

> WHO TO CONTACT IN THE CASE OF MYCOTOXIN-RELATED QUESTIONS:

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Newsletter

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> EDITORIAL

The potential harm to humans and animals by certain mycotoxins generally makes contaminated crops unacceptable for food and feed. Both feed and food industry know that the combined effects of mycotoxin-related feed- and food-losses decrease the supply and raise the price of various farm commodities. You may also be aware of the fact that mycotoxins in agricultural commodities lead to expenditures on research, regulatory enforcement, mitigation, lawsuits, testing and quality control. But have you ever thought about the potential economic costs of mycotoxins in detail?

The authors of the recently published CAST (Council for Agricultural Science and Technology)-report comprising a highly qualified group of international scientists including the Who's Who in mycotoxin research, provide an estimate of the potential costs of mycotoxin contamination in the United States economy. Potential annual costs are estimated to be the sum of the value of food losses, feed losses and mitigation efforts, and thus to range from \$418 million to \$1.66 billion, with the mean estimated cost at about \$932 million. In addition, mitigation costs and livestock losses could add another \$472 million to the mean calculated costs.

These figures clearly demonstrate that mycotoxins in crops could potentially impose enormous costs on the economy and that further progress in developing successful counteracting methods is urgently needed. However, Biomin's research team is still on the right track. But have a look for yourself ... and enjoy reading!



Mycofix® Plus product line – always a step ahead in mycotoxin deactivation!



Mycofix® Plus product line

Although agronomic and other practices are aimed at decreasing or eliminating mycotoxins in the field, there are still considerable reasons to look at postharvest means to counteract mycotoxins in grains and other commodities. The approaches to this are varied and may be categorized as physical methods, chemical decontamination, treatments to decrease the bioavailability of mycotoxins to the host animal and biological detoxification. Some clearly are more practical and effective than others, however, their individual efficacy is outlined in the following.

A New Approach in Managing Mycotoxins in Animal Feed

Several studies evidenced in the past that economic losses due to mycotoxins occur at all levels of food and feed production, including crop and animal production, processing and distribution. Even during favourable climatic periods, millions of dollars are lost as a consequence of respective crop contamination (*see Editorial*).

Mycotoxins occur despite the most strenuous efforts on prevention

Prevention of fungal infections during plant growth, harvest, storage and distribution would be the most efficient and effective way to avoid mycotoxins in agricultural commodities.

Extract from an article published in Feed Mix – The International Journal on Feed, Nutrition and Technology – Volume 11 Number 1, Jan 2003

Dian Heidler

**2. World Mycotoxin Forum**

Noordwijk aan Zee, Netherlands, February, 17-18, 2003

1. Panamerican Symposium on Mycotoxins in Industry

Canacina, Mexico, April 1-4, 2003

25. Mykotoxin-Workshop

Giessen, Germany, May 19-21, 2003

Mycotoxins in Food Production Systems

University of Bath, England, June 25-27, 2003

> LITERATURE

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...available by request

> IMPRESSUM

Newsletter is published by the export department of Biomin Innovative Animal Nutrition GmbH
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However, contamination of grains with mycotoxins occurs despite the most strenuous efforts on prevention and the economic impacts are felt by crop- and animal producers as well as by food- and feed-processors.

Physical and chemical decontamination - chances of success are rather slim

The ever increasing number of reports on the presence of mycotoxins in foods and feeds dictates the exigency for practical and economical detoxification procedures. So far, there are a number of physical and chemical approaches to counteract mycotoxins, however, only a few have apparent practical application.

The efficacy of physical techniques highly depends on the grade of contamination and the distribution of mycotoxins throughout the grain. Subsequently the results obtained are uncertain and often connected with high product losses. Moreover, some of these treatments are relatively costly and may remove or destroy essential nutrients in feed. Thus it is obvious that their practical application is very limited. Chemical methods require not only suitable reaction facilities but also additional treatments (drying, cleaning) that make them very time consuming and expensive. Only a limited number of tested chemicals turned out to be effective without diminishing nutritional value or palatability and without leaving toxic by-products.

Use of adsorbing substances - a successful solution against aflatoxicosis

Costs and limitations of physical and chemical treatments of feed prompted the search for other solutions concerning the mycotoxin hazard. Consequently, techniques were investigated based on deactivation of mycotoxins directly in the gastrointestinal tract of animals.

Up to now, the most widely investigated method in this field is the addition of chemisorbents with the capacity to tightly bind and immobilize mycotoxins in the gastrointestinal tract of animals. In several studies, hydrated sodium calcium aluminosilicates (HSCAS) have proven to be the most promising adsorbents. However, whereas good and scientifically explained results were obtained for counteracting aflatoxins, adsorption of other mycotoxins was limited (e.g. zearalenone, ochratoxin A) or even failed under field conditions (e.g. deoxynivalenol).

