ADISSEO: UNITED STATES OF AMERICA 2019 MYCOTOXIN SURVEY IN CORN AND CORN SILAGE

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Introduction

The presence of mycotoxins in feed and foodstuffs is an important concern for human and animal health. The Aspergillus, Fusarium and Claviceps species of fungi are ubiquitous in nature and under ideal conditions, they often can infect crops and forages in fields, during storage, shipment and processing. Mycotoxins can cause serious health problems in animals and their presence in agricultural commodities may result in serious economic losses. Mycotoxins have been implicated in a variety of human diseases, including some forms of cancer. It has been estimated that mycotoxin-contaminated grains cost grain handlers and the livestock industry several hundred million dollars annually (CAST, 2003).

Picture 1: Corn harvested in Iowa (US) 2019

The 2019 Adisseo mycotoxin survey included 48 corn and silage samples from across the United States of America (USA) (i.e. Iowa, Illinois, Nebraska, Minnesota, Missouri, South Dakota, Pennsylvania, New York, Wisconsin, Idaho, Ohio). All samples were collected almost immediately after the harvest from farms or animal feed production sites. Sample providers were advised to follow the principles of good sampling (Richard, 2000). Analytical personnel and/or laboratory staff were not involved in the sampling and did not influence any part of this procedure.

A total of 48 analyses were conducted to test for the occurrence of the 11 mycotoxins most commonly found in agricultural commodities intended for animal production. The survey provided an insight into the incidences of aflatoxin B_1 (AfB_1), aflatoxin B_2 (AfB_2), aflatoxin G_1 (AfG_1), aflatoxin G_2 (AfG_2) ochratoxin A (OTA), zearalenone (ZEN), deoxynivalenol (DON), T-2 toxin, HT-2 toxin, fumonisin B_1 (FB_1) and fumonisin B_2 (FB_2).

All 11 mycotoxins were analyzed by liquid chromatography tandem mass spectrometry (LC MS/MS). For the purpose of data analysis, non-detection levels were based on the limits of quantification (LOQ) of the test method for each mycotoxin: AfB_1 <20 µg/kg; AfB_2 <20 µg/kg; AfG_1 <20 µg/kg; AfG_1 <20 µg/kg; ZEN <100 µg/kg; DON <200 µg/kg; FB_1 <200 µg/kg; FB_2 <200 µg/kg; OTA <20 µg/kg; T-2 toxin <20 µg/kg and HT2-toxin <200 µg/kg.

Results

The results showed that 4.5% of the silage samples and 34.6% of the corn samples were contaminated with ZEN (Table 1), a mycotoxin which can affect the fertility performance of most species. The average concentration of ZEN in silage was 158 µg/kg and 527.90 µg/kg in corn. These levels of ZEN in corn are considered to carry a medium risk and can be harmful especially to dairy cows and herd bulls. In ruminants such as cows and bulls, ZEN is converted by the rumen flora into its major component, hydroxy-metabolite α-zearalenol (approximately 90%) and to a lesser extent to β-zearalenol (Kennedy et al., 1998). α-zearalenol has a higher estrogenic potency compared to the parent ZEN (Seeling et al., 2005).

86.4% of the silage samples and all of the corn samples were contaminated with DON. There was a high average concentration of DON of 1370.6 µg/kg and a maximum concentration of 4357 µg/kg detected in one of the silage samples. The highest concentration of DON detected in one of the corn samples was almost the same as the concentration detected in silage and was equally high at 4118 µg/kg. A medium average concentration of 966.4 µg/kg of DON was detected in corn.

As expected, 50% of corn and 18.2 % of silage samples contained FB_1. The maximum concentration of FB_1 toxin found in one of the corn samples was 4574 µg/kg. This high concentration is usual for corn grown in the USA and may have a significant effect on the health and performance of farm animals, especially swine and horses.
T-2 toxin was detected in 15.4% of corn samples and 4.5% of silage samples. OTA, AfB_1, AfB_2, AfG_1, AfG_2 and HT-2 toxins were not detected in any of the analyzed samples.
Several samples had 2 to 4 different mycotoxins detected which could lead to synergistic interactions among them. In total, 22%, 15% and 11% of samples were contaminated with 2, 3 and 4 mycotoxins, respectively (Figure 1).
The average concentrations of all the detected mycotoxins were low to medium (>LOQ and above US Food and Drug Administration [FDA] regulatory and advisory levels).

Table 1: Mycotoxin contamination of corn in the USA 2019

	% of positive samples		Average concentration of positive samples (µg/kg)		Maximum concentration of positive mycotoxin (µg/kg)	
Mycotoxins	Corn	Silage	Corn	Silage	Corn	Silage
AfB_1	ND	ND	ND	ND	ND	ND
AfB_2	ND	ND	ND	ND	ND	ND
AfG_1	ND	ND	ND	ND	ND	ND
AfG_2	ND	ND	ND	ND	ND	ND
DON	100.0	86.4	966.4	1370.6	4118.0	4357.0
ZEN	34.6	4.5	527.9	158.0	2022.0	158.0
FB_1	50.0	18.2	1771.8	424.3	4574.0	385.0
FB_2	30.0	ND	711.3	ND	1423.0	ND
T2	15.4	4.5	29.5	28.0	33.0	28.0
HT-2	ND	ND	ND	ND	ND	ND
OTA	ND	ND	ND	ND	ND	ND

AfB_1 = aflatoxin B_1
AfB_2 = aflatoxin B_2
AfG_1 = aflatoxin G_1
AfG_2 = aflatoxin G_2
DON = deoxynivalenol
FB_1 = fumonisin B_1
FB_2 = fumonisin B_2
OTA = ochratoxin A
ZEN = zearalenone
T2 = T2 toxin
HT2 = HT_2 toxin
ND = not detected

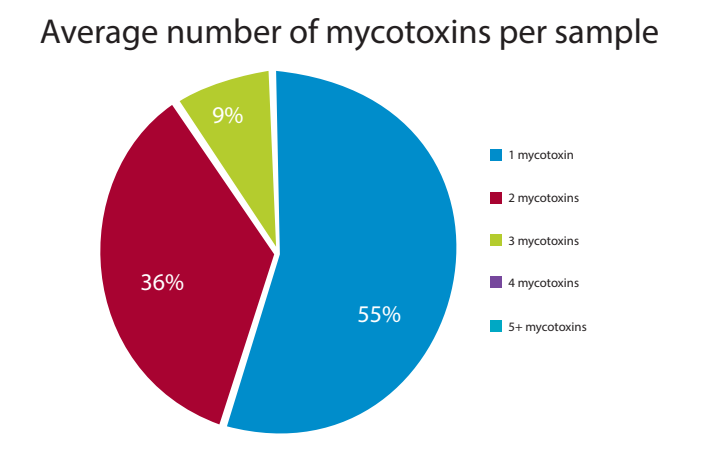

Figure 1: Average number of mycotoxins per sample [%]

Conclusion

The Adisseo 2019 mycotoxin survey concluded that the 2019 corn and corn silage harvest in the USA was of medium (>LOQ but below FDA regulatory and advisory levels) quality in terms of mycotoxin contamination.

Based on the results of this survey which was conducted immediately after the 2019 harvest, the 2019 corn crop in the USA should not automatically be considered safe for inclusion into finished feed rations for all animal species. A degree of vigilance is prudent.

The last possible line of defense is the application of effective mycotoxin management strategies. The application of mycotoxin management strategy is a very common method to prevent mycotoxicosis and is an effective strategy to keep mycotoxin risk low under any and all conditions

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