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Mycotoxin contamination in silages

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Silages made from different forage crops constitute an important component of modern dairy diets. The typical parameters utilized to measure silage quality many times exclude mycotoxin analysis.

Mycotoxins are toxic secondary fungal metabolites that can contaminate feeds (including forages) in the field, during harvest, during storage and processing (including the ensiling process), and even during feedout. Our knowledge base on molds and mycotoxins in silages is minimal in comparison to that of cereal grains and proteinaceous feed materials.

Molds are ubiquitous in nature and exist as plant pathogens. During growth, forage crops can be infected with several different fungi, some of which can produce mycotoxins. Therefore, forage crops can be contaminated with several mycotoxins at harvest, or when directly grazed upon.

Proper silage preparation creates conditions (anaerobic and rapid pH change) in which further mold growth and mycotoxins production can be controlled. Some molds, however, can survive in these extreme conditions and still manage to produce mycotoxins. Furthermore, toxins existing prior to ensiling will be present in the silage even if proper silage fermentation occurs.

If we consider the state of many silages seen in the field, where anaerobic conditions are not always maintained (improperly compacted, improperly covered, tears on the plastic or improperly managed silo face), it is not hard to imagine that many

Photo courtesy of Mark Moore

silages are, in fact, contaminated with these harmful toxins.

The primary toxin producing molds are Fusarium, Penicillium and Aspergillus species. Other molds like Mucor and Alternaria species should also be considered as potential mycotoxins producers in forages. These molds produce hundreds of known mycotoxins including the Aflatoxins, Deoxynivalenol (DON), Nivalenol, Zearalenone, PR toxin, Patulin, and Citrinin. Most mycotoxins affect animals either by interfering with nutrient absorption and metabolism, by affecting endocrine and neuroendocrine function, or by suppression of the immune system.

Several studies have examined the presence of mycotoxins in forage crops prior to and after ensiling. These studies have frequently found high concentrations of tricothecenes mycotoxins (i.e. deoxynivalenol) and of zearalenone. A 12-year evaluation of samples submitted by farmers for analysis in the Southeastern U.S. revealed a high frequency of DON, zearalenone and fumonisins in corn silage samples. Other studies have found high concentrations of the mycotoxins aflatoxin B1 and ochratoxin A in silage samples.

Little or no data is available on the presence of Penicillium-produced toxins like Roquefortine C, PR toxin. This is quite

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amazing considering that studies conducted in the U.S., United Kingdom and Germany have revealed that Penicillium molds are frequently found in silages. Some (i.e. P. vorioti and P. roquefortine) should be of high priority when analyzing silages, since these molds are considered micro-aerophilic or indifferent to the presence of oxygen. These molds can produce many different mycotoxins, but Roquefortine C and PR toxin seem to be the most common and most toxic.

Because of ruminal microbial degradation of mycotoxins, cattle typically have been believed to be more resistant to effects associated with the ingestion of mycotoxins. In vitro evidence, however, suggests ruminal degradation may be quite low for most mycotoxins and some degradation products may be as toxic or even more so than the parent compound. Additionally, many other factors may compromise the ability of rumen microbes to degrade these toxins.

Protozoa are more active in the detoxification of mycotoxins than bacteria. The high grain intake and low ruminal pH typical of high producing dairy cattle negatively affect protozoa in the rumen, and thus limit ruminal mycotoxin degradation. Other factors like high dietary intake and rapid passage time can also compromise the rumens' ability to degrade mycotoxins. Production stress, interactions with infectious agents, marginal nutrient deficiencies, genetic vulnerability, and interactions between different mycotoxins may also play an important part in dairy cattle susceptibility to mycotoxins.

Mycotoxins can increase disease incidence and reduce production efficiency in cattle. They can cause dermal toxicity, reproductive effects, carcinogenicity (cancer production), neurotoxicity (affecting nerve tissue), teratogenicity (affecting developing embryos), nephotoxicity (kidneys damage), and hepatoxicity (liver damage). Additionally, mycotoxins may affect immune function and cause lipid peroxidation.

Because of their presence in commonly ensiled forages and their potential for affecting dairy cattle production and health, mycotoxin analysis should be part of the routine evaluation of silages.

