

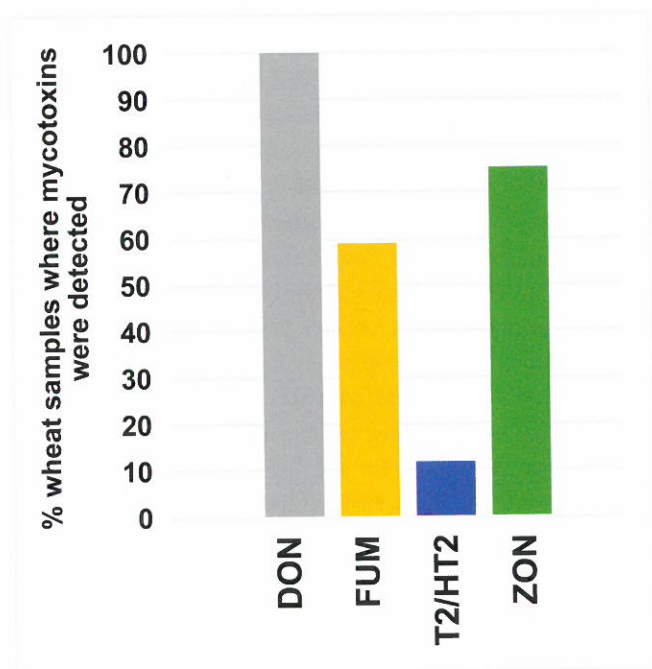
The Impact and Control of DEOXYNIVALENOL (DON) Contamination in Pig Feed

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When it comes to mycotoxin contamination of pig feed, much of the attention is quite rightly focussed on fumonisin (FUM) and zearalenone (ZON). Both are acutely toxic to pigs, and are produced by the *Fusarium* moulds that commonly infect the cereal grains used in pig diets.

However, the most prevalent mycotoxin found within pig feeds and feed ingredients is actually deoxynivalenol (DON) (see Figure 1). And although DON is not as specifically toxic to pigs as FUM or ZON, it can still be highly damaging to pig health, fertility and growth performance.

Figure 1: Mycotoxin contamination of feed ingredient samples from across Europe, the Middle East and Russia



(Source: Micron Biosystems)

Feed ingredient susceptibility

Part of a key group of mycotoxins known as the trichothecenes, which also includes T2 Toxin, DON is produced by the same *Fusarium* moulds responsible for FUM and ZON. As with all mycotoxins the level of DON contamination can vary enormously, being influenced by

environmental conditions pre and post-harvest, insect or pest damage – which can increase susceptibility to *Fusarium* infection – as well as grain processing, transport and storage.

Mycotoxins also rarely occur in isolation, with the presence of multiple mycotoxins potentially acting additively or even synergistically. The effects of DON can therefore be increased by the presence of other common mycotoxins like FUM, ZON or T2 Toxin and the overall mycotoxin load experienced by commercially produced pigs in modern production units can be considerable.

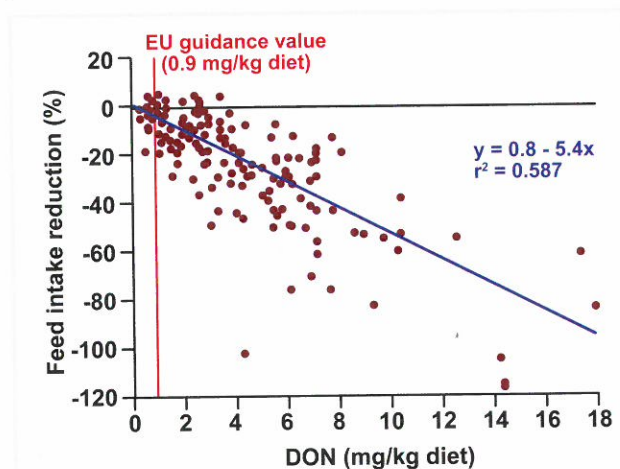
Species-specific risk

This mycotoxin loading is also species-specific. At 200 ppb, for example, a pig consuming 5 kg of feed per day will be exposed to 10 mg of mycotoxin, which equates to around 0.07 mg/kg bodyweight. Yet for poultry consuming similarly contaminated feed (at 100 g per day), the exposure is only 0.02 mg, or just 0.01 mg/kg bodyweight.

Interestingly, although European Union (EU) guidance values for DON contamination are relatively high for individual cereals and cereal by-products at 8,000 ppb (except for maize by-products at 12,000 ppb), the figure for complete feeds is just 900 ppb (0.9 mg/kg). However, even at this level pig performance can be affected.

