The contamination of feedstuffs with mycotoxins poses a serious threat to the health and productivity of livestock and poultry. The toxicological effects of mycotoxins are very diverse as they do not belong to a single class of chemical compounds. Unfortunately, low level contamination can elicit sub-clinical effects that are often not apparent, but they can reduce the overall performance and productivity of those animals, eventually resulting in high economic losses for producers. The biological system where the subclinical effects of mycotoxins are most notable is the immune system.

Find out more on this month's blog:

The Immunosuppressive Consequences of Mycotoxins In Livestock and Poultry

The immune system is affected by many types of mycotoxins including aflatoxins, trichothecenes, fumonisins and ochratoxin A. All of these toxic compounds have been shown to suppress the immune system, decrease the animals' resistance to environmental and microbial stressors and make them more vulnerable to diseases.

The primary function of the gastrointestinal tract is to digest and absorb nutrients in order to meet metabolic demands for maintenance, growth, and development. It also acts as a vital barrier preventing the entry of several potentially harmful pathogens from the external environment. Considering the fact that 70% of the immune system resides in the gastrointestinal tract, great care must be taken to protect it from threats such as mycotoxins. Furthermore, due to their ability to inhibit protein synthesis, mycotoxins and their metabolites specifically target areas with rapidly dividing cells and high levels of protein turnover, which are commonplace in the gastrointestinal tract whether it be the epithelial cells that line the intestinal tract or the immune cells that reside in the underlying lamina propria. Mycotoxins can also target other tissues with high cellular proliferation such as the lymphoid organs, which include the thymus and bone marrow (bursa of Fabricius in poultry) where T and B cells develop and mature, respectively. As these cells are important components of the immune system, any damage to these tissues can lead to substantial immunosuppressive effects and enhanced susceptibility to subsequent diseases.

Negative impacts of various mycotoxins

Aflatoxins are considered to be the most potent in terms of their immunosuppressive effects. It predominantly exerts its effects by binding to both DNA and RNA, blocking

transcription, and thus inhibiting protein synthesis. The main immunosuppressive effects of aflatoxins are:

- Suppressed antibody production
- Reduced complement activity
- Impaired proliferation and altered production of cytokines by T-cells
- Depressed macrophage effector cell function

Over 180 trichothecenes have been identified so far and most of them inhibit protein synthesis by binding to eukaryotic ribosomes. The main immunosuppressive effects of trichothecenes are:

- Reduced proliferation and activity of B- and T-cells
- Suppressed antibody production
- Depressed macrophage effector cell function
- Decreased mucus production
- Weakened intestinal cell tight junctions

Fumonisins disrupt sphingolipid metabolism and block the synthesis of complex sphingolipids from sphinganine (Sa) and sphingosine (So). As a consequence, Sa and So accumulate in tissues and inhibit many cellular activities. The main immunosuppressive effects of fumonisins are:

- Reduced antibody response
- Impaired efficacy of vaccines
- Reduced macrophage numbers and effector cell function
- Decreased lymphocyte count and activity

Ochratoxins act by inhibiting the translation portion of protein synthesis by blocking phenylalanine tRNA synthetase. The main immunosuppressive effects of ochratoxins include:

- Cellular depletion of lymphoid organs
- Reduced antibody production
- Suppressed macrophage and heterophil effector cell activities

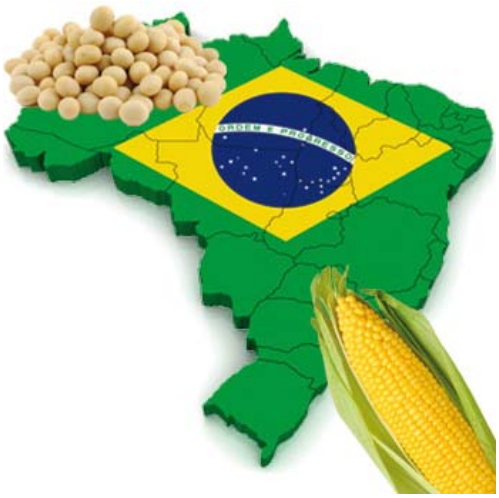
It is important to realize that the effects of mycotoxins on the immune system may severely impact the health status of the entire farm by not only increasing the susceptibility of the animals to disease, but also by lowering the efficacy of vaccination programs. Combatting mycotoxins in the feed will undoubtedly be more cost effective than dealing with the aftermath of these toxins. Therefore, an effective mycotoxin counteracting strategy must be implemented to protect animal health and profit margins.

