Issue 28 • Swine
A magazine of Biomin®

Science & Solutions

Profitable piglets

Space in feed formulation

Photo: Aumsama

Post-Weaning Dip:
Guarding Against Toxins

Photo: fotostorm

What's Wrong with My Pigs?

Part 4: Ear Necrosis

Editorial

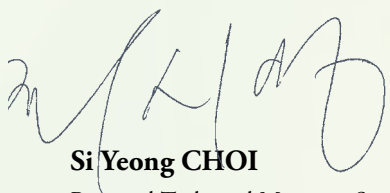
The Take on Productivity

Genetic companies have conducted research to improve productivity for several decades to produce genetically superior lines that possess higher genetic potential. Around 10 live born piglets per litter in the 1980s has risen to 13-14 live born per litter today. However, it is still difficult to achieve this full genetic potential in the face of low quality grain, diseases challenges, changes in environmental conditions, etc.

In this issue of **Science&Solutions** we look at how to make room for a number of feed additives in swine diets in pursuit of several health and performance goals.

The immediate post-weaning period makes piglets particularly vulnerable to both mycotoxins and infections. Low DON-contaminated feed crept into a trial designed to demonstrate the effectiveness of Mycofix® in combatting the harm cause by endotoxins produced by bacterial pathogens such as *E. coli*, revealing that even low level mycotoxin contamination can have significant negative impacts on piglet's intestinal immune system and villi. A mycotoxin deactivating feed additive goes a long way to protecting animals from the harms posed by endotoxins and mycotoxins.

Many experts have described the different ways to improve the performance of animals in a variety of conditions. I hope that this edition of **Science&Solutions** provides you a scientific, practical view that cuts through the deluge of information. It goes along with our continuing emphasis on natural, sustainable ways to help producers improve livestock productivity.



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Science & Solutions is a monthly publication of BIOMIN Holding GmbH, distributed free-of-charge to our customers and partners. Each issue of **Science & Solutions** presents topics on the most current scientific insights in animal nutrition and health with a focus on one species (aquaculture, poultry, swine or ruminant) per issue.
ISSN: 2309-5954

For a digital copy and details, visit: http://magazine.biomin.net
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Printed in Austria by: Johann Sandler GesmbH & Co KG
Printed on eco-friendly paper: Austrian Ecolabel (Österreichisches Umweltzeichen)

Illustration: micha360

Making room for feed additives in piglet diets

Organic acid use in piglet diets can be considered routine nowadays. Yet, high levels of organic acids in feed formulation take up a lot of otherwise useful space in the feed. Replacing a portion of organic acids with a more powerful additive can create room to further enhance feed formulation or add more economical raw materials at no additional cost.

By **Attila Kovács**, Global Product Line Manager – Acidifiers

Swine producers apply organic acids to feed mainly to combat microbial and fungal contamination that causes the deterioration of feed and to decrease the pH in animals' stomachs. Constant treatment with organic acids has the added benefit of preventing recontamination of feed, whereas methods such as heat treatment do not.

A number of factors support the rationale for dietary acidification for juvenile animals, especially weaning pigs. At weaning, piglets often register limited digestive and absorption capacity, typically due to insufficient hydrochloric acid and pancreatic enzymes secretion. Add on top of this, stress associated with the weaning process, sudden feed consistency and environmental changes – all of which can have a negative effect on the digestion, feed absorption and intestinal microflora of the piglets.

E. coli inhibition and beneficial bacteria promotion

Various studies show that acidification of piglet diets at reported pH levels ranging from 4.36 to 5.79 can reduce the coliform and *E. coli* counts along the

Photo: luismmolina

Organic acids positively influence the growth of *Lactobacilli* in the gastrointestinal tract, which may competitively inhibit the proliferation of *E. coli*

Table 1. Change in the bacterial flora of the intestinal tract using Biotonic® Top3.

