The value of mycotoxin management programmes in pig production

by Swamy Haladi, global technical manager, Alltech Inc, Bangalore, India.

Moulds or fungi and the mycotoxins they produce are an ever present threat to the quality and security of feedstuffs. The growth of moulds, present on all crops in varying amounts each year, depends hugely on the climatic growing conditions.

Drought conditions which have swept across large portions of southern Europe over the last number of months and heavy rains in northern and western Europe have significantly increased the risk of mycotoxin contamination.

Coupled with the extensive drought conditions in the USA this year, we can expect to see a far greater risk of mycotoxin contamination than has been seen in recent years.

Global trade of raw materials means that the mycotoxin challenges faced in one region are shared around the world.

The USA is the world's top exporter of grains and is experiencing a drought on a scale not seen in 25 years.

Effective mycotoxin management is, now more than ever, fundamental to the success of any farm or feedmill. Pigs are particularly sensitive to mycotoxins and, as such, producers should implement an integrated mycotoxin management programme to limit their negative effects.

There are over 500 known mycotoxins with each one exhibiting different toxicity and symptoms.

Standard analytical methods used are limited to the detection of just five mycotoxins and so do not give producers an accurate picture of the true level of contamination.

In order to help producers adequately address the particular challenge they face, Alltech have developed their 37⁺ Program.

Most sensitive analysis

The 37⁺ Program is the widest and most sensitive analysis of feedstuffs available to producers. By analysing as many mycotoxins as possible we can gain a greater understanding of mycotoxin interactions in the animal and ultimately develop solutions to minimise instances of future contamination.

The objective is to evaluate global feedstuffs for multiple mycotoxins using UPLC-MS/MS instrumentation developed at Alltech's global headquarters in Kentucky, USA.

Alltech's 37⁺ Program represents a real breakthrough compared to standard commercial methods that can only show 'snapshots' of contamination.

These standard techniques are limited in terms of the number of toxins detected, selectivity, and sensitivity for given biological matrices. A European example is provided below.

Table 1. The list of mycotoxins tested and the corresponding mycotoxin groups.

Mycotoxins	Mycotoxin group
Aflatoxin B_1, B_2, G_1, & G_2	Aflatoxins
Ochratoxin A and B	Ochratoxins
T-2 toxin, DAS, HT-2 toxin, Neosolaniol	Type A Trichothecenes
DON, 3-acetyl DON, 15-acetyl DON, Nivalenol, Fusarenon-X, masked DON	Type B Trichothecenes
Fumonisin B_1, B_2, and B_3	Fumonisins
Zearalenone, α-zearalenol, β-zearalenol and Zearalanone	Zearalenone
Patulin, Roquefortine C, Penicillic acid, Mycophenolic acid, Gliotoxin, Sterigmatocystin, Verruculogen, Wortmannin	Penicillium mycotoxins
2-bromo-alpha-ergocryptine, Ergocornine, Ergometrine, Ergotamine, Lysergol, Methylergonovine	Ergot mycotoxins
Alternariol	Alternaria toxin

Sample and analysis details

One hundred and four samples from the 2011 harvest, collected from different regions across Europe, were subjected to analysis of the 38 mycotoxins listed in Table 1.

For ease of interpretation of the total toxicity to animals and the toxins of similar structure and effects were grouped as in Table 1. Feed ingredients used in swine feed such as corn, wheat, barley and DDGS were part of this analysis.

Of the samples tested, 89.5% were found to be contaminated with one or more mycotoxins. Only 11 samples out of 104 tested were negative for all the mycotoxins tested (Table 3). Type B mycotoxins were detected in 70% of the samples followed by fumonisins (46%). Type A mycotoxins were

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present in 22% of samples tested as were Penicillium mycotoxins (Fig. 1). Aflatoxins, ochratoxins, ergot toxins and zearalenone toxins were detected in between four and 16% of the samples tested.

Major issue in Europe

It can be concluded, therefore, that field borne Fusarium mycotoxins are the biggest challenges in European feedstuffs.

When the averages for the entire dataset were calculated, fumonisins were present at the highest concentrations (1,039ppb) followed by Type B mycotoxins (760ppb) and Penicillium toxins (179ppb). A maximum concentration for an individual sample was recorded for fumonisins (40,000ppb) followed by Type B mycotoxins (5,923ppb) and Penicillium toxins (5,736ppb).

Fumonisins detection in European feedstuffs was not expected. Fusarium moulds capable of producing fumonisins tend to grow in an environment with high temperatures. The presence of predisposing factors such as insect damage further increases their incidence. European feedstuffs should be monitored for fumonisins on a regular basis.

These findings further exemplify the need for analysing feedstuffs for multiple mycotoxins and not just aflatoxins and vomitoxin. The findings also support the need for the implementation of suitable strategies to counteract multiple mycotoxins and not just one or two.

