

Science & Solutions

The Right Approach?

Tackling the Fumonisin Challenge
in Pig Production

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Breakout
Session
SWINE

Global industry trends

Highlights from the
World Nutrition Forum 2014



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What's Wrong with My Pigs?

Part 1: Immune Depression

Editorial

Managing the big pig menaces

Among all domestic animals produced for human food consumption, the pig is the most susceptible to lethal fumonisin poisoning. Only as recently as 1981 did we learn that porcine pulmonary edema (PPE) is caused by pigs' consumption of corn contaminated with *Fusarium verticillioides*.

Since then, extensive studies have revealed how fumonisins exert an immunosuppressive effect in pigs and play a role in predisposing the animal to various diseases. Even at low contamination levels, prolonged exposure to fumonisins decreases the proliferation of undifferentiated porcine intestinal epithelial cells, compromising the integrity of enterocytes and resulting in the easy translocation of pathogens into the circulatory system of the pig.

In this edition of **Science & Solutions**, we address how fumonisins pose a major threat to swine health and performance, and explore new ways to counter the detrimental effects of fumonisins in pig production.

Another compelling issue affecting the industry is the increasing costs of feed ingredients and grains. Feed costs have historically represented 65-75% of the variable costs of swine production, and are even higher now for many producers, especially in countries that rely heavily on imported raw materials. As a result, feed costs play a major role in determining the profitability of a swine enterprise. Swine nutritionists worldwide struggle daily to formulate nutritionally-balanced diets at minimal cost while maximizing cost effectiveness. Read on to discover how BIOMIN is dedicated to helping producers fully optimize the nutritional value of feed ingredients to achieve ever-greater performance and profitability.



Justin TAN

Sales & Marketing Director



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The Right Approach?

Tackling the Fumonisin Challenge in

by **Shu Guan**, Technical Manager



Photo: alphaspirit

Pig Production

Fumonisin—a group of toxic and carcinogenic fungal metabolites commonly found in corn (maize) and its by-products—pose a significant threat to swine production. Recent scientific developments regarding detection and treatment are set to revolutionize mycotoxin risk management.

In real farm scenarios, animals are often confronted with other interacting factors and challenges which increase their susceptibility to mycotoxins. Furthermore, the presence of multiple different mycotoxins poses further harm to animals.



A worldwide phenomenon

Pig diets rely heavily on corn (maize) and its by-products such as dried distillers grains with solubles (DDGS) and corn gluten—all a major source of fumonisin contamination in feedstocks. The latest BIOMIN Mycotoxin Survey results, based on thousands of commodity feedstock samples taken worldwide, show fumonisin contamination occurring in many at levels that pose real health threats to swine, especially piglets and sows (*Figure 1*).

Clinical effects on pig production

Fumonisin are known to inhibit the biosynthesis of sphingolipids, induce hepatotoxicity, possess renal toxicity and elevate serum cholesterol concentrations in most animal species (Colvin *et al.*, 1993). In swine, fumonisin contamination is associated with Porcine

Pulmonary Edema (PPE) (Haschek *et al.*, 2001). Heavy, wet lungs with widened interlobular septa as well as fluid in the airways and the thoracic cavity are often identified in this case (Harrison *et al.*, 1990). An increasing number of cases of PPE which relate to fumonisin contamination at 2-3 parts per million (ppm) in corn have recently been reported in south-eastern and southern provinces in China.

Subclinical effects on pig production

Fumonisin contamination in swine is difficult to detect mainly because it tends to occur at subclinical levels—necessitating measurement of the sphinganine/sphingosine (Sa/So) ratio, a scientifically-recognized biomarker for identifying fumonisin exposure in pigs (*see Science & Solutions Issue 12*).

Though often overlooked, long-term ingestion

Figure 1. Global fumonisin occurrence above the risk threshold (>750 ppb).