Log cfu/g	Control	Positive control	Biotronic® Top3
Ileum			
E. coli	6.302[a]	5.970[b]	5.873[b]
Coliforms	8.277[a]	7.977[b]	8.151[b]
Salmonella typhimurium	8.220[a]	7.941[b]	8.053[ab]
Lactobacillus	6.295[a]	6.172[a]	6.515[b]
Bifidobacteria	6.891[a]	6.878[a]	7.130[b]

[a,b] Means with different superscripts differ significantly; P<0.05
Positive control: Colistin 100g/t + CTC 100g/t

Source: BIOMIN

intestinal tract, decreasing scouring and mortality of piglets (*Table 1*). Organic acids positively influence the growth of *Lactobacilli* in the gastrointestinal tract, which may competitively inhibit the proliferation of *E. coli* and produces lactic acid and other metabolites which lower the pH or have an antimicrobial effect and inhibit *E. coli* even more.

Inclusion levels

To decrease the buffer capacity and feed pH levels, organic acids are typically used in the feed manufacturing process. These typically include formic acid, benzoic acid, lactic acid and acetic acid. Dietary acidification by a mixture of organic acids decreases the pH value of swine diets by 0.15 to 0.98 pH units, depending on the inclusion levels (varying from 0.5% to 3.0%) and diet composition. The inclusion level of the organic acids varies considerably in every feed manufacturing plant, depending also on the type of organic acids, the carrier and if the acids are added alone or blended.

Replacement of single acids in the diet

The feed formulation is a delicate process that must balance the nutrient requirements of animals at each production stage, the nutritional value of various feed raw materials, premixes, vitamins and minerals along with price and availability considerations. Space can be an issue, because trying to include all ingredients at an optimum level is not easy. Piglet diets that also contain organic acids pose an additional challenge.

One approach is to replace part of the single acids with a more powerful feed additive, thereby making space in the feed formulation in a cost effective way. Biotronic® Top line combines the unique Biomin® Permeabilizing Complex, a phytochemical, a selected blend of organic acids and their salts, fully utilizing a unique synergism in their mode of action. The Biomin® Permeabilizing Complex boosts the activity of the active ingredients and facilitates their entry in the cytoplasm by permeabilizing the outer membrane of Gram-negative bacteria. Replacing 2 to 3 kg of a single acid with 1 kg of Biotronic® Top3 boosts the antimicrobial effect of the acid blend, reducing the bacterial load and improving animal growth performance. When looking to create space in feed formulation, it is generally recommended to use this 2:1 ratio to replace a single acid with Biotronic® Top line products.

Maximizing space in the practice

Several field and scientific trials have been conducted to replace benzoic acid and formic acid in different commercial formulations in piglet diets. In one recent case, a producer in Germany wanted to reduce the space taken up by the acids in the formulation by entirely replacing 6 kg per ton of a product based on formic acid salt (ACID) with Biotronic® Top3, provided that it could be done with no additional cost. For that trial, we doubled the recommended replacement ratio to 4:1, substituting the acid in question by Biotronic® Top3. The feed formulation also contained other acids that were not changed in either the initial or replacement diets (*Table 2*).

The acid component of the replacement diet using Biotronic® Top3 cost 19% less than the initial diet using the product based on formic acid salt (ACID); a savings of € 3.60/ ton. After evaluating the growth performance in a field trial using 380 weaning piglets (*Figure 1*) it was clear that the replacement of the 0.60% of ACID with

Attila Kovács
Global Product Line Manager – Acidifiers

Photo: harneshkp

Organic acids are essential in the piglet feed, especially in the weaning period, but at the same time they can be a limiting factor for the feed formulation.

Table 2. Acid content and price in the weaner pig's diets.

Component	Inclusion (%)	Inclusion (%)
Biotronic® Top3	0	0.15
ACID	0.60	0
Calcium Formiate	0.43	0.43
Fumaric acid	0.12	0.12
Citric acid	0.12	0.12
Price of acids € per ton of feed*	€ 19.20	€ 15.60

*prices originate from the German market

Source: BIOMIN

0.15% of Biotronic® Top3 caused no change in growth performance, though it did generate an extra profit of € 0.5 per piglet. The Biotronic® group had higher feed intake and lower FCR (*Figures 2* and *3*).

