Ruminant Mycotoxicosis

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KEYWORDS

• Molds • Mycotoxins • Ruminants • Toxicosis

Mycotoxins are naturally occurring compounds or secondary metabolites produced by fungi growing on plants in the field or during storage periods. The source of toxigenic fungi or mold in both cases is the field. *Fusarium* species and *Claviceps purpurea* can act as plant pathogens on cereal crops or grasses in the field. *Fusarium verticillioides* and *Aspergillus flavus* can produce mycotoxins on stressed or senescent plants, particularly corn. Fungi that occur on developing kernels in the field and later proliferate in storage, especially on ensiled cereals or baled forages, are typically the *Penicillium* and *Aspergillus* species. Additional fungi have been associated with grass endophytes such as *Neotyphodium coenophialum* in tall fescue. Numerous mycotoxins can be produced by fungi invading plant material; however, only a few mycotoxins have been recognized as toxic to animals. This article focuses on mycotoxins affecting ruminants in North America. Ruminants are often considered less sensitive to mycotoxins than are monogastrics because of rumen microflora metabolism to less toxic compounds. However, ruminants occupy wide agricultural niches from roaming range or grass pastures to housing in dairy lots or small farms with localized feed sources to confinement in feedlots using numerous commercial sources of grains or by-products, which exposes animals to diverse toxins in widely different conditions.[1] Often, the more moldy and potentially highly contaminated feeds end up at a feedlot and, in poor crop years, beef cows can be fed contaminated screenings, straw, and cereal by-products, poorly preserved silages or baled forages, or be turned onto moldy fields for crop salvage. In the United States during 2008, approximately 70% to 75% of agricultural commodities were sent into commercial channels with only 25% to 30% retained for on-farm use (Kim Koch, PhD, Fargo, ND, personal communication, September 2010). Therefore, veterinary practitioners need to be aware of the local environmental conditions and potential mycotoxins in animal feed and regional mycotoxin problems in grain that could be brought into local channels.

The authors have nothing to disclose.

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A critical factor in mycotoxicosis is obtaining a representative sample of suspect feed or feeds that livestock have been consuming. Analytical results and their interpretation depend on representative sampling. This review covers factors associated with mold production in feedstuffs and major mycotoxins affecting ruminants: aflatoxin, ergot alkaloids, trichothecene mycotoxins, and several mycotoxins associated with tremors, photosensitization, and silage contamination. The estrogenic mycotoxin zearalenone and the reproductive effects of ergot alkaloids and associated summer slump and fat necrosis are discussed by Tim J. Evans elsewhere in this issue.

CROP MOLDS AND POTENTIAL MYCOTOXINS

Veterinarians frequently evaluate suspect feeds associated with clinical illness in livestock. Feeds can be cultured by mycologists and plant pathologists for mold identification providing a record or biologic indicator of storage conditions and potential mycotoxins. Mold cultures can provide direction in analytical testing for mycotoxins. Stored grains and seeds can be damaged by insects and fungi if not properly conditioned and protected. Damage from field and storage molds can include reduced germination, heating, reduction in market grade and grain value, loss of feed and oil quality, mycotoxin contamination, fires, explosions, and worker health hazards associated with dust and mycotoxin inhalation and falling through crusted grain. Mold damage occurs both before and after harvest. Those fungi associated with damage before harvest are termed field molds and they grow in equilibrium with relative humidity greater than 90% to 95% (**Table 1**). Fungi associated with damage in storage can grow in equilibrium with relative humidity between 65% and 85% (**Table 2**). Grains and seeds readily absorb or lose moisture and achieve moisture in equilibrium with the moisture vapor available in the air between seeds or grains. Moisture and temperature are the primary factors determining the ability of molds to grow, as well as their rate of growth. The growth of storage fungi results in increased temperatures and increased moisture caused by the metabolism of these fungi. Thus, once molds begin growth, grains and seeds gain in moisture and allow growth of storage fungi that require higher equilibrium moistures. For example, *Aspergillus glaucus* can grow at 15% moisture in starchy grains but, as it grows, it produces heat and moisture that allow growth of *Aspergillus candidus* or even *A flavus* or *Penicillium* species that require 16% to 18% moisture. Growth of *A glaucus* and *A candidus* can be rapid and generate temperatures as high as 60°C (140°F). A good management practice is to avoid blending low-moisture and high-moisture grains; grain moisture in a blending process will progress to the high moisture levels.

Grain and seeds are at highest quality and have the lowest storage risk when they are fully mature before harvest, free of field mold damage, have no mechanical damage to the seed coat, and harvest is not delayed by weather or other factors. The intact seed coat is an effective barrier to seed infection by storage molds, and extra care in preventing mechanical damage during harvest and handling is critical to managing storage mold damage. Grain or seeds infected by field molds such as *Fusarium*, *Helminthosporium*, *Penicillium*, *Sclerotinia*, *Botrytis*, *Ascochyta*, *Alternaria*, and *Cladosporium* are at higher risk for damage by storage molds than intact seeds and will likely have lower germination rates. **Table 1** lists diseases caused by field molds that may predispose grains and seeds to damage by storage molds. **Table 3** lists selected molds and associated mycotoxicoses in ruminants. Even though toxigenic molds may grow in a given set of conditions, they do not necessarily produce mycotoxins. The mold can undergo additional stress conditions