Corn smut may indicate mycotoxins loom

by Alvaro Garcia

THIS past September, our team visited some cornfields in Minnesota, and we were surprised by the abundance of corn smut found in damaged ears. Corn smut is a fungus, known formally as *Ustilago maydis* in the plant world.

Corn smut grows as galls that can develop in the aerial part of the corn plant, particularly in the ears. It is an easily recognizable bundle often made of garlic-clove shaped growth with a characteristic light blue color when physiologically mature.

In Mexico, it is called "huitlacoche," and it is considered a delicacy of earthy flavor, sold fresh, canned, or dried. Most of the fungus in late September was already past its prime and had a dark, almost charred look.

Triggered by stress

This fungus proliferates when the corn plants are wounded or debilitated by stress. Common stressors can be hail or wind. In this case, the fields had been subjected to extreme wind that resulted in either some lodging or even green snap, depending on the hybrid. The concern for livestock nutritionists is not corn smut but that the fungus is a telltale sign of plant stressors that allow other pathogenic molds to proliferate. Even some old dried-up galls showed mold growth in their periphery.

The Biological Control of Pests Research Unit from USDA's Agricultural Research Service (ARS) division recently conducted an experiment over a two-year period on corn smut and its cross contamination with other mycotoxin-producing fungi. The results showed the presence of mycotoxins in corn smut galls during ear development at various physiological stages.

Fumonisin was the most frequent mycotoxin detected in corn smut gall samples. It was found in 63% of sample levels less than or equal to 150.7 micrograms per gram (μg g^{-1}). Next, aflatoxin was found in 30.6% of samples at a rate of less than or equal to 10.8 nanograms per gram (ng $g^{-1)}$. Zearalenone was found in far fewer samples at less than or equal to 41.70 ng g^{-1}, and deoxynivalenol (DON) was only detected in one of the two years at less than or equal to 1.6 μg g^{-1}.

The fact that these mycotoxins were closely associated with corn smut galls suggests the conditions for development of other fungi were also right. It is highly likely that spores of pathogenic molds also reached other corn-damaged tissue where they could proliferate. While the presence of corn smut, then, is not a concern, it is an indicator of the likely presence of other dangerous mycotoxins.

Of these mycotoxins, fumonisin is the one that would pose the greatest concern to livestock because of its high concentration, such as that observed in corn smut in the work conducted by the ARS. Its presence suggest that Fusarium molds were the more likely contaminants since they are responsible for producing fumonisin, in addition to deoxynivalenol (DON), zearalenone, and trichothecenes.

While fumonisin seems to be better tolerated by ruminants, feed intake and milk production can be negatively affected in dairy cows. Always remember that the effect of mycotoxins is dose dependent, so if this corn (either silage or grain) is a significant portion of the diet, fumonisin will also be present in higher concentrations.

Aspergillus (*A. flavus* and *A. parasiticus*) produce mycotoxins known as aflatoxins. These were the second toxins in concentration found associated with corn smut by the ARS.

Four aflatoxins can be found in livestock feeds, namely B1, B2, G1, and G2. The most common and biologically active component is aflatoxin B1, a potent carcinogen. Rumen microorganisms can degrade up to 42% of aflatoxin B1, but they are also capable of producing aflatoxicol. A liver metabolite of B1 called aflatoxin M1 can show up in milk and is of concern in humans since it is also a potent carcinogen.

Aflatoxin M1 is produced from B1 in the liver and can end up in the rumen through the rumino-hepatic circulation. The toxicity of aflatoxicol and M1 is like that of B1, and they are readily absorbed by the intestine. Therefore, even when B1 is degraded in the rumen to aflatoxicol and transformed in the liver to M1, the toxic end-result is similar. The metabolite M1 circulates from the liver into the blood and ends up in milk or urine.

The third toxin reported in the ARS study was zearalenone. At the present time, the Food and Drug Administration (FDA) has not established action levels for zearalenone. It has been suggested that the concern level should be around 560 parts per billion (ppb) for both individual ingredients and the total diets. The concentrations reported by the ARS did not suggest levels of concern associated with corn smut.

Cut the concentration

Healthy dairy cows usually tolerate moderate amounts of molds in feed unless they are immunosuppressed. Stresses that impair the immune function elevate their susceptibility to mycotoxicosis. It is important to reduce the mycotoxin concentration to boost the immunity of the animal by reducing overall stress.

Reinforcing the diet with antioxidant compounds, such as selenium, vitamins A and E, and beta carotenes above and beyond the daily nutritional requirements may help strengthen the cow's immune status. Monitor animal performance along with the appearance of clinical signs. If the effects are subtle, the amount of feed offered can be reduced. When concentrations are above the level of concern, it may be necessary to discontinue the use of that feed altogether.

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