The data in Figure 2 shows that for each 1,000 ppb (1 mg/kg) of

Figure 2: Impact of increasing DON ingestion on feed intake (Source: Schothorst Feed Research)



DON above that EU guidance value, feed intake will typically drop by around 5%. Such an effect can have a profound impact on efficiency and profitability, even without taking into account the additional effects of DON on fertility, health and growth performance.

Impact on production

The reason feed intake is so dramatically affected is that the gastro-intestinal tract (GIT) is the structure within the pig's body that faces the highest levels of mycotoxin exposure. Acting to inhibit protein synthesis, the effects of DON are widespread.

A reduction in gut epithelial cell integrity reduces nutrient digestion and absorption. Combined with lower feed intake, the result is a reduction in liveweight gain and poorer feed conversion efficiency (FCE). In severe cases, vomiting and overt feed refusal can be present, with intestinal lesions, stomach lesions and intestinal bleeding also reported, particularly where the diet contains a high proportion of fine feed particles.

In addition, DON can impair immune function, either through suppression (increasing susceptibility to disease and potentially reducing vaccine efficacy) or stimulation (localised inflammation). Its impact on reproductive performance is typically seen as a reduction in litter size.

All these effects are exhibited more strongly in young pigs. For example, in a meta-analysis of over 85 published studies, age and total mycotoxin exposure were found to be the two factors having greatest influence on the extent of growth rate impairment. Male pigs were more susceptible than females, and although stage of production was another key factor, mycotoxins were a threat to overall efficiency throughout the pig's life, even at low, chronic levels of contamination.

Countering mycotoxin contamination

The specific nature of DON also has an influence on the efficacy of any in-feed mycotoxin binders and de-activators used to counter potential contamination. Until recently, such products were developed on a one-size-fits-all basis, with the same formulation used for pigs, poultry and ruminants, to the detriment of overall performance.

Fortunately, that is now changing as understanding around the specific requirements of each species increases – not only in terms of the threat faced, but also in the differing conditions within the GIT. Just as the traditional clay-based binders were superseded by combination products capable of also transforming and degrading mycotoxins, so too are these one-size-fits-all products being superseded by species-specific solutions.

Binding (adsorption) still remains the most common approach, with specific clay minerals such as bentonite used to bind with polar mycotoxins such as aflatoxin. Yeast cell walls have demonstrated some efficacy against non-polar *Fusarium* mycotoxins (such as DON), but the ability to maintain efficacy within the pH range typically found in the pig's GIT (pH 3-7) is critical to success.

The direct adsorption of DON is also rarely firm enough to reliably inactivate it in all situations. To improve this binding affinity, particular

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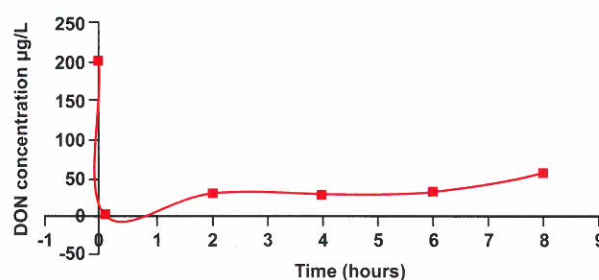
functional groups on the surface of the DON molecule must be removed or modified. Depending on the compounds involved, this transformation process can act to either increase the binding affinity of DON, and so make binding effective, or directly render the mycotoxin harmless.

The third mechanism employed is degradation, which is the application of multiple transformations to ensure that any mycotoxin fragments remaining after transformation – even if bound to a mineral binder – no longer retain any toxic effect.

Targeting DON elimination

The strategy of transformation and degradation is particularly pertinent to DON, due to the previously mentioned difficulty in getting it to bind strongly to mineral or yeast cell wall binders. In fact, in vitro studies have demonstrated an almost immediate disappearance of the mycotoxin in the presence of a specific intact *Saccharomyces cerevisiae* yeast capable of transforming and degrading DON (see Figure 3).

Figure 3: Effect of *S. cerevisiae* yeast on DON in vitro



(Source: Micron Biosystems)

Over time, some DON was detected as remaining in solution, but subsequent studies reported 50% of this was subsequently adsorbed when a mineral binder was added, clearly indicating that transformation had taken place.

Such advances are critically important in the fight against DON contamination of pig feeds and feed ingredients. The threat posed by this particular mycotoxin is substantial, yet too often the specific requirements needed for effective control in pigs are overlooked. It may not be the most toxic mycotoxin for pigs, but it remains a major threat to pig unit profitability, and one that requires a carefully targeted approach if control is to be effective.