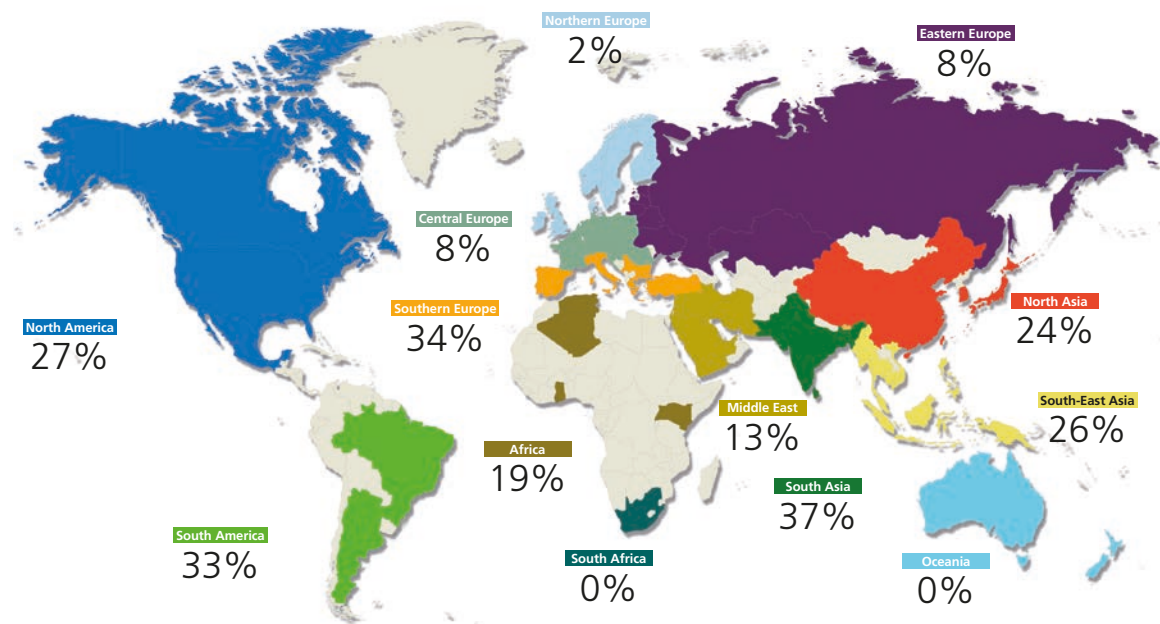




Photo: idal

of fumonisins can cause chronic effects and immune suppression (Casteel *et al.*, 1993), representing real economic loss for farmers due to increased disease rates and reduced animal performance. Low doses of fumonisin B₁ at 0.5 mg/kg body weight/day can reportedly increase susceptibility of pigs to pathogenic *E. coli* strains, *Pseudomonas aeruginosa* and *Pasteurella multocida* (Halloy *et al.*, 2005). Fumonisin is also known to increase the susceptibility of pigs to Porcine Reproductive and Respiratory Syndrome (PRRS), decrease antibody titres against Aujeszky's disease, decrease phagocytosis of *Salmonella typhimurium* in alveolar macrophages and impair production of antibodies against *Mycoplasma agalactiae* (Marin *et al.*, 2006; Moreno *et al.*, 2010; Posa *et al.*, 2011; Stoev *et al.*, 2012).

Setting the bar

To combat mycotoxin contamination, legislative caps on the allowable amount of mycotoxins in animal feedstuffs have been introduced (Table 1), although regulations are still pending in many countries. Yet, these guideline and regulatory levels are very much based on policy considerations instead of animals' tolerance to mycotoxins and their harmful effects.

Table 1. Regulatory guidelines regarding fumonisins (ppb)

	EU	US
Corn (maize) and corn products	60000	20000 ¹
Feedstuffs for swine	5000	-

¹For <50% in diet per US FDA

Sources: EFSA, US FDA.