Room for more performance

The extra space that is spared in the feed formulation can be used to include other feed additives that can further enhance growth performance or support animal health. A mycotoxin deactivator or phytogenic feed additive figure among the most common ones paired with organic acids. Having extra space also allows for greater flexibility regarding the inclusion level of the raw materials to optimize the energy or vitamin/mineral levels, or costs.

Conclusion

Organic acids are essential in the piglet feed, especially in the weaning period, but at the same time they can be a limiting factor for the feed formulation. Biotronic® Top line products can replace part of the organic acids in the formulation with additional economical benefits for the farmer. The modulation of the bacterial load in the intestinal tract together with a more efficient usage of the feed by the animal will not only cover the costs of the product, but bring also an added benefit.

Figure 1. Body weight (kg) of the animals.

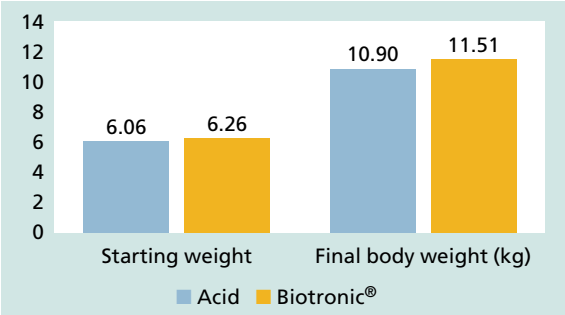

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Figure 2. Average daily feed intake (g) in the trial groups after 24 days of trial.

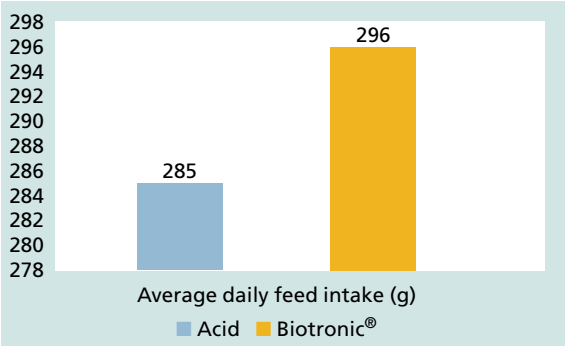

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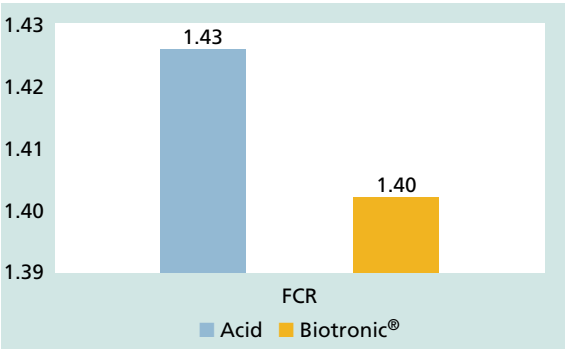
Figure 3. FCR in the trial groups after 24 days of trial.



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Toxins Attack during Post-Weaning Dip

Many articles are written about the stressful period piglets experience right after weaning, though too often on-farm discussions focus on issues such as diarrhea or oedema that occur anywhere from 1 week to 1 month post-weaning. Antibiotics and/or high levels of zinc oxide are often applied in these cases. However, public concern and stricter rules regarding the former have propelled efforts to curtail antibiotic use in farm animals worldwide.

By **Andre Van Lankveld** and **Diego Padoan**, Technical Sales Managers

It is well known that the immediate consequence of weaning is a drastic reduction in feed intake and a loss of body weight in the first few days. Some piglets will not even eat during the first 48 hours. This lack of nutrient intake has a dramatic impact on the anatomy, functions and microorganisms of the gastrointestinal tract, impairing efficient digestive processes and barrier functions. Many researchers have shown that this reduced nutrient intake leads to villi atrophy (decrease of villus height up to 30%), negative effects on tight junctions and lower barrier function of the gastrointestinal tract (GIT).

Overload

After this reduced feed intake, piglets start to eat and will often try to compensate these nutrient deficiencies, and end up overeating. Excess feed intake at a time of lower digestibility means that protein will be less digested, providing a good source of nutrients for pathogens such as *E. coli*.

