VAN BEEK NUTRITION
3537 West YZ Avenue
Schoolcraft, MI 49087
ph: 269.679.5441
toll free: 888.679.5441
fax: 269.679.5400
www.vanbeeknutrition.com

Dr. Edmar Freitas, DVM, Ph.D.

Ruminant Nutritionist

Van Beek Nutrition

MOLDS AND MYCOTOXINS IN DAIRY CATTLE PRODUCTION*

Examining the effects of Mycotoxins on Dairy Cattle

In my visits to farms in Michigan, I have heard a lot of concerns about toxins. The intention of this paper is to present some existent information about mycotoxins related to dairy cattle.

The name mycotoxin combines the Greek word for fungus '***mykes***' and the Latin word '***toxicum***' meaning poison. 'St Anthony's fire' was one of the earliest recognized diseases caused by mycotoxins well known by the end of the first millennium. This was the result of eating rye contaminated with ergot alkaloids produced by the mold *Claviceps purpurea*. The epileptic fits and excruciating burning sensation experienced led many pilgrims to the shrine of St Anthony in France in hope of a cure.

Molds can affect animals causing **mycosis,** when a mold infection results in disease. Ex: *Aspergillus fumigatus* is known to cause mycotic pneumonia, mastitis and abortions, or cause **mycotoxicosis**, which is a mycotoxin-induced disease. Mycotoxicosis will be the focus of this note.

What are mycotoxins? Where do they come from?

Mycotoxins are organic compounds that are produced by a fungus to increase its virulence as a plant pathogen by reducing the ability of the plant's resistance. During colonization fungi secrete enzymes to digest organic materials into simpler compounds. The simpler compounds are primary and secondary metabolites. The secondary metabolites are called mycotoxins. These metabolites give molds competitive advantages over other surrounding molds growing in the same proximity.

In field situations, the occurrence of mycotoxins can be simultaneously affecting the toxicity of the animals. Deoxynivalenol (DON), zearalenone, T2 toxin, and fumonisin are all produced by molds of the genus *Fusarium*. Molds in this genus collectively are capable of producing 70 different mycotoxins. Some strains of *Fusarium* may produce as many as 17 mycotoxins simultaneously. Aflatoxins are extremely toxic, mutagenic, and carcinogenic compounds produced by *Aspergillus flavus* and *A. parasiticus*. The FDA limits aflatoxin to no more than 20 ppb in lactating dairy feeds and to 0.5 ppb in milk. The University of Vermont found toxins in haylage, corn silage, dry hay, grains, and all commodities.

Table 1 – Fungal genera and mycotoxin production

Fungal genera	Mycotoxins
Aspergillus	Aflatoxin, Ochratoxin, Sterigmatocystin, Fumitremorgens, Fumigaclavines, Fumitoxins, Cyclopiazonoic Acid, Gliotoxin
Fusarium	Deoxynivalenol(DON-Vomitoxin), Zearalenone, T-2 Toxin, Fumonisin, Moniliformin, Nivalenol, Diacetoxyscirpenol, Butenolide, Neosolaniol, Fusaric Acid, Fusarochromanone, Wortmannin, Fusarin C, Fusaproliferin
Penicillium	Ochratoxin, PR Toxin, Patulin, Penicillic Acid, Citrinin, Penetrem, Cyclopiazonic Acid, Roquefortine, Isofumigaclavines A and B, Mycophenolic Acid
Claviceps	Ergot alkaloids in seed/grain of small grains, sorghum, grasses
Epichloe and Neotyphodium	Ergot alkaloids in fescue grass
Stachybotrys	Stachybotryotoxins, Trichothecenes

Toxin effects on the animals

Mycotoxins may cause acute health or production problems in a dairy herd but more likely, they will contribute to chronic problems including a higher incidence of disease. Mycotoxins affect dairy cattle by: a) reducing feed consumption, b) reducing nutrient utilization, c) altering rumen fermentation, d) suppressing immunity (perhaps the most important), e) altering reproduction.

MOLDS AND MYCOTOXINS IN DAIRY CATTLE PRODUCTION*

Examining the effects of Mycotoxins on Dairy Cattle

Symptoms of mycotoxicosis vary depending on the mycotoxins involved and their interactions with other stress factors and can result from a progression of effects, or of opportunistic diseases. Animals that are already under stress like transition cows and very high producing cows may be the first to show the symptoms.

