Biomin®

SCIENCE & SOLUTIONS

Keeping you naturally informed | Issue 56 | Swine

Life after zinc oxide – 3 tips for tackling post-weaning diarrhea

Natural feed additives as alternatives to in-feed antibiotics in nursery pigs

Taking the perfect sample for mycotoxin analysis

Natural alternatives for post-weaning diarrhea

Pork production in a new context

Animal production is a dynamic environment. A continuous trade-off occurs between meeting increasing demands, environmental impacts, welfare concerns, producing a safe product, and respecting consumer preferences. The risk of antibiotic resistance, regulatory pressure and consumer demand for antibiotic-free products have spurred the reduction of antibiotic usage globally. The environmental impact of therapeutic levels of zinc in piglet feeds has dictated a search for alternatives.

There is no "silver bullet" for solving these challenges. Instead, a holistic approach focusing on different aspects of production like management, health, biosecurity and nutrition is required. However, natural feed additives can be a piece of the puzzle. BIOMIN is a pioneer of naturally ahead thinking, developing products and services in this context.

In this issue of Science & Solutions, we consider the post-weaning challenge in an antibiotic- and zinc-free context. We use different perspectives to build on the holistic approach.

A review of the history of zinc oxide use in pig production is followed by the main factors affecting post-weaning diarrhea, concluding with useful tips in order to control it. The BIOMIN product portfolio is reviewed for alternatives to antibiotics and we share recent trial results in weaning piglets that show the potential and added value of using both Biotronic® Top3 and Digestarom® P.E.P.

Finally, an eight-step guide on sampling for mycotoxins is presented. Considering the inhomogeneous mycotoxin distribution pattern in feeds, preparing a representative sample from a feed batch is of paramount importance when implementing an efficient mycotoxin management program.

Enjoy reading this issue of Science & Solutions, keeping you naturally informed.

Konstantinos Sarantis MSc,
Product Manager Mycotoxins

SCIENCE& SOLUTIONS

ISSN: 2309-5954
For a digital copy and details, visit:
http://magazine.biomin.net
For article reprints or to subscribe to Science & Solutions, please contact us:
magazine@biomin.net

Editors: Ryan Hines, Caroline Noonan
Contributors: Konstantinos Sarantis MSc, Diego Padoan DVM, Roger Berrios B Vet Med and Santa Maria Mendoza PhD.
Marketing: Herbert Kneissl, Karin Nährer
Graphics: GraphX ERBER AG
Research: Franz Waxenecker, Ursula Hofstetter
Publisher: BIOMIN Holding GmbH
Erber Campus, 3131 Getzersdorf, Austria
Tel: +43 2782 8030, www.biomin.net

Life After Zinc Oxide – 3 Tips for Tackling Post-Weaning Diarrhea

Post-weaning diarrhea is a problem for pig producers all around the world that has a big impact on future pig performance. With both antibiotics and now zinc oxide being removed from piglet diets in the EU, the pig industry is shifting its attention to new strategies to overcome this problem in young pigs.

Diego Padoan DVM
Swine Technical Manager

Konstantinos Sarantis MSc
Product Manager Mycotoxins

IN BRIEF

- The post-weaning gap is caused by a decrease in feed intake when the diet is switched from liquid to dry feed. This usually results in PWD.
- PWD was commonly treated with antibiotics or with ZnO.
- Antibiotic use in feeds is decreasing, driven by consumer demand. And due to environmental concerns, the EU has banned medicinal levels of ZnO.
- There is no single product available as a substitute for antibiotics and ZnO. Combining various feed additives including mycotoxin deactivators, acidifiers and phytogenics will support the gut microbiome and maintain pig performance levels.

During weaning, the piglet is changed from a liquid diet to dry feed. The animal also has to adapt to new housing, often with new pen mates. This period of multiple stressors results in a dramatic decrease in feed consumption, leading to a nutrient deficit known as the post-weaning gap. Nutrient deficiency compromises the functionality of the gastrointestinal tract and its morphology, allowing pathogens to grow and thrive. In pig production units around the world, closing the post-weaning gap is a constant challenge. One of the most common pathogenic strains is enterotoxigenic *Escherichia coli* (ETEC), which causes post-weaning diarrhea (PWD).

The rising popularity of zinc

Previously, PWD was commonly prevented by using in-feed antibiotics as growth promoters as well as antimicrobial agents. However, the increasing occurrence of antibiotic-resistant bacteria and the importance of some antibiotics to human medicine forced the European Union to ban antibiotics used as growth promoters. The ban came into effect on 1 January 2006. Today, other countries around the world have also followed this policy.

The first academic research into the efficacy of zinc oxide (ZnO) for use against PWD was presented in 1989 at the 40th annual meeting of the European Association for Animal Production held in Dublin. Although it was the first publication, the on-farm use of pharmaceutical levels of ZnO for avoiding PWD was already being practised across Europe at that time.

By the early 1990s, the use of ZnO to control PWD was common practice worldwide. Zinc oxide probably played a role in allowing the smooth transition away from antibiotic

growth promoter use. Zinc oxide is currently permitted for use in the European Union under veterinary prescription. However, due to environmental concerns, the European Union was considering a ban on the medicinal use of ZnO. Manure rich in zinc can cause accumulations in the soil, posing a risk of run-off into underground water.

EU bans ZnO by 2022

At end of 2016, the European Medicines Agency Committee for Medicinal Products for Veterinary Use found that the environmental risks of using ZnO outweighed the benefits of diarrhea prevention in piglets. The committee recommended a refusal on future authorizations for medicinal products containing zinc, and a withdrawal of approvals for existing products that contain zinc.