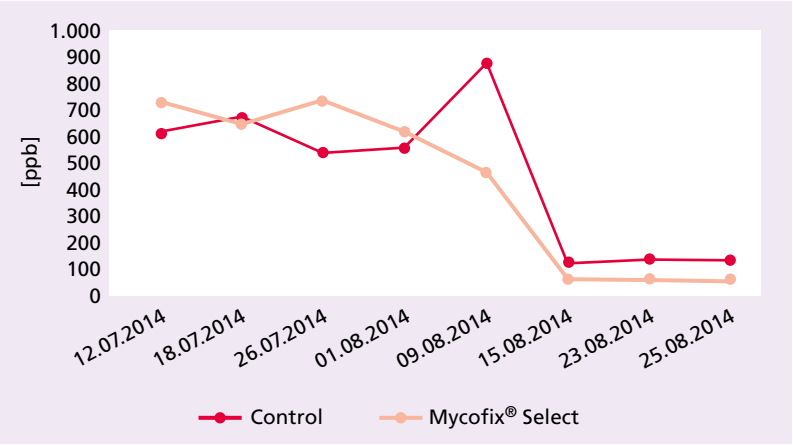
During this period, pathogens are also better able to adhere to the intestine wall where they can multiply and produce endotoxins.

Harmful substances

Endotoxins, or lipopolysaccharides (LPS), are parts of the cell wall of Gram-negative bacteria (e. g. *E. coli*, *Salmonella*), that are released by bacteria after death or during proliferation. GIT barrier impairment through decreased nutrient intake or overconsumption, for example, can lead to an increased passage of endotoxins, which in turn result in local or systemic damage or inflammatory reactions.

Endotoxins themselves are able to damage tight junctions among epithelial layer cells, enhancing the already compromised TEER (Trans Epithelial electric Resistance) by the presence of mycotoxins, or the reverse. TEER is a measure of gut wall permeability, giving account of the level of leaking situation that brings a dramatic increase of pathological consequences by the adsorption and flow to the blood of endogenous and exogenous toxins such as bacteria. Endotoxins are synergetic with tricothecenes in the leaking effect. Not to be underestimated, the effect of endotoxins on feed intake can reach a 26% decrease—a considerable amount.

Figure 1. Mycotoxin contamination in feed (ppb).



Source: BIOMIN

Nutritional strategies to reduce the stress around weaning and to help to overcome the weaning dip are often advised in the direction of increasing nutrient intake and implementing highly digestible ingredients. In recent research increasingly demonstrates that even small amounts of the mycotoxin deoxynivalenol (DON) affects the intestinal immune system and harms intestinal villi. A healthy gastrointestinal tract is crucial for an efficient uptake of nutrients, immune system function, and the indigenous microflora.

Accept the reality

In a recent experiment with DanAVL genetics, the main goal of the trial was to see the effect of Mycofix® on the technical performance, diarrhea score and ear necrosis in a non-contaminated feed. This setup should prove the efficiency of Mycofix® on the reduction of negative effects of endotoxins in this period. After analyzing of the different badges of the trial feed there was shown a medium-low contamination level of DON in the weaner diet (between 600-800 ppb, *Figure 1*). The feed producer was unaware of this low contamination in the ingredients.

During this period, pathogens are also better able to adhere to the intestine wall where they can multiply and produce endotoxins.

Figure 2. Body weight (kg/animal).