Microbial detoxification - a brand-new method that already proved to work

For less- and non- adsorbable mycotoxins an alternative way of detoxification had to be found. Enzymatic degradation of mycotoxins has already been a subject of research for more than 30 years. A great deal of respective literature is available concerning trichothecenes. By now it is well known that the 12,13-epoxide ring of these compounds is responsible for their toxic activity and that a reductive de-epoxidation caused by either enzymes or live microbes entails a significant loss of toxicity (figure 1).

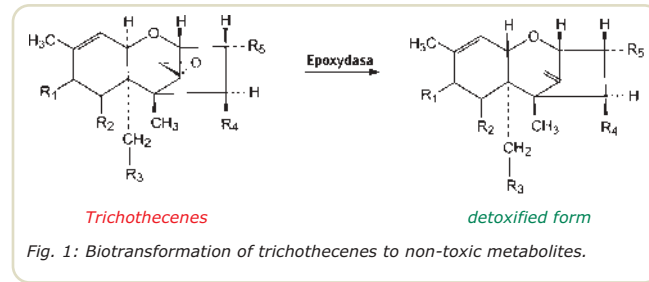


Fig. 1: Biotransformation of trichothecenes to non-toxic metabolites.

degradation activity were isolated in the past [3, 4, 5, 6, 10, 11] Binder *et al.* [1] were the first to develop a mycotoxin deactivating feed additive based on live microbes.

The *Eubacterium* strain BBSH 797 is a bacterium with trichothecene-detoxifying activity (figure 2). Investigations using *in vitro* intestine models revealed that this microbe works well in the gastrointestinal tract of animals and can therefore be used as feed additive to detoxify trichothecenes in the gut. In order to prove the *in vivo* efficacy of BBSH 797 scientific feeding trials were conducted at the University for Veterinary Medicine in Vienna. Highly significant results (P<0.001) were obtained in piglet feeding trials with a contamination of 2.5 ppm DON. After 45 days animals fed contaminated feed weighed only 16.4 kg (FCR of 2.0) while groups receiving contaminated feed plus different concentrations of BBSH 797 weighed between 22.3 and 23.6 kg (FCR of 1.6). Piglet trials with lower DON-contaminations (0.5-1.5 ppm) displayed no statistically significant results, but non-the less showed clear tendencies (table 1). In broiler trials (10.5 ppm DON, 0.2 ppm AcDON) addition of BBSH 797 reduced mortality from 19.4 to 5.5 % and had a significantly (P<0.5) positive influence on weight development of animals.

A very recent invention refers to ochratoxin A (OTA) which is a mycotoxin with nephrotoxic-, hepatotoxic-, carcinogenic- and immunosuppressive-properties. During animal production OTA causes economic losses mainly through a decrease in growth performance. However, reduced productivity, the risk of residues in animal tissues and the possible carry over to humans when contaminated meat is consumed, finally led to an intensified search for suitable counteracting methods.

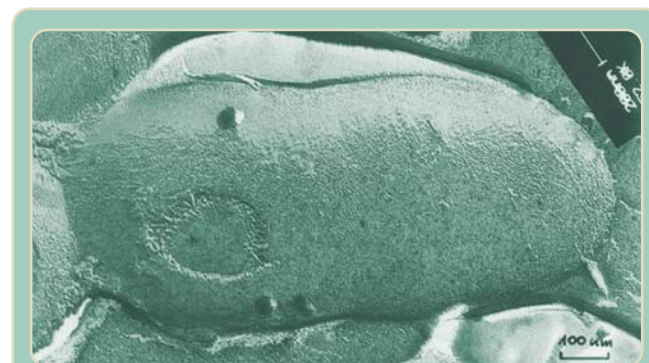


Fig. 2: BBSH 797, originally isolated from bovine rumen contents by the research team Binder, Binder, Schatzmayr and Heidler in July 1997. Electron micrograph.

Tab. 1: Piglet trial results with diets containing 0.5 and 1.5 ppm DON. Control group: contaminated feed, no BBSH 79 7. Trial group: contaminated feed with BBSH 797.

| | CONTROL GROUP | TRIAL GROUP | CONTROL GROUP | TRIAL GROUP |
|-------------------------------|---------------|-------------|---------------|-------------|
| DON [ppm] | 0.5 | 0.5 | 1.5 | 1.5 |
| starting body mass [kg] | 7.9 | 7.6 | 10.4 | 11.0 |
| body mass at day 73 [kg] | 27.3 | 28.1 | 25.3 | 27.2 |
| feed conversion rate | 1.94 | 1.89 | 2.09 | 1.83 |
| daily feed intake [g] | 730 | 750 | 689 | 660 |
| average daily weight gain [g] | 376 | 407 | 330 | 360 |

As “binders” do not work effectively enough against OTA a project was realized by Biomin with the aim of finding microorganisms with the capability to deactivate this mycotoxin in the intestinal tract of animals.