In real farm scenarios, animals are often confronted with other interacting factors and challenges which increase their susceptibility to mycotoxins. Furthermore, the presence of multiple different mycotoxins poses further harm to animals. For these reasons, it is common to see animals in the field negatively affected by mycotoxins at levels below legislative thresholds. Drawing upon several

decades of worldwide practical experience in the field and scientific trials conducted to mimic field situations, BIOMIN developed a set of risk levels of fumonisins in swine as a practical tool for the industry (Table 2).

Table 2. Risk levels of fumonisins in complete ration for swine in practical conditions

Fumonisin (ppb or µg/kg feed)	Low	Medium	High
Pig (sow, piglet)	<750	750-1000	>1000
Pig (finisher)	<1000	1000-1500	>1500

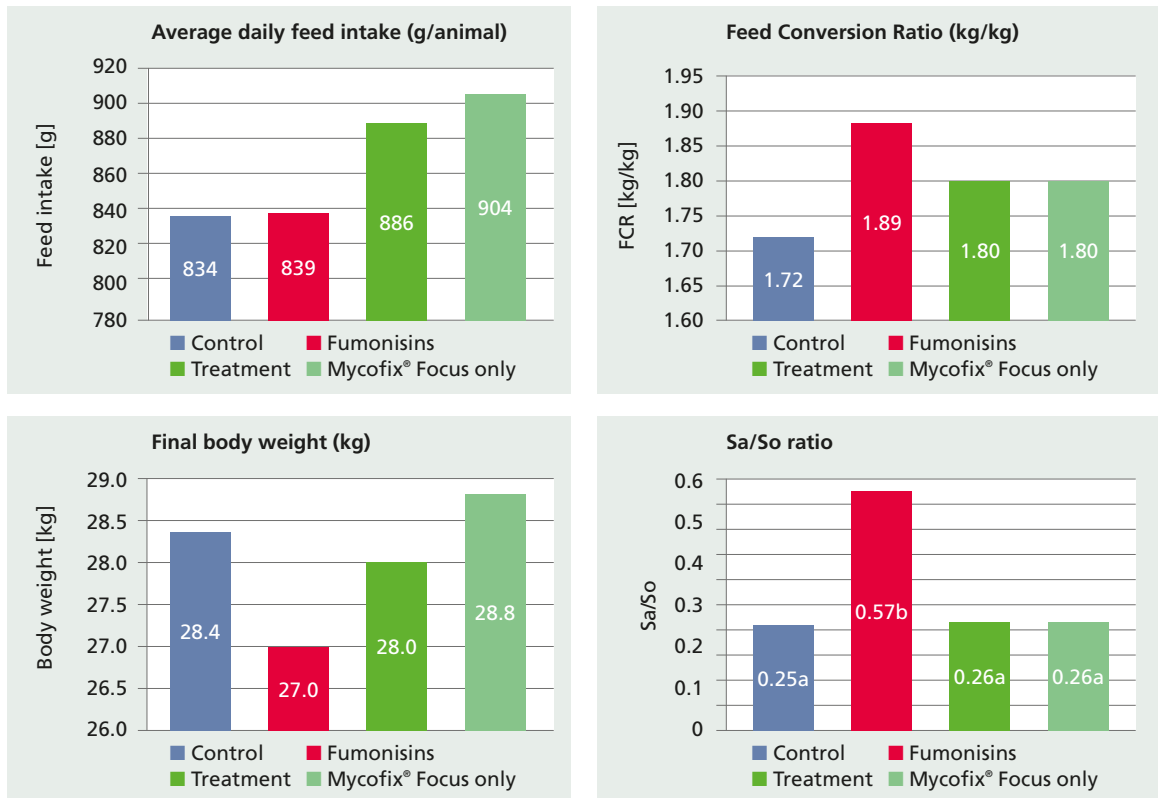
Source: BIOMIN Fumonisin Compendium, 2013

In a bind

Binders are compounds that adhere to toxins thus reducing the amount of toxins that can enter an animal's bloodstream—a neutralization process known as adsorption. For over a decade, mycotoxin binders have been commonly employed to prevent mycotoxicosis. While binders work in some instances (aflatoxins, one class of mycotoxins, can be adsorbed quite efficiently), they are less effective or ineffective against certain types of mycotoxins such as zearalenones or trichothecenes. In the case of fumonisins, no adsorbent materials have been identified thus far that are proven to bind fumonisins effectively (Solfrizzo *et al.*, 2001; Piva *et al.*, 2005; Avantaggiato *et al.*, 2005; BIOMIN Guide to Mycotoxins, 2012).