Diagnosis of a mycotoxicosis is difficult, since the symptoms may be non-specific and wide ranging and include: rumen disorders, reduced microbial digestion, intermittent diarrhea (sometimes with bloody or dark manure), reduced feed consumption, reduced production (milk production may drop by more than 15%), elevated milk somatic cell counts, decline in fertility, abortions, weight loss, and hormonal-like changes such mammary gland enlargement in virgin heifers. More occurrences of displaced abomasum, ketosis, retained placenta, metritis, mastitis, fatty livers and death can be observed.

In the last two decades, the total feed ingestion per cow per day has increased significantly, which means that the toxin ingestion has also increased and this can account for the increase in reported mycotoxin problems.

Prevention of Mycotoxins in Silages

Prevention of mycotoxins in silages includes good ensiling practices aimed at inhibiting mold growth through elimination of oxygen and reducing the pH. The molds grow and proliferate under the presence of oxygen, near neutral (except *penicillium*) pH (6.0-7.0), at high grain moisture (30-40 %) and at different temperatures depending on the type of mold. When corn is ensiled, pH is reduced by fermentation (or by the addition of an additive) to 4.0-4.5, the environment of the ensiled mass becomes anaerobic (without oxygen), and ensiled mass temperatures range from 25-90^{o}F during fermentation and storage.

Silo size should be matched to herd size to ensure daily removal of silage at a rate faster than deterioration. Feed bunks should be cleaned regularly. Since mycotoxins are highly soluble in water, do not allow rain to wash through upper layers of spoiled feed.

Prevention in grains

Management of crops and storage is important to reduce mycotoxin contamination in grains. When the environmental conditions for a particular fungus occur, the growth cycle begins. When that happens, the crop damage has started and cannot be reversed.

A special concern exists with Dried Distillers' Grains (DDGs). If the original corn is contaminated with mycotoxins, the DDGs produced from it can contain two to three times the amount of the original mycotoxin concentration. This is because only about one-third of the original grain remains as DDG residue, resulting in a concentration of the mycotoxins.

When to test for Mycotoxins

Testing for mycotoxins should be considered when signs of potential effects on performance and health exist and cannot be readily explained or if you are concerned that mold risks could be a problem.

Samples must be representative of the lot and of sufficient size to compensate for the non-uniform distribution of the contaminant, as well as, the ultralow levels (parts per billion) that must be detected.

Information about how to take samples can be obtained in the paper "Mold and mycotoxin problems in livestock feeding", from Penn State University or requested to Edmar Freitas at VBN (edmarf@vanbeek nutrition.com).

Final considerations

- Avoid feeding any feed that is obviously moldy, it may be a high risk to animal health and/or performance, due to toxins; Moldy feeds are less palatable and may reduce intake even in the absence of mycotoxins.
- Ruminal degradation of mycotoxins helps to protect the cow against acute toxicity, but may contribute to chronic problems, associated with long term consumption of low levels of mycotoxins.
- With your veterinarian or nutritionist, consider the use of feed binders (used as flow agents and for pellet quality) and recognized as safe (GRAS), but are not approved by the FDA as mycotoxin binders.
- Enhance rations with antioxidants such as; vitamin A and E, copper, zinc, manganese, and selenium, to promote cow health and may reduce the incidence and severity of health disorders.
- Mycotoxins can occur at concentrations high enough to cause major losses in health and performance of animals. However, a more likely scenario is to find mycotoxins at lower levels interacting with other stressors to cause losses.
- The economic impact of reduced animal productivity can be many times greater than the impact caused by death due to mycotoxin poisoning.
- Prevention of mycotoxin formation is essential since there are few ways to completely overcome problems once mycotoxins are present (heat processing and ensiling do not destroy mycotoxins).

VAN BEEK NUTRITION

Dr. Edmar Freitas, DVM, Ph.D.

Ruminant Nutritionist

Van Beek Nutrition
3537 West YZ Ave.
Schoolcraft, MI 49087
Ph. 269-350-0584
edmarf@vanbeeknutrition.com

*References omitted due to lack of space are available upon request