where problems may arise, especially when you're dealing with transition cows. In this webinar, you can learn how to use records to track performance of transition and early lactation cows to diagnose problems in your nutrition program.

2012 Kentucky 4-H Dairy Judging Team
Larissa Tucker and George Heersche, Jr.

The 2012 Kentucky 4-H Dairy Judging Team members are: Cecilia Petersen, Spencer County; Shane Greenwell, Spencer County; Monica Poindexter, Cumberland County; and Taylor Grider, Cumberland County. This year's team participated in the Pennsylvania All-American in Harrisburg, Pennsylvania on September 17th. The team placed third in Guernsey's. Cecilia placed fourth in Guernseys.

The National 4-H Dairy Judging Contest was held on October 1, in Madison, Wisconsin, at the World Dairy Expo. The team placed 22nd overall in the team competition at the National Contest. During the trip team members had the opportunity to visit the Hoard's Dairyman Farm, the Dairy Shrine Museum, and several top quality dairy farms.

There are several people that we would like to thank for their continued support of the Dairy Judging program. The following breeders served as hosts for the workouts: University of Kentucky Coldstream Dairy, and Alpine Hill Swiss. We also thank the following sponsors for all their help and financial support: Farm Credit Services of Mid-America, Oliver & Virginia Payne 4-H Dairy Endowment, Dairy Farmers of America, Kentucky Jersey Cattle Club, Church & Dwight, Neogen, Kentucky Dairy Development Council, Kentucky Department of Agriculture, Louisville Area Jersey Cattle Club, Select Sires of MidAmerica, Venture Grant by the Kentucky 4-H Foundation, and Kentucky State Fair.

2012 Kentucky 4-H Dairy Judging Team
Left to Right: Shane Greenwell, Larissa Tucker-Coach, and Monica Poindexter.
Left to Right: Taylor Grider and Cecilia Petersen.

New Resources Available
Click on the link below to see the new factsheets or type in the web address or visit your local cooperative extension service office to get a copy.

New Calf Health Factsheet
http://www.extension.org/pages/65519/early-identification-of-sick-dairy-calves-important-to-their-survival-and-future-milk-production

New On-Farm Dairy Processing Factsheet
Considerations for Starting an On-Farm Dairy Processing Enterprise.
http://www.ca.uky.edu/agc/pubs/ID/ID207/ID207.pdf

We hope you find these useful!

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North American International Livestock Exposition
Dairy Shows

November 14
A Dairyman's Discussion @ 11:00 CST
Peden Dairy Farm, Glasgow, KY

December 3
UK Precision Dairy Showcase
Locust Trace AgriScience Farm
3951 Leestown Road, Lexington, KY

December 4-6
Alltech Global 500
Lexington, KY