Binders incur two significant drawbacks. First, adsorption is reversible, meaning that bound fumonisins can be cleaved (released) and thus pose an active threat to animal health. Second, binders are highly pH-dependent. While binders can be shown to be effective in a static laboratory setting (indeed, some have high adsorption rates of fumonisins in buffer solutions with stable pH levels), they have shown considerably less effectiveness in conditions that mimic an animal's gastrointestinal tract. In these more realistic simulations, toxin adsorption effectiveness fell by more than 50%—largely due to the fact that most binders have shown an extremely low

Figure 2. Effects of FUMzyme® on growth performance and Sa/So ratio in pigs after 42 days



Source: BIOMIN Trial Report, 2013

binding capacity of fumonisins at pH values of 6 and 7. As a consequence, most fumonisin that is bound in the stomach would be released in the intestinal juice, posing a risk to animals.

A new, powerful tool

Until quite recently, binders were essentially the only way to combat fumonisins. Now, a new method has emerged: enzymatic biotransformation. Through 10 years of scientific investigation, BIOMIN developed FUMzyme® -- the first purified enzyme that transforms fumonisins into non-toxic metabolites and the only product of its kind authorized by the EU. FUMzyme® converts fumonisins into non-toxic hydrolyzed FB₁ (HFB₁). Scientific research indicates that HFB₁ does not cause intestinal or hepatic toxicity in the pig model and does not induce major changes in the sphingolipid metabolism (Voss *et al.*, 2009).

Biotransformation via enzymes has four clear advantages over traditional binders. First, biotransformation is irreversible, so it does not succumb to binders' primary drawback. Second, enzymes used for biotransformation are not hampered by the GI tract. Third, FUMzyme® is a specific solution designed to counteract fumonisins.

Fourth, FUMzyme® has proven effectiveness. *In vivo* pig trials in Austria, Brazil and France have demonstrated the beneficial effects of Mycofix® Focus (containing FUMzyme® and bentonite) in counteracting fumonisins. In a recent trial conducted in Korea, the application of Mycofix® Focus alleviated 5 ppm of fumonisin effect on feed intake, body weight gain and FCR within 42 days (Figure 2). A biomarker for fumonisin exposure, sphinganine/sphingosine or Sa/So ratio, reached elevated levels in the fumonisins group (P<0.05) on day 42. Treatment reduced Sa/So ratio to the control level, which demonstrates the efficacy in controlling fumonisin toxicity *in vivo*.

Conclusion

Fumonisin is highly prevalent across the world, particularly posing a threat in Asia, South America and Southern Europe of late. While binders have proven effective in combating some types of mycotoxins—particularly aflatoxins—they are considerably less effective against fumonisins and others. Thanks to recent scientific developments, enzymatic biotransformation offers a unique, specific and irreversible way to counteract fumonisins.



Swine Highlights from the World Nutrition Forum 2014

The 2014 Swine Breakout Session brought together leaders in swine research and production to discuss the current state of the industry in several countries across the globe, highlighting commonalities and differences along the way. In addition, the session explored the topic of 'sustain:ability' and how gut health and integrity play a major role in promoting growth and achieving efficient performance.

October saw more than 800 delegates from 86 countries visit Munich for the 2014 World Nutrition Forum hosted by BIOMIN. The theme for the forum was 'sustain:ability' which reflects tomorrow's challenge of feeding a larger global population (9 billion people by 2050) in the face of resource constraints. BIOMIN has long been concerned with improving sustainability with its 3-pillar approach—Performance, Profit and Planet.

The first part of the session explored the extent to which swine producers in different geographies face similar challenges.

