Brazilian experiences with mycotoxins

by Dr Douglas Zaviezo, Special Nutrients Inc, 2766 Douglas Road, Miami, Florida 33133, USA.

Brazil is one of the largest grain, poultry and swine producers in the world. For many years they were very fortunate because the only mycotoxin problem they had was aflatoxin; but in the last four years fumonisin, zearalenone and vomitoxin started to be detected at high levels in corn, wheat and soy, affecting animal production.

A sudden influx of mycotoxin binders began to appear offering solutions based more on marketing than on scientifically proven results. The Brazilian government, facing the mycotoxin problem and the abundance of products, decided to take action to provide a real solution to this situation.

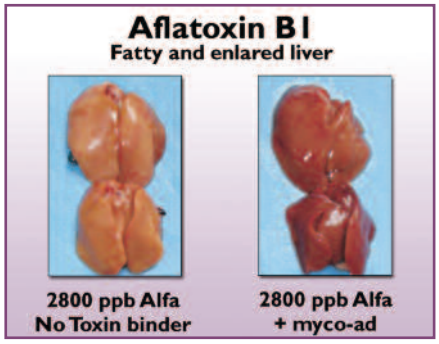

Table 1 shows the most recent data of mycotoxin contamination found in animal feed samples in Brazil.

Brazilians approached the situation in a very efficient and practical way. First of all, they recognised that they have a mycotoxin problem affecting animal performance and that it was a great challenge for the producers as well as for technical personnel to identify the most effective mycotoxin binders.

Therefore, they formed a committee of scientists and experts in this field to create and develop the methodology and regulation for the approval of anti-mycotoxin additives (binders, adsorbents and detoxifiers).

The conclusion from the committee was to implement a programme consisting of a three stage process for the approval of anti-mycotoxin additives that will be conducted in a Brazilian university recognised for being a leader in the mycotoxin field.

The university assigned for this project was Universidade Federal de Santa Maria (UFSM), Departamento de Medicina Veterinaria Preventiva, Laboratorio de Análises Micotoxicológicas (LAMIC), under the direction of Dr Carlos Mallmann.

LAMIC was founded 15 years ago and it is now one of the top five independent mycotoxin laboratories in the world. This laboratory has nine HPLC machines and two MS/MS spectrophotometers dedicated exclusively to mycotoxin analyses. It also has its own poultry and swine experimental research stations, including animal processing facilities for the in vivo studies.

Table 1. Main mycotoxins found in animal feed in Brazil (Dr Mallmann et al, LAMIC-UFSM, 2008).

Mycotoxin	Samples analysed	Positives (%)	Average (ppb)
Aflatoxin	82,452	40.8	11.8
Zearalenone	69,417	16.6	43.4
Ochratoxin A	19,730	2.9	0.6
Deoxynivalenol (DON)	15,348	39.4	233.7
Fumonisin	14,162	53.4	1073.2
T-2 toxin	10,952	1.3	13.9
Diacetoxyscirpenol (DAS)	747	6.0	9.5

Mycotoxin	Target organ	Damage
Aflatoxin	Liver in poultry and swine	Enlarged, fatty, friable
Ochratoxin	Kidney in poultry and swine	Enlarge, congested Urate deposits in poultry
T-2/DAS	Mouth, tongue and gizzard in poultry, tongue in swine	Necrosis, ulcers, erosions
Zearalenone	Female reproductive organs in swine	Enlarged, vulvovaginitis
Deoxynivalenol	Liver	Size reduction
Fumonisin	Lungs, liver and heart in swine	Enlarged

Table 2. Target organs that must be evaluated in poultry and swine when testing an anti-mycotoxin additive.

In vitro study

The process of approval starts with an in vitro study conducted with high performance liquid chromatography (HPLC) using a methodology considering two types of solutions, one of approximate pH 2 and another of approximately pH 6, mimicking the gastric and the intestinal mediums, respectively.

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Several levels of the anti-mycotoxin additive are used and, depending on the mycotoxin tested, the mycotoxin level can vary from 1000 to 2500ppb. If the product has an acceptable performance; better than 80% efficacy, then it can enter into the second phase.

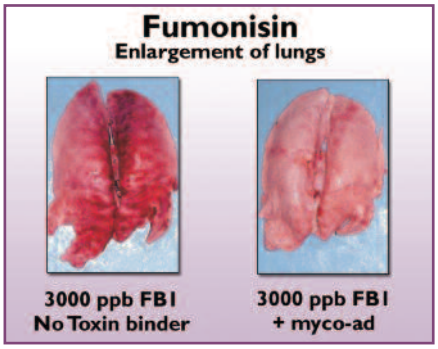
In vivo study

The second phase is an in vivo study that is performed with only one mycotoxin at a time, using 1,000 to 50,000ppb, depending on the mycotoxin; and tested on a specific type of animal at a time. There is a standard or basic experimental protocol consisting of three or four treatments: a control without mycotoxins; a control with mycotoxin; and one with mycotoxin with adsorbent.

The fourth treatment could be one without mycotoxin with adsorbent. Additional treatments can be included to this experimental design, such as different testing levels of the adsorbent.

Besides the productive performance measurements (body weight gain, feed consumption and feed efficiency), it was concluded that it is critical to evaluate the statistical significant beneficial effect of the mycotoxin inactivator on the target organ or organs affected by the mycotoxin tested.

Table 2 shows the organs most affected by different mycotoxins. It is important to evaluate the target organs since they reflect the specific damage of the mycotoxin and also because there are some adsorbents that base their effectiveness on a positive effect on performance, which is obtained mainly due to the presence of enzymes, beneficial bacteria, yeast and/or immuno-stimulant in the composition of those products.



Third phase

The third phase consists of re-testing the mycotoxin binder in vitro every six months and in vivo every two years to ensure that the manufacturers are selling the same product that was originally approved.

Products approved

This programme was implemented about two years ago and few products have been approved; all of them are clay based products. So far there are 18 products approved for the prevention of aflatoxin toxicity in poultry; three for the prevention of aflatoxin toxicity in swine; two for the prevention of fumonisin toxicity in poultry; one for the prevention of fumonisin toxicity in swine; and five for the prevention of zearalenone in swine. Of these 30 approvals 29 are for clay based products and only two products have been approved for more than one mycotoxin at this time.

Through this approval process it was evident that a product that prevented a specific mycotoxin toxicity in poultry will not necessarily prevent the toxicity of the same mycotoxin in swine or vice versa.

It was also demonstrated that clays are not only effective at preventing aflatoxin toxicity, but few of them are very efficacious in preventing zearalenone and fumonisin toxicities.

Effectiveness of mycotoxin adsorbents can not be based only on in vitro trials anymore; they must be evaluated in vivo using a scientific experimental design with measurements of the beneficial effects of the product on animal performance and on the target organ(s) affected by the mycotoxin being studied. The Brazilian producers should be very proud of UFSM-LAMIC for its professional work and grateful for the government's action of preventing the sale of anti-mycotoxin additives based on marketing instead of serious scientific evaluation. ■