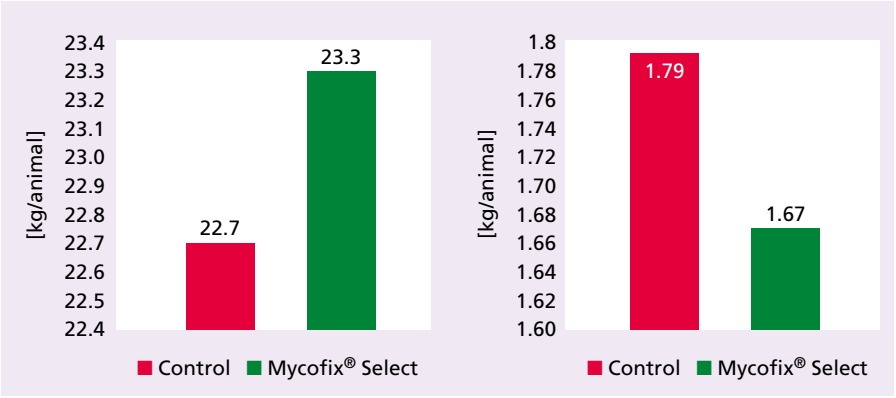
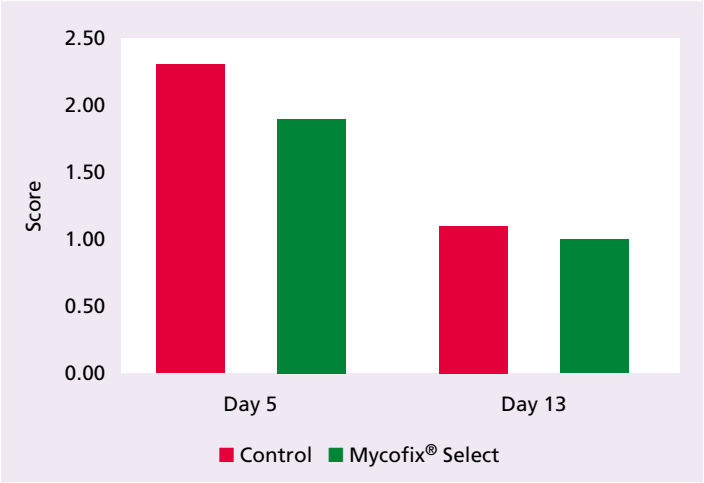


Figure 3. FCR (kg/kg).

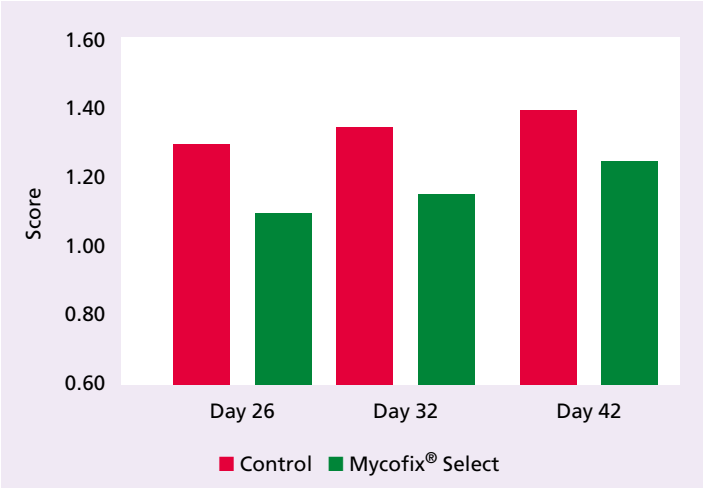
Source: BIOMIN

Figure 4. Diarrhea score (1 = no diarrhea to 5 = severe diarrhea).



Source: BIOMIN

Figure 5. Score top ear necrosis (1 = no necrosis to 5 = severe necrosis).



Source: BIOMIN

The trial was conducted with 720 piglets. Those in the Mycofix®-supplemented treatment group gained 0.6 kg more (*Figure 2*) and had an improved feed conversion rate 0.12 (*Figure 3*).

Further improvement

In addition to performance, some animal health-related parameters that may occur in connection with enhanced mycotoxins in the feed or increased levels of endotoxins in the GIT were evaluated as well. Mycofix® showed a lower incidence of diarrhea in the first 14 days after weaning (*Figure 4*), and of top ear necrosis (*Figure 5*).

This trial offers a perfect example how problems in the field could be diagnosed. In discussion about disappointing results of performance of piglets, often the quality of the ingredients assumed to be correct. It can be difficult to accept that even low level mycotoxin contamination can have huge influences on performance and health status. Another point of view in this context could be that the effect of adding Mycofix® has influence on the reduction of the negative effect of endotoxins.