Chaired by **Franz Waxenecker**, director Development Department at BIOMIN, the swine breakout session explored recent research findings and views from academic and industry experts. The first part of the

session covered the extent to which swine producers in different geographies face similar challenges.

Hans Aarestrup, CEO of Danske Svineproducenter (Association of Danish Pig Producers), spoke about Central Europe—the 'powerhouse of pig production'—one of the densest swine producing regions worldwide with over 5 million sows and 125 million slaughter pigs within a 700 km radius in a given cycle.

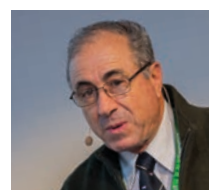
He contrasted people's voting behavior with people's shopping behavior; the former often emphasizes animal welfare, use of antibiotics and environmental issues while in the latter price considerations dominate. He discussed pressures to compete in the global economy while facing extra costs stemming from regulation, biosecurity, etc. In addition, he emphasized the value of knowledge



Franz Waxenecker



Hans Aarestrup



Alberto Stephano

Improving animal performance has beneficial impacts on both profit and sustainable use of resources.



Dr. Pieter J. Grimbeek



Prof. Yulong Yin



Barbara Rüel



Merlin D. Lindemann



Frans Dirven



Prof. Cheol-Heui Yun



Prof. Duong Duy Dong

sharing among pig producing geographies in order to promote the industry.

Also touching on vigorous global competition and import/export patterns, **Alberto Stephano** of Stephano Consultores SC highlighted key trends in Latino American swine production. While there is lots of variation among Latin and South American countries regarding swine production, some common themes emerge. Comparing production costs across the Western hemisphere, he showed higher feed costs in South America vs. the US and Canada. The region has seen high production growth as of late and very high farrowing rates. Yet, domestic consumption remains rather low. According to Dr. Stephano, some South American countries will step up production in order to meet growing demand in regions such as Asia. In doing so, they will face the challenge of producing more with less (e.g. water, land, disease).

Dr. **Pieter J. Grimbeek**, a private veterinary consultant, spoke about similar world challenges in an isolated industry for pig production in South Africa. He outlined a move—also seen elsewhere—towards larger farms with professional managers. In his words, ‘farmers today are risk managers.’ South Africa faces animal welfare issues similar to Denmark and other countries. According to Dr. Grimbeek, although domestic consumption is extremely low, producers adapt well to fulfilling consumer expectations. Growing domestic consumption buoyed by an emerging middle class and the export market may hold promise for the future.

Prof. **Yulong Yin**, professor of animal nutrition and feed sciences at the Institute of Sub-Tropical Agriculture at the Chinese


Academy of Sciences, revealed three main pig production models in China, underscoring the wide differences in size between small backyard farms and large international enterprises. He also outlined trends in the Chinese swine sector.

Barbara Rüel, Director Nutritional Products at BIOMIN spoke about efficient resource management through dietary solutions in swine and how, from a nutritionist’s perspective, digestibility is very important. The key to efficient resource management is to support gut health.

Looking to the decades ahead, **Merlin D. Lindemann**, professor at the University of Kentucky, USA, discussed ways to achieve sustainable swine production through an improved understanding of feedstuffs and the animal.

Frans Dirven, founder and co-owner Lintjeshof, addressed the Dutch experience around sustainable use of antibiotics in swine production, detailing a significant reduction in antibiotics’ use over 5 years. Related to this, he looked at the players and considerations involved in bio-efficient food production, emphasizing the importance of animal health.

On a related note, **Cheol-Heui Yun**, professor of Seoul National University in South Korea spoke to the immunological and nutritional aspects of inflammatory response in pigs, focusing on stress conditions in animal farming. He underscored the links between nutrition, immune response and animal productivity—along with the potential use of biomarkers in monitoring animal health.

To round out the breakout session, **Duong Duy Dong**, professor at Nong Lam University in Vietnam explored how phyto-genics can serve as alternatives to antibiotic growth promoter in swine diets, along with other uses such as to enhance nutrient digestibility. Furthermore, he raised a number of considerations related to the choice of phyto-genics in animal feed. 