References are available on request.

Corn and soy are the most important feed ingredients for pig and poultry worldwide. With a year total of 20 million metric tons of corn and 14 million metric tons of soy, Brazil is the second largest exporting country in the world. In Northern Mato Grosso, which accounts for 27 percent of Brazil's second corn crop output, in February of this year there was 21% more rain than the historical average, according to data from Somar and the Geographical and Statistical Brazilian Institute. This meant that growers were not able to harvest their soybeans in time, and led to postponed replanting of fields with corn. In March, it was predicted that the corn harvest of 2014 would be threatened by the return of rain to corn-growing regions.

Highlights and threats in Brazilian corn and soy

A total of 34 corn and 23 soy samples from the current harvest season were screened for the presence of multiple mycotoxins and other secondary metabolites using Spectrum 380®, a method based on Liquid Chromatography coupled with tandem Mass Spectrometry (LC-MS/MS). This state of the art technique developed at the hot spot for mycotoxin investigation the IFA-Tulln based in Austria, enables the detection of more than 380 metabolites in one go. This unique method not only includes the most commonly found mycotoxins but also allows the detection of other less known metabolites and provides the full picture of toxic load in the sample.



The multi-mycotoxin analysis is a tool that is changing the way we see mycotoxin contamination. Previous methods which focused on the main mycotoxins in agricultural commodities included only aflatoxins (Afla), deoxynivalenol (DON), zearalenone (ZEN), ochratoxins (OTA) or fumonisins (FUM) in the analysis. According to our long term experience in the field of mycotoxins and our 10 year Mycotoxin Survey program, DON and FUM are worldwide the most prevalent substances found in agricultural commodities.

Fumonisins compromise Brazilian corn quality

A total of 20 metabolites were found in over 60% of the Brazilian corn samples, the majority of these substances are produced by *Fusarium* species. As expected, fumonisins are the main concern in Brazilian corn. Fumonisin B_1, B_2 and B_4 were present in all corn samples at average concentrations of 3664 ppb FB_1, 1472 ppb FB_2 and 563 ppb FB_4. Also fumonisin B_3 was detected in over 90% of these corn samples. Total fumonisins were present in 65% of all corn samples at levels above 1000 ppb, a concentration that poses a possible risk for most livestock animals.

ZEN was detected in 68% of the corn samples at an average concentration of 265 ppb, a level that may pose a risk to breeding and young animals which are most sensitive to the effects of this mycoestrogenic substance.

Type B trichothecenes were present in 85% of the corn samples. The most common type B trichothecene was nivalenol with a prevalence of 85% at an average of 1021 ppb. DON was present in 29% of these samples at an average of 875 ppb. Conjugated DON in the form of DON-3-glucoside had a slightly higher prevalence as its parental form (32%) and its average concentration (178 ppb) represents 20% of DON. Total type B trichothecenes were present in 32% of the corn samples at levels above 200 ppb, a concentration that poses a high risk for piglets. Type A trichothecenes, such as T-2 toxin, show higher toxicity than type B trichothecenes. In total, 88% of the Brazilian corn samples contained T-2 toxin at relatively low concentrations.

Although aflatoxin B_1 was only present in 20% of the samples, the average concentration was 181 ppb. This is a level considered to pose a health risk for most livestock animals, especially dairy cattle, which show highest sensitivity.

Zearalenone and its metabolites are common in Brazilian soy

Soy samples showed lower levels of contamination compared to corn samples. However, a total of 12 metabolites were found in more than 60% of the soy samples. These metabolites include some emerging mycotoxins such as beauvericin (present in all soy samples), which has been currently taken into consideration as a potential risk factor for humans and animals by the European Food Safety Authority (EFSA).

As expected in soy, ZEN was present in a high number of samples (78%). Alpha-zearalenol, which is approximately 10 times more estrogenic than ZEN, was detected in 34% of the soy samples. Beta-zearalenol and conjugated ZEN (ZEN-sulfate) were present in 17% of these samples.

An important advantage of multi-mycotoxin analysis is the detection of normally undetected masked mycotoxins, as for instance more than 50% of deoxynivalenol are thought to exist in commodities in a masked form. Performing multi-mycotoxin analysis also allows the evaluation of the occurrence of mycotoxins which are not commonly measured and may be posing a threat to the animal. The effects of such mycotoxins on health and performance of humans and animals still need to be elucidated.

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