Besides formulating pre-starter / weaning diets on increased nutrient intake, more highly digestible ingredients and digestion-enhancing additives, it is also recommended to use Mycofix® in a standard solution to counteract low level mycotoxin contamination and the negative effects of endotoxins on piglets' heath and performance.

Cut & Keep Checklist

What's Wrong with My Pigs? Part 4: Ear necrosis

Porcine ear necrosis syndrome (PENS) in pigs has been reported as an increasing health problem in many countries with intensive pig farming. PENS exhibits as tissue damage to the tips of ears. Researchers have found it occasionally in pigs at three weeks, but it is most common in pigs 5 to 16 weeks of age.

Sometimes only a few pigs are affected and the lesions are barely noticeable, but there are outbreaks where all the pigs are affected and many with extensive lesions.

The disease does not result in mortality, but can make it difficult for a farmer to sell feeder pigs. The cause of this disease is complex and the presumed triggering factors can be divided into infectious and non-infectious agents.

Weissenbacher-Lang (2012) has published a research in which they looked for the causative factors of porcine ear necrosis syndrome (PENS) in 72 pigs, 5.5-10 weeks. Streptococci and staphylococci were isolated from most of the pinnae.

Porcine circovirus 2 (PCV2) could not be detected and porcine reproductive and respiratory syndrome (PRRS) in only 10% of the piglets. As main mycotoxins deoxynivalenol and ergot alkaloids were detected in the feed.

A positive correlation was found between deoxynivalenol and focal epidermal necrosis and bacterial growth in the superficial cell debris. Ergotamine is positively associated with vasculitis and acute phase of PENS. The findings suggest that PENS is multifactorial in origin and that although infectious agents can be involved in the development of the syndrome they are not the exclusive triggering factor. Also in some cases there is a direct link between disorder of gut micro flora and the levels of endotoxins (lipopolysaccharide in the gut and symptoms of PENS).

Specific actions to prevent ear tip necrosis have proved very difficult to formulate. Clearly, control of co-existing disease is a vital part of any herd health strategy and will help to minimise development of lesions.

Minimizing trauma to ear tips by attending to pen divisions, feed hopper design and water access as well as reducing competition by increasing space provision and decreasing group size may help. Provision of fresh air may also help. Streptococci and Staphylococci require high humidity to thrive, so increasing air exchange and reducing humidity as well as attention to hygiene could be helpful.

Providing mash feed instead of pellets has been shown to reduce ear tip necrosis. It is not clear whether decreased particle size during the pressing operation is the cause, or the heat treatment which destroys certain important substances in the feed. It is also important to promote the healing of wounds so that infections cannot strike quickly. The inhibition of inflammation in the capillaries of the ears could be improved through nutritional measures such as adding higher levels of B-vitamins, introducing certain phytogenics and ensuring the right balance between omega 6 and omega 3 fatty acids.

Check list	Corrective action
Potential cause: Trichothecenes (for example deoxynivalenol), ergot alkaloids	
• Positive raw materials ELISA, feed HPLC. • Origin of raw materials historically contaminated • Symptoms pertaining to mix of infections • Decline of herd/phase performances	• Check raw materials and feed • Hygiene of feed and water lines • Use Mycofix® at suitable inclusion rate
Potential cause: PATHOGENS: Streptococci and Staphylococci	
• Epidemiology, symptomatology • Necropsy • Immune-histochemistry, PCR, ELISA	• Biosecurity • Vaccination • Antibiotics
Potential cause: dysbiose of gut micro flora	
• Increase of Gram negative bacteria / endotoxin levels • Digestibility and level of protein • Content of fermentable fibres	• Check raw materials and feed formulation • Use Mycofix® to bind the endotoxins
Potential cause: Nutritional factors	
• Too low digestible protein level • Vitamins levels (B, K, E and anti-oxidants) • Ratio omega 3/omega 6 fatty acids • Mash feed instead of pellets	• Check raw materials and feed formulation • Proper management and nutrition (Fish oil, Mycofix®, phytogenics).
Potential cause: Management	
• Overcrowding, mixing • Ventilation/oxygen levels • Design of feed hopper and water access	• Increasing space • Check ventilation

References are available on request

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