Although many authors have reported that protozoa are mainly responsible for the detoxification of OTA in rumen fluid Schatzmayr *et al.* [7] clearly demonstrated that bacteria play an important role in degrading ochratoxin A. Two bacterial species (related to *Clostridium sporogenes* and *Lactobacillus vitulinus*) able to cleave OTA into non-toxic metabolites could be isolated out of rumen fluid (figure 3). The same research group screened for OTA-detoxifying microorganisms in different segments of pig-intestine. Four bacterial strains were finally obtained (related to *Streptococcus pleomorphus*, *Eubacterium callanderi*, *E. ramulus*) that compared to the investigated ruminal bacteria showed a more rapid deactivation of the toxin. Furthermore several aerobic OTA-transforming bacteria were enriched and isolated out of soil samples. The most active ones belonged to the genera *Sphingomonas*, *Stenotrophomonas*, *Rhodococcus*, *Ralstonia* and *Ochrobactrum*.

Besides bacterial strains, Schatzmayr *et al.* [8] investigated yeasts of the genera *Trichosporon*, *Rhodotorula* and *Cryptococcus* for their ochratoxin A detoxifying activity. However, all these strains mentioned above were scientifically investigated for their potential use as feed additive. At the end of a very comprehensive selection process a new yeast species came out on top

(*Trichosporon sp. nov.*, figure 4).

A feeding trial conducted at the University of Maribor with broilers already revealed that the negative influence of OTA on performance data could be neutralized by addition of

stabilized *Trichosporon* cells. The final weight of the group receiving

1ppm OTA and yeast was on average 61 g higher than that of the positive control (1ppm OTA without additive) and even better than the negative control (figure 5).

Incubation experiments with *Trichosporon sp. nov.* showed that zearalenone could also be successfully degraded. Subsequent cell culture tests carried out at the University of Utrecht confirmed the loss of estrogenic effects due to the yeast strain.

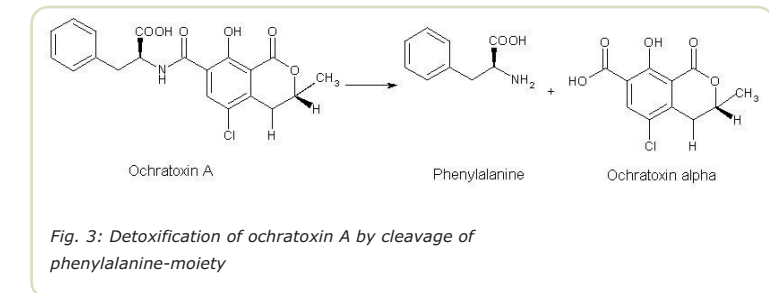


Fig. 3: Detoxification of ochratoxin A by cleavage of phenylalanine-moiety

Combination of adsorption and biological detoxification - the only way to success

Biological methods described above may become the technology of choice in the field of mycotoxin-deactivation, as enzymatic reactions offer a specific, irreversible, efficient and environmentally friendly way of detoxification that neither leaves toxic residues nor undesired by-products. Research teams working in this field are convinced that combination of selected adsorbing agents and bio-transformation methods will ensure an effective treatment against mycotoxins in contaminated animal feed.

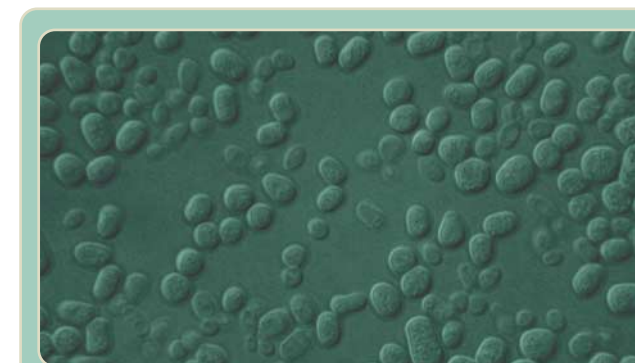


Fig. 4: Microscopic picture of ochratoxin A-detoxifying yeast strain *Trichosporon sp. nov.*

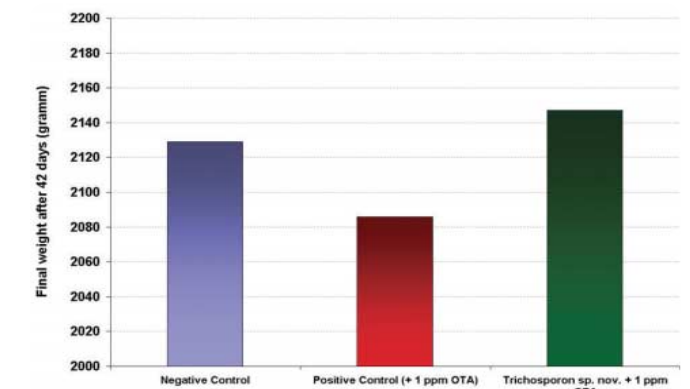


Fig. 5: Final weight of broiler chicken in a trial evaluating *Trichosporon sp. nov.* for in vivo detoxification of OTA