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Mycotoxins and their Effects on Beef Cattle

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From time to time producers are faced with decisions on feeding moldy feeds or forages. With feed prices relatively high, it may be tempting to use moldy feed or forage supplies in beef cattle nutrition programs. It is important to recognize risky feeding situations and to be familiar with the potential impacts of feeding moldy feedstuffs.

Mycotoxins

Certain species of fungi (molds) produce toxic substances called mycotoxins. These fungi may be found growing on feed, silage, or hay in the field or in storage. Most mycotoxin production occurs in the field before harvest, but poor storage practices can increase already existing mycotoxin levels. Mycotoxins can cause cattle health and productivity problems at very low dosages, parts per million (ppm) or parts per billion (ppb). Mycotoxins are not necessarily produced whenever feed or forage becomes moldy, but evidence of mold indicates a risk of toxins. Fungi growth may also be present but undetectable upon casual observation.

Hundreds of mycotoxins have been identified. Mycotoxins of greatest importance worldwide include aflatoxins, trichothecenes, fumonisins, zearalenone, ochratoxin A and ergot alkaloids. Mycotoxins are regulated by Food and Drug Administration (FDA). The FDA Center for Veterinary Medicine focuses on 5 major mycotoxins in the U.S.: aflatoxins, fumonisins, vomitoxin, ochratoxin A, and zearalenone.

Toxin producing fungi include molds from the *Aspergillus*, *Fusarium*, and *Penicillium* genera. Mississippi weather can be conducive to growth of molds in feedstuffs that are of concern for use in beef cattle diets. Generally, cool, wet conditions favor *Fusarium* species growth, while hot, dry conditions favor *Aspergillus* species growth.

Aspergillus Toxins

Aflatoxin

The *Aspergillus* species molds can produce aflatoxin and ochratoxin under stress conditions. Aflatoxin is likely the most commonly produced mycotoxin in the Southern U.S. In fact, aflatoxins occur most commonly in the warm, humid regions of the nation. Both aflatoxin and ochratoxin cause livestock health problems. Aflatoxins are produced by the *Aspergillus* species, *A. flavus* and *A. parasiticus*. Corn, cottonseed, peanuts, and sorghum are potential feed substrates for aflatoxin production. High levels of aflatoxins are associated with above-average temperature and below-average rainfall. For instance, aflatoxin production may occur with maturing corn undergoing drought and insect stress during prolonged periods of hot weather and drought. However, weather conditions are not a guarantee of mycotoxin production.

Aflatoxin is a potent carcinogen, protein synthesis inhibitor, and immunosuppressant. Aflatoxin-contaminated grain should not be fed to lactating dairy cattle, as it will appear in the milk. Cattle fed aflatoxin contaminated feedstuffs may exhibit dry muzzles and decreased body temperature. Aflatoxins have tremendous antibiotic activity and disrupt normal rumen function. Young animals are more susceptible to aflatoxicosis than adult livestock. Likewise, monogastric animals (swine, poultry) are more susceptible than ruminants (cattle, goats, deer).

FDA Action Levels for Total Aflatoxins in Livestock Feed

Class of Animals	Feed	Aflatoxin Level
Finishing beef cattle	Corn and peanut products	300 ppb
Beef cattle, swine or poultry	Cottonseed meal	300 ppb
Breeding cattle	Corn and peanut products	100 ppb
Immature animals	Animal feeds and ingredients, excluding cottonseed meal	20 ppb
Dairy animals or unknown use	Animal feeds and ingredients	20 ppb

Ochratoxin

Ochratoxin is a relatively uncommon mycotoxin of cereal grains (corn, barley, wheat and rye) that is produced by *Aspergillus* species (*A. ochraceus*) and *Penicillium* species (*P. viridicatum*). Ochratoxin, a suspected carcinogen, causes increased water consumption and urination and can lead to permanent scarring of the kidneys. At least nine ochratoxins have been identified, but ochratoxin A is the most common and has the greatest toxicological significance. No FDA action, advisory or guidance levels are currently established for ochratoxin A in U.S. feed.

Fusarium Mycotoxins

Cool, wet conditions favor the growth of *Fusarium* species molds, which can produce several mycotoxins detrimental to livestock. Fusarium mold species can produce fumonisins, vomitoxin, and zearalenone.

Fumonisins

Fumonisins, a group of toxins produced mainly in corn and particularly corn screenings, are believed to be most prevalent when cool weather and high humidity at crop maturity follows hot and dry weather. Fumonisins are thought to be carcinogens and are produced by *Fusarium* species (*F. verticillioides*). Liver damage and elevated serum liver enzymes occur in all livestock. Cattle can develop mild liver lesions at fumonisin concentrations above 100 ppm. However, this liver damage is temporary, and liver function returns to normal when fumonisin exposure ends. Toxin concentration is typically highest in broken grain. For breeding cattle, FDA guidance levels for total fumonisins in animal feeds indicate that with corn and corn by-products not to exceed 50% of dietary dry matter, fumonisin levels in corn and corn by-products should not exceed 30 ppm and in finished feeds should not exceed 15 ppm. In calves 3 months of age and younger, these guidance levels are 60 ppm and 30 ppm, respectively.

