Mycotoxins detoxifying agents for use in animal feed explained

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MYCOTOXINS are secondary metabolites formed by several fungal species. Some fungi can produce multiple mycotoxins, and some mycotoxins can be produced by more than one fungus. More than 300 types of mycotoxins are currently known.

The mycotoxins of highest importance due to their frequent occurrence and the harm they cause in livestock are aflatoxin, deoxynivalenol (DON), fumonisin, ochratoxin and zearalenone (Chaytor et al., 2011a).

Strategies to prevent growth of mycotoxins in grains in the field and in storage do exist; however, these are not always implemented and do not guarantee the absence of mycotoxins in grains. Some compounds have been shown to reduce the toxicity of mycotoxins when included in animal feeds. These are commonly known as mycotoxin detoxifying agents and can be split into two groups: adsorbing agents binders and biotransforming agents/modifiers (Vila-Donat et al., 2018).

Adsorbing agents or binders physically bind mycotoxins through the gastrointestinal tract to prevent absorption into the bloodstream. Biotransforming agents or modifiers can transform mycotoxins into less toxic substances through a variety of routes to lessen their impact in the animal.

Adsorbing agents/binders

Inorganic absorbing agents consist primarily of aluminosilicates, which are a common group of rock-forming minerals, or clays, containing silicon and oxygen. Mycotoxins with flat chemical structures, such as aflatoxins, can be “trapped” between layers in the clay, preventing uptake into the bloodstream.

Clay groups that have shown mycotoxin binding efficacy include hydrated sodium calcium aluminosilicate, bentonites and zeolites. Hydrated sodium calcium aluminosilicates have been shown to effectively bind aflatoxin but have not shown impacts on other fusarium mycotoxins (Vila-Donat et al., 2018). Most bentonites have been shown to bind aflatoxins more effectively than zearalenone and ochratoxin (Huwig et al., 2001). Zeolites have demonstrated effective adsorption of aflatoxins and fumonisins; modified zeolites are more effective in adsorption of fumonisins than natural zeolites (Dakovic et al., 2010; Baglieri et al., 2013).

Organic absorbents have also been proposed, including yeast cell wall, lactic acid bacteria, micronized fibers and bio-sorbents and activated carbon. Yeast cell wall has demonstrated some binding efficacy across many mycotoxins, including zearalenone, ochratoxins and fumonisins (Faucet-Marquis et al., 2014; Pfohl-Leszkowicz et al., 2015).

Some lactic acid bacteria strains have been shown to bind certain aflatoxins and zearalenone, likely due to the cell wall peptidoglycans, polysaccharides and teichoic acid (Vila-Donat et al., 2018).

Micronized wheat fibers have shown efficacy with ochratoxin (Aoudia et al., 2009). Humic acids have also demonstrated some efficiency in binding zearalenone and ochratoxin (Sabater-Vilar et al., 2007; Santos et al., 2011).

Activated carbon has demonstrated high affinity for different mycotoxins in vitro, but these results have not been confirmed in vivo (Avantaggiato et al., 2005). Activated carbon is a non-specific absorber; thus, it is capable of absorbing key dietary nutrients as well.

Biotransforming agents/modifiers

DON (vomitoxin) was the most frequently occurring mycotoxin in feed components, including corn, wheat, barley, rice, soybean meal, corn gluten meal, dried distillers grains, silage and others, according to BIOMIN’s 2017 survey (biomin.net).

In the 2016 U.S. corn crop, 75% of analyzed samples were positive for DON, at an average concentration of 955 parts per billion, or 0.9 parts per million (Hendel et al., 2017). As of June 2018, 29% of corn samples had DON levels greater than 1 ppm, which is above the threshold level in complete feeds established by the Food & Drug Administration (FDA Mycotoxin Regulatory Guidance, 2011).

Many studies have confirmed the inability of various commercially available products (including mineral clays, yeast products and enzymes) to recover the decrease in performance of pigs consuming DON (Danicke et al., 2004; Patience et al., 2014; Frobose et al., 2015, 2016, 2017). This is likely due to the chemical structure not being as flat as other toxins.

However, products containing sodium metabisulfite have consistently shown to improve performance of pigs fed DON-contaminated feed (Danicke et al., 2005; Patience et al., 2014; Frobose et al., 2017). More recently, Shawk (2018) found that there were benefits in performance when...

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nursery pigs received products containing sodium metabisulfite for longer (42 days) versus shorter (35 days) periods in diets containing DON at 1.5 mg/kg. Sodium metabisulfite reacts with DON, generating DON-sulfonate, and its lower toxicity derives from the faster urinary excretion of sulfonate products (Beyer et al., 2010).

The Bottom Line

Growth and storage conditions can leave grain susceptible to mycotoxin contamination. This is aggravated by the complexity of diets and different sources of ingredients, which can make it difficult to predict which toxins will be present in the complete feed.

Moreover, some types of molds produce different toxins; for example, Fusarium species produce zearalenone, fumonisin and DON, and those are frequently found in combination (Chaytor et al., 2011b; Frobose et al., 2016). Because mycotoxicity detoxifying agents are only effective on certain mycotoxins, a combination of products providing wide-spectrum coverage of toxins is recommended.

References


