Mycotoxins and Their Impact on Animal Welfare and Productivity

The welfare of your animals is an important component of production. Proper nutrition, housing and management all contribute significantly to high standards of physical and mental well-being in animals. However, there are many challenges on-farm that can have equally adverse effects. One often-overlooked factor playing a role in farm operations is the threat from mycotoxins. Mycotoxins are toxic metabolites naturally produced by molds that contaminate 60–80% of agricultural crops globally. The formation of mycotoxins can occur both pre- and post-harvest, as well as during storage. Once formed, they are highly stable, allowing them to persist during harvest, processing and storage.

Furthermore, multiple mycotoxins often co-contaminate a feedstuff or feed, increasing the challenge. The presence of these natural contaminants could threaten welfare standards by leading to performance losses, hunger, damage to tissues and organs, disease occurrence, discomfort and survivability. Although the action of mycotoxins is complex, their presence should be considered by the agricultural industry in order to minimise their influence on farm productivity, welfare and profitability.

Role of mycotoxins on feed intake and feeding behavior

The consumption of mycotoxins by animals is well known to impact feed intake, feed efficiency and, in turn, growth performance. Meta-analytical reviews assessing the effects of a range of mycotoxin types and concentrations show the impacts of mycotoxin, where, for example, broilers may have reduced feed intake by 9–17% and lowered weight gain by 14–21%. Similarly, growing pigs may have reduced feed intake by 6–42% and weight gain by 11–45%. Furthermore, deoxynivalenol (DON) consumption by pigs can alter behavior to increase time lying down and reduce time standing and drinking, compounding the effect on feed intake.

The effects of mycotoxins on reducing feed intake and prolonging feeding time are also reported in ruminants. When these animals are exposed to molds and mycotoxins, they often develop a negative energy balance, leading to the mobilisation of nutrient and fat stores that influence body condition and health. A further challenge for the ruminant animal is the influence of mycotoxins on ruminal microflora due to their antimicrobial, anti-protozoal and antifungal activity. Thus, the contamination of mycotoxin-contaminated materials may lead to reduced feed intake and rumen fill, poor feed conversion and digestion, gastrointestinal upset and downstream effects, such as altered milk production or components. As such, the impact that mycotoxins have on feed intake, behavior and performance can influence the critical role that nutrition plays in animal welfare.

Mycotoxins, the occurrence of disease and survivability

The gastrointestinal tract often represents the first line of defense against contaminants such as mycotoxins. However, despite this layer of protection, mycotoxins can cause various damages at the intestinal level and be absorbed to cause further internal injury. When mycotoxin-contaminated feed is consumed, mycotoxins can directly damage the mucosa and epithelium, resulting in lesions and necrosis. This process occurs through the ability of mycotoxins to inhibit DNA, RNA and protein synthesis, as well as induce cell death. Another critical effect of mycotoxins is their ability to not only reduce villus height but also alter intestinal barrier function, which is measured by a decrease in the tight junction proteins between epithelial cells. These changes in intestinal structure and function can alter gut biochemistry, nutrient digestion and nutrient absorption. Through the mycotoxin-induced changes to the intestinal tract, animals may be more susceptible to disease occurrence from pathogens such as E. coli and Salmonella. Pigs consuming fumonisins at 5–8 mg/kg are shown to have greater intestinal *E. coli* colonisation, and broiler chickens consuming DON at 5 mg/kg were more prone to developing necrotic enteritis lesions.

The immune system is another target of mycotoxins due to their immunosuppressive activity in both monogastric and ruminant animals. The role that mycotoxins play in

immunity may often be undiagnosed on-farm but can represent a significant factor in animal health and well-being. Mycotoxin exposure through contaminated feed can increase susceptibility to diseases, vaccine program failures, uniformity issues and overall performance loss. Pigs consuming DON are shown to have reduced vaccine efficacy to porcine reproductive and respiratory syndrome (PRRS), while fumonisin consumption can increase the severity of PRRS. Similarly, vaccination efficacy is also shown to be lowered in poultry consuming mycotoxins. Although many factors influence disease occurrence, mycotoxin exposure should be considered one of the potential causes due to their frequent presence in animal feedstuffs and significant role in gut health and immunity.

Through the impacts on gut health, organ health and immunity, mycotoxins can have a negative effect on animal survivability. Many published research trials show an increase in mortality rate when mycotoxins are consumed. Progeny survival can also be impacted, mycotoxins have been shown to increase the number of stillborn piglets, chick embryonic mortality and the mortality rate of young animals, including lambs and calves. Changes to quality of life and increased mortality rates associated with mycotoxins can undoubtedly play a role in overall farm performance.

Minimising animal health or welfare issues associated with mycotoxins

Although mycotoxins are a challenge for the agricultural industry, management strategies are available for reducing mycotoxin concentration in feeds and the negative effects on animals. One of the most vital strategies for understanding mycotoxin risk is the pre- and post-harvest use of analytical technologies that allow for mycotoxin quantification and monitoring. These technologies may include enzyme-linked immunosorbent assay (ELISA) based technology or liquid chromatography-tandem mass spectrometry (LC-MS/MS). Additionally, feed additives or supplements may be used to minimise the effects of mycotoxins on the animal. One such additive, the yeast cell wall extract (YCWE, Mycosorb®, Alltech, Inc.), has demonstrated a considerable ability to bind several mycotoxins *in vitro*, *ex vivo* and *in vivo*. The inclusion of YCWE during mycotoxin challenges is an effective technique to lessen the toxic effects caused by these contaminants. As such, the performance, health and welfare of animals reared under an appropriate mycotoxin management program may be improved.

Dr. Alexandra Weaver

Dr. Alexandra Weaver obtained her master's and Ph.D. in animal science and nutrition from North Carolina State University under the direction of Dr. Sung Woo Kim. Her dissertation, entitled "The impact of mycotoxins on growth and health of swine," investigated the effects of mycotoxins on performance, immunity, oxidative stress, gut health, and reproductive capacity of pigs. Alexandra joined the Alltech Mycotoxin Management program in 2013 and provides global technical support. Although supporting many areas of mycotoxin management, Alexandra has particular interest in developing computer programs to track mycotoxin risk and assess the physical and financial impact of mycotoxins on animals. Alexandra has published multiple research articles in peer-reviewed journals and hopes to help producers and nutritionists of all species understand and manage mycotoxins.