Vomitoxin

Vomitoxin (also known as deoxynivalenol, DON, or refusal factor) gets its name from the resulting vomiting and feed refusal that it induces in swine. It is produced by *Fusarium* species (*F. graminearum*) and is commonly found on wheat, barley, rye, and

oats. Vomitoxin occurrence is most frequently reported in cool, temperate regions of the Northern U.S. and Canada.

Vomitoxin is a protein synthesis inhibitor, affecting the digestive tract and immune system. Cattle are quite tolerant to vomitoxin, apparently due to rumen microbial activity. Cattle have consumed up to 10 ppm vomitoxin with no adverse effects. Dietary dry matter concentrations of up to 21 ppm vomitoxin in growing cattle diets were demonstrated to have no adverse effects on health or production performance. In cows fed 6.4 ppm vomitoxin (diet dry matter) for 70 days, no vomitoxin residue was found in their milk. Advisory levels from FDA regarding vomitoxin in livestock feeds indicate that, in ruminating beef and feedlot cattle older than 4 months, vomitoxin contaminated grain and grain by-products should not exceed 50% of the diet with maximum vomitoxin levels of 10 ppm in grains and grain by-products and 5 ppm in finished feed.

Zearalenone

Zearalenone (also known as F-2 toxin or giberella toxin) is an estrogenic mycotoxin that occurs in corn, wheat, barley, and sometimes oats. Zearalenone is produced by *Fusarium* species (primarily *F. graminearum*) with high humidity and low temperatures favoring its production. Zearalenone and vomitoxin can sometimes occur together. Cattle consuming more than 10 ppm zearalenone may have infertility and estrous cycle disruptions. Heifers are sensitive to zearalenone effects on reproduction when concentration exceeds 5 ppm of the dietary dry matter intake. At present, no FDA action, advisory or guidance levels are established for zearalenone in U.S. feed supplies.

Producer Actions to Combat Mycotoxin Problems

In cases of disease outbreaks and reproductive problems where feed is a potential culprit, the feed in question should be removed from cattle diets and tested for a full range of mycotoxins. Large operations should consider routinely screening feeds for mycotoxins. Proper sampling techniques for mycotoxin analysis is critical as mycotoxin formation is not uniform throughout a feedstuff.

Risk of mycotoxin formation can be minimized by dry cleaning (scraping) feed storage bins to reduce moisture, mold, and mycotoxin contamination. Caked material and moisture should be removed during routine feed storage facility cleaning. Storage of commodities under low (less than 14%) moisture conditions will minimize fungal growth and mycotoxin production. Facility maintenance must be sufficient to protect feed supplies from moisture. Adequately drying grains prior to storage and keeping grains free of insect damage may decrease mycotoxin occurrence. Silage and baleage will not typically undergo molding in the ensiling container but may mold when exposed to oxygen out of storage.

In situations where mycotoxins are detected, there are often usually as many or more clean lots of feedstuffs as contaminated ones. Testing each lot is the only way to confirm mycotoxin presence or absence and levels. Once mycoses or mycotoxicosis are confirmed in forages or grains, one of the few practical strategies appears to be blending to an acceptable nontoxic concentration at feeding, except for aflatoxin-

contaminated feedstuffs. If you must feed moldy, wet, or flood-damaged feed, proceed with extreme caution, particularly when feeding moldy protein concentrates.

Initially mix moldy feedstuffs with uncontaminated feedstuffs at a level not to exceed 10% of the total dietary dry matter as moldy feedstuffs to significantly reduce potential mycotoxin intake. Environmental stress, poor nutrition, disease exposure, multiple mycotoxin presence, and other factors increase cattle susceptibility to mycotoxins. Therefore, maximum mycotoxin level recommendations must consider these factors as well when attempting to mix contaminated feedstuffs with other feedstuffs to dilute mycotoxin levels to acceptable feeding levels. Badly molded feedstuffs, soured feedstuffs, or moldy legume hays should not be fed to livestock. Avoid feeding mold contaminated feedstuffs to pregnant cattle altogether.

Watch cattle carefully for reduced feed intake and signs of illness including respiratory or nervous disorders resulting from inhalation of mold spores. Contact a veterinarian and completely remove potentially contaminated feedstuffs from cattle diets if signs of illness are observed. In addition to the potential for toxins produced by molds, heated or spoiled feedstuffs may also have reduced nutritive value for livestock because molds remove nutrients from feedstuffs. If multiple species of livestock are present on a beef cattle operation, it is important to note that other species of livestock respond differently to mycotoxin exposure and may be highly susceptible to specific mycotoxins or levels of mycotoxins that would not be problematic in cattle. For more information on mycotoxins in beef cattle production or related topics, contact your local county Extension office.