Dairy herds experiencing a mycotoxicosis which is severe enough to reduce milk production will usually display other symptoms. Often there is intermittent diarrhea, sometimes with bloody or dark manure. Cows may not respond well to typical veterinary therapy.

Symptoms that may be nonspecific and wide ranging include reduced feed intake, feed refusal, unthriftiness, rough hair coat, undernourished appearance, subnormal production, increased abortions or embryonic mortalities, silent heats, irregular estrus cycles, expression of estrus in pregnant cows, and decreased conception rates. Fresh cows perform poorly and generally have an increased incidence of disease, particularly those that are most opportunistic in a dairy herd. There may be a higher incidence of displaced abomasums, ketosis, retained placenta, metritis, mastitis and fatty livers.

It is important to emphasize that there may only be a few or many of these symptoms evident.

Because of their presence in commonly ensiled forages and their potential for affecting dairy cattle production and health, mycotoxin analysis should be part of the routine evaluation of silages. More research is needed, especially in the area of Penicillium-produced toxins, to further advance our knowledge of the harmful compounds and how they can be avoided.

We do know, however, that proper silage management practices can significantly reduce conditions favorable for molds to produce mycotoxins.

Joining forces to reduce tractor injuries

The National Institute for Occupational Safety and Health (NIOSH) has awarded a $504,000 two-year grant to a consortium of 11 university-based agricultural safety and health research centers, including centers in the Pacific Northwest, California, and High Plains Intermountain Region, to build their capacity to launch a national public health campaign for preventing deaths and serious injuries from tractor overturns and other related incidents.

Tractor overturns, runovers, power take-off entanglements, and collisions with non-farm vehicles on public roads are the leading cause of death and serious injury in U.S. agriculture. On average, more than 250 farmers, family members, and farm employees die annually in such incidents, half of them when a tractor overturns and crushes the operator.

Although no official statistics are available, University of Kentucky researchers estimate that 4.46 non-fatal injuries from overturns occur for every fatality. These injuries are often severe and disabling. They also can be financially devastating, with immediate and long term medical expenses and the loss of family farms when an owner-operator is incapacitated.

Technological means, including rollover protective structures (ROPS), exist for preventing death and injury from overturns. When used with seatbelts, ROPS have proven effective at virtually eliminating fatalities and serious injuries. However, more than half of the approximately 4.7 million agricultural tractors in the U.S. lack ROPS.

"We are pleased to support this initiative, which enables the centers to join in an unprecedented team effort on this compelling public health issue," said NIOSH Director John Howard, M.D. "Finding effective ways to promote tractor safety is a tremendous national challenge to which we and our partners are bringing new resources.

Steve Reynolds, PhD, who directs the High Plains Intermountain Center for Agricultural Health and Safety at Colorado State University, which will lead the initiative, said "By 2007, building on the results of this effort, we will be in a good position to seek the involvement of all the stakeholders affected by tractor injuries and fatalities – farm and safety groups, equipment manufacturers and dealers, government agencies and legislators, educators and outreach specialists, and most importantly, farmers, ranchers, and their families. Together, we can make a difference."

Under the initiative, the centers will:

- Study the costs of injuries from farm tractor overturns and highway collisions and identify who bears those costs.
- Assess the impact of changes in ROPS standards, regulations, and technology and their effect on future ROPS availability.
- Examine the acceptability of, and procedures for, financial incentives to retrofit tractors with ROPS.
- Create a database of potential partners to help guide the planned national campaign and launch an intranet to facilitate communication about tractor safety among the centers.

The most ambitious of the projects, involving eight of the 10 centers, will test community-based social marketing in 36 venues across the U.S. Social marketing seeks to influence behavior to benefit the intended audience.

"We are eager to see if we can use some of the techniques developed in the last few decades to 'sell' tractor operators on safer practices," said Dr. Reynolds. "Unless we can begin changing attitudes and behavior, we are not going to solve this problem."

Information about the Centers is available at www.cdc.gov/niosh/agctrhom.html. More information on NIOSH is available at www.cdc.gov/niosh. The National Agricultural Tractor Safety Initiative document, produced by the Centers in 2004, can be found at http://depts.washington.edu/pnash/tractor.html

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