Silage molds affect rumen health

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The occurrence of molds and their toxins in feed is an increasing global challenge, and multiple environmental pre-harvest and post-harvest practices may contribute to feed contamination. Moldy feed and mycotoxins have been associated with lower feed intake, reduced digestibility and health disorders in ruminants. An array of pathogens present in moldy silage, some of which are normally found in concentrates.

The mycotoxins of greatest concern are those produced by Penicillium spp., such as PT toxin, mycophenolic acid, roquefortine C and patulin. The clinical signs of mycotoxicosis are often subtle, and the diagnosis, therefore, is often missed. A mycotoxin challenge is commonly used in dairy production to safeguard against the potential production-depressant effects of mycotoxins.

Silage molds
Molds are everywhere, and more than 80 different fungal species have been identified in corn and grass silage. Silage is invaded by molds that have adapted to the growth of acid-tolerant yeasts and molds. Penicillium roqueforti is commonly found because they are acid tolerant and have a low oxygen requirement. Molds produce high levels of mycotoxins depending on environmental conditions. The distribution and extent of the spread of the molds and toxin formation in silage are highly variable. Molds have uneven growth in the silage, and the growth rate, production and stability of various mycotoxins varies.

Penicillium roqueforti is able to invade and degrade corn and grass both in the field and in storage silos. P. roqueforti comes later in the silage period than some other mold toxins. This uneven temporal and spatial distribution of toxins creates challenges where molds are taken to detect a mycotoxin challenge.

Mycotoxins
PT toxin has an antimicrobial effect and is considered a marker for problem silages (Sumarah et al., 2000). In cattle, PT toxin has been associated with reduced feed intake, rumen, intestinal, respiratory and abortion disturbances, including an increased risk of abortion, placenta and reduced fertility.

Penicillium acid has antimicrobial effects and can destabilize the rumen microbial flora. Roquefortine C is a neurotoxin.

Health effects
Cows are exposed to various mold and mycotoxins both through inhalation and ingestion. The rumen has long been considered a very strong buffer against all of these toxins because rumen microflora work together to detoxify mycotoxins (Schiefer, 1990). This ability makes ruminants relatively resistant to these toxins. However, this is not the case for all mycotoxins and high-producing animals. Lactating dairy cows, for example, have an increased rumen passage rate, which may overwhelm the rumen microflora so that they will not be able to detoxify all of the toxins in the contaminated feed (Kiessling et al., 1984). Furthermore, young calves do not have fully developed rumens and are also more susceptible to mycotoxins. Mycotoxins create a cascade of events by destabilizing the rumen environment, leading to endotoxin formation and ruminal wall leakage. Toxins with an antibacterial effect can disturb the rumen microflora to the point that they cannot properly handle toxins. The sludge-derived mycotoxins may, through their antibacterial effects on rumen flora, result in common pre-harvest mycotoxins such as deoxynivalenol, zearalenone and tremorgens becoming a health problem.

Mycotoxins can produce a variety of symptoms in dairy cattle that are vague and nonspecific. Mycotoxins absorbed into the systemic circulation will have various effects and can result in an activation of the immune system (Bennett, 2003).

Often, there are no clinical signs but subclinical production losses that have a serious economic impact on farm profitability. Mycotoxins in feed will often cause a 10-15% loss in milk production and up to a 50% loss in serious clinical cases.

Diagnostic methods
As mentioned, detecting molds and toxins in feed is difficult and not very informative. A lot of research has been carried out to find diagnostic markers for a mycotoxin challenge in the animal model (Gibson et al., 2006). Various markers of metabolic distress are not unique to mycotoxins but can act as a challenge. Research is ongoing to find biomarkers, and researchers are currently developing a bovine signature that will mark the presence of mycotoxins in the diagnosis of mycotoxicosis.

Gene expression analysis may also be a good approach to present biomarkers of effect when animals are exposed to multiple mycotoxins. When a mycotoxin challenge is suspected, a practical method is to use Ruminococcus albus as a broad-spectrum mycotoxin binder. If the clinical symptoms decrease or disappear, administration of the mycotoxin binder, then it is very probable that it is a mycotoxin challenge through the feed.

This approach avoids issues that arise with uneven sampling of materials and the difficulties of interpreting the risks associated with mycotoxin levels when they are found in combination.

Silage management
Silage is a preserved feed where microbial processes have depleted the oxygen supply and lowered the pH through the production of organic acids. Silage management recommendations are designed to achieve an anaerobic and acidic environment to prevent further microbial growth. Under these conditions, undesirable spoilage microorganisms will not grow.

Good silage management is very important for preventing molds and mycotoxins. Plant stress needs to be minimized through optimized planting and harvesting times and proper moisture levels; packing and sealing are essential to ensure the exclusion of air. Inclusion of a silage inoculant optimizes the fermentation and preservation of the forage.

The feeding face should be cut cleanly to avoid deterioration, and 15-30 cm should be removed daily to prevent deterioration of the feeding face. Silage should be fed directly after removal from the silo, and moldy silage should be discarded.

Rumen interventions
Stable rumen fermentation is important for optimizing mycotoxin degradation in the rumen. A general recommendation to minimize the effect of mycotoxins on the rumen is to include a silage inoculant at the time of feeding. The use of a live yeast product contributes to a stable rumen pH and thereby optimizes rumen fermentation. A good-quality, broad-spectrum mycotoxin binder should be used to bind mycotoxins.

For example, in a study determining mycotoxin-associated oxidative stress, 40% of cows supplemented with Mycosorb (Alltech) for two weeks showed reduced levels of oxidative stress, lower somatic cell counts and increased milk production (Sanitos and Fink-Gremmels, 2010).

Summary
Silage feeds and mycotoxin challenges to cows are common in many countries. There is an increasing number of optimizing cow health and production. Detecting molds in feed is challenging due to their even presence and spatial distribution. The antibiotic effects of some of these silage molds can disturb the rumen microbial environment, paving the way for other mold toxins, yeasts and bacterial hazards. Symptoms of mycotoxin exposure are nonspecific and often subclinical, and production losses can be significant.

Molds should be kept in mind when dealing with any type of suboptimal performance in ruminants, and including an appropriate mycotoxin binder is recommended.

References