Multiple mycotoxin profile

The highest percentage of samples, 35.58%, contained between three and five mycotoxins followed by 13.46% containing between five and 10 mycotoxins. 24% of samples tested contained one mycotoxin, while only 10.5% of the samples tested contained no mycotoxins at quantifiable levels (Table 3).

Table 2. Examples of peer-reviewed mycotoxin interactions in pigs.

Mycotoxin combination	Type of interaction
Aflatoxin x T-2 toxin	Additive or less than additive
Aflatoxin x Fumonisin B1	Additive or synergistic
Ochratoxin x T-2 toxin	Additive
Ochratoxin x DON	Additive
Ochratoxin x Penicillic acid	Synergistic
DON x T-2 toxin	Additive
DON x Fumonisin B1	Additive or more than additive
DON x Fusaric acid	Synergistic

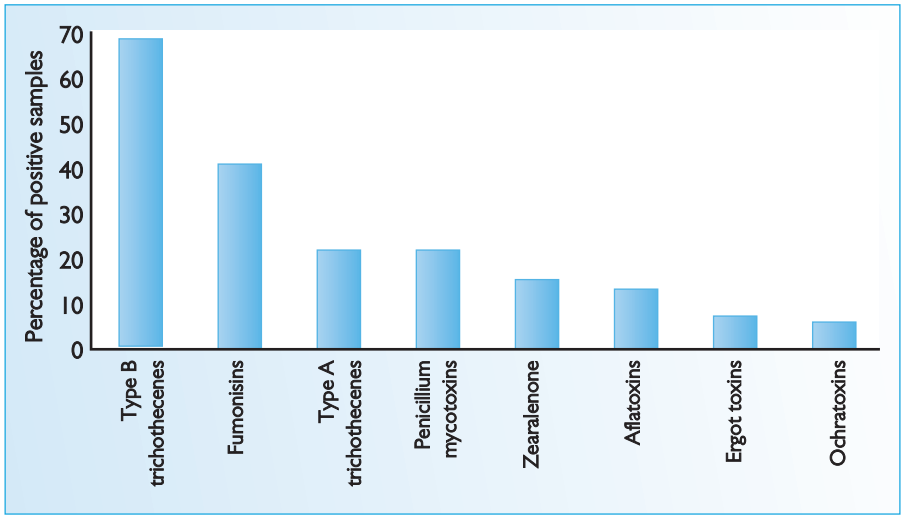

Fig. 1. Percentage of samples positive for various mycotoxins.

Corn, DDGS, barley, and wheat were all predominantly contaminated with Type B trichothecenes and fumonisins. Such information will not only assist in understanding the mycotoxin contribution to final pig feed but also helps in determining the safer inclusion levels of such ingredients.

Mycotoxin interactions in pigs

Since one mould can produce several mycotoxins and several mould species can be present in any given feedstuff, it is expected that there are a substantially larger variety of mycotoxins present than is presumed. This co-occurrence makes the tolerance level for individual mycotoxins (safe levels) irrelevant and therefore, the presence of multiple mycotoxins in swine feed should be considered when choosing an appropriate control strategy. Mycotoxin interactions in pigs are very well proven (Table 2). These interactions are mainly additive in nature, but can be synergistic and antagonistic as well.

It is important to note that the type of interaction can vary for different parameters in the same animals.

MIKO programme

Once the mycotoxin issue has been diagnosed, a programme (MIKO) should be developed to ensure that the associated risk to animal health and production is reduced.

When choosing an effective mycotoxin management programme, feed mills and producers should ensure that it includes detailed management for critical control points; whether at farm or feedmill level. Alltech established its MIKO Program, based on HACCP principles to address this issue. MIKO involves setting up monitoring procedures as well as identifying critical mycotoxin levels for the given animal species being fed.

With this information, the correct balance can be struck between economical feeding and optimal animal performance as it relates to mycotoxins. A successful mycotoxin control programme should:

- Incorporate monitoring procedures.
- Establish corrective actions.
- Contain checks and measurements.
- Include a way to record information.
- Importance of motivation.

Implementation requires practical understanding and, as with any long term project, it should involve education and training so that it is as effective as possible.

Conclusions

The time has passed to question the relevance of mycotoxins in pig production. Pigs are the most sensitive animal species to many of the common mycotoxins.

Pigs are very sensitive to fumonisins, DON and zearalenone which are by far the most common mycotoxins globally.

The use of Alltech's 37+ Program aids in developing a better understanding of mycotoxin profile in global feedstuffs.

This involves the analysis of some lesser or unknown mycotoxins and such analysis further helps in understanding mycotoxin interactions. The implementation of Alltech's MIKO Program (based on HACCP principles) on farms and feedmills allows for an integrated approach to deal with mycotoxin challenges. ■

References are available from author on request

Table 3. Multiple mycotoxins profile for entire data analysed.

Number of mycotoxins	Number of samples	Samples (%)
0	22	10.58
1	25	24.04
2	16	15.38
3-5	37	35.58
5-10	14	13.46
>10	1	0.96