What's Wrong With My Pigs? Part 1: Immune Depression



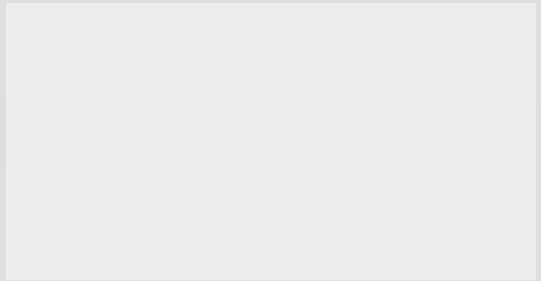
A handy checklist for diagnosing swine ailments that you can cut out and keep with you for reference.

A number of biological agents are able to compromise immune integrity of animals, from mycotoxins to infections to drugs. A single instance or concomitant administration and poisoning of the above mentioned caused by these elements can undermine through suppression or disrupt regular development of body defenses and are resulting in lower performances, increased disease outbreaks and vaccine failures. Most often the syndromes stem from so-called "conditioned diseases" such as *E. coli*, *Streptococcus*, *Salmonella*, *Pasteurella*, *Influenza*, etc.. It is well known nowadays that diseases come from multifactorial causes; immune depression can let loose many latent infections, presenting a challenge for practitioners regarding etiology and therapy.

	Potential cause	Check list	Corrective action
MYCOTOXINS	<ul style="list-style-type: none"> • AFB₁, DON, DAS, T-2, OTA, FUM 	<ul style="list-style-type: none"> <input type="checkbox"/> Positive raw materials (ELISA) or feed (HPLC) <input type="checkbox"/> Origin of raw materials historically contaminated <input type="checkbox"/> Symptoms pertaining to mix of infections, vaccine failure <input type="checkbox"/> Decline of herd/phase performances 	<ul style="list-style-type: none"> <input type="checkbox"/> Check raw materials and feed <input type="checkbox"/> Hygiene of feed and water lines <input type="checkbox"/> Use Mycofix® at suitable inclusion rate
PATHOGENS	<p>Virus:</p> <ul style="list-style-type: none"> • <i>Circovirus</i>, <i>Herpes virus (Aujeszky's)</i>, <i>Asfivirus (ASF)</i>, <i>Orthomyxovirus (Flu)</i>, and <i>Arterivirus (PRRS)</i> <p>Bacteria:</p> <ul style="list-style-type: none"> • <i>Mycoplasma</i>, <i>Pasteurella</i>, <i>APP</i>, <i>Salmonella</i> 	<ul style="list-style-type: none"> <input type="checkbox"/> Epidemiology, symptomatology <input type="checkbox"/> Necropsy <input type="checkbox"/> Immune-histochemistry, PCR, ELISA 	<ul style="list-style-type: none"> <input type="checkbox"/> Biosecurity <input type="checkbox"/> Vaccination <input type="checkbox"/> Antibiotics
ANTIBIOTICS	<ul style="list-style-type: none"> • Tetracyclines, penicillins, sulphametazine, streptomycin, chloramphenicol (forbidden in EU) 	<ul style="list-style-type: none"> <input type="checkbox"/> Overdosing <input type="checkbox"/> Prolonged treatment <input type="checkbox"/> Unwise adoption 	<ul style="list-style-type: none"> <input type="checkbox"/> Proper management and nutrition (acidifiers, phytogenics) <input type="checkbox"/> Alternative antibiotics

For more information, visit www.mycotoxins.info

DISCLAIMER: This table contains general advice on swine-related matters which most commonly affect swine and may be related to the presence of mycotoxins in feed. Swine diseases and problems include, but are not confined to the ones present in the table. BIOMIN accepts no responsibility or liability whatsoever arising from or in any way connected with the use of this table or its content. Before acting on the basis of the contents of this table, advice should be obtained directly from your veterinarian.



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