From 21 June 2017, the EU gave all its member states up to five years to phase out ZnO at medicinal levels in piglet feeds. Any use of ZnO must be kept to 150 parts per million advised as the nutritional requirement for zinc in pigs; some publications state a lower level of 75 parts per million. Zinc is often used together with copper sulphate ($CuSO_4$) which has a moderate constipating effect, decreasing the symptoms of diarrhea.

Treating PWD without antibiotics or zinc

Antibiotic use in animal production is more likely to be replaced with multiple substitute products or combined approaches (Allen *et al.*, 2013). According to Pluske (2013), future alternatives to antibiotics and ZnO include acidifiers, enzymes, fermentation and inoculation of feed, and prebiotics. The best results will be achieved when producers and stockpersons are trained and fully responsible for ensuring the quality of drinking water, providing the necessary immunizations, delivering high-quality colostrum and encouraging high feed intake post-weaning, maintaining high levels of hygiene, adopting all-in-all-out production processes, and enforcing biosecurity (*Figure 1*).

Colostrum and weaning

Colostrum is the feed of life. Each piglet must ingest a minimum of 3000 ml of colostrum to successfully face the challenges of the first weeks of life and weaning. First farrowing gilts have fewer antibodies and produce less colostrum, thus piglets born from these gilts receive less protection, they are the first to surrender to challenges at weaning, and they can compromise the growth of stronger piglets. Segregation of piglets from gilts at weaning is advantageous for the whole weaning batch.

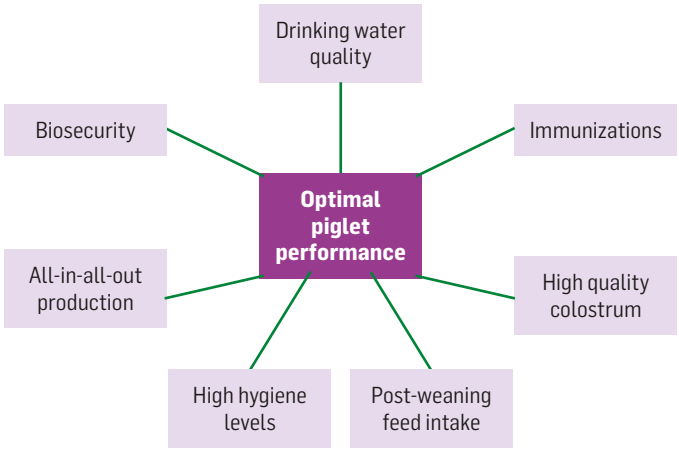
BIOMIN solutions

Feed additive solutions are available and proposed to pig producers using a variety of management practices via local BIOMIN technical sales representatives. Including a mix of mycotoxin deactivators (Mycofix® product line), Gram-negative modulators (Biotronic® product line) and phytogenics (Digestarom® product line) in the diet will help to regulate the gut microbiome and achieve high levels of animal performance.

3 tips for tackling PWD without ZnO

1. **Reduce stress as much as possible**. Weaning is a very stressful time for piglets as their environment and diet change significantly. Where possible, minimize stress by gradually introducing change to the diet, and making the environment as comfortable as possible for them.
2. **Train staff**. Make sure that staff are fully trained on how to achieve optimal piglet performance. This includes ensuring clean and plentiful water is available, ensuring colostrum intake and monitoring post-weaning feed intake, administering immunizations, and upholding high standards of hygiene and biosecurity.
3. **Use dietary supplements**. Mycotoxin deactivators, Gram-negative modulators and phytogenic products added to the diet can alleviate dietary stress and support optimal development of the gastro-intestinal tract.

Figure 1.
7 key factors for optimal piglet performance



References

Allen, H.K., Levine, U.Y., Looft, T., Bandrick, M. and Casey, T.A. (2013). Treatment, promotion, commotion: antibiotic alternatives in food-producing animals. ARS/USDA, 1920 Dayton Ave., IA, USA; DOI: http://dx.doi.org/10.1016/j.tim.2012.11.001

Pluske, J.R. (2013). The efficacy and potential for developing alternative additives and strategies to replace the role of antibiotic feed additives in pig production. An. Sci. Biotechnol, 2013; 4(1):1.

Natural Feed Additives as Alternatives to In-Feed Antibiotics in Nursery Pigs

Roger Berríos B Vet Med
Product Manager Acids

Santa Maria Mendoza PhD
Swine Technical Sales Manager

Intensive pig production puts additional stress on the weaned piglet at a time of already heightened vulnerability to infections. With a global trend towards the reduction and elimination of antibiotics for growth promotion from pig diets, can natural alternatives really close the performance gap?

Commercial pig production has changed dramatically in the last decades. A transition from extensive housing systems with low animal density to intense production systems with a high degree of confinement was driven by the need to increase meat production and satisfy the demands of a growing population. The production cycle of a pig is divided into stages, each with different housing systems, management styles and challenges.

Intensive production adds stress to piglets

Within swine production, the weaner unit represents a big challenge. Under natural conditions, the sows wean their litters gradually over the first 17 weeks of lactation, yet in intensive production, the weaning process is abrupt and can start as early as 3-4 weeks. Weaning at this young age often means that the piglets are not physiologically, immunologically or behaviorally ready. And at the same time, they suffer a large variety of stressors including abrupt separation from the mother, transport, handling and social stress caused by regrouping several litters, changes in environment, change of water supply, change of feed source from a milk-based diet to solid feed with high levels of protein from plant origin, and exposure to pathogens among others. A fasting period is commonly observed immediately after weaning due to adaptation to dietary changes; this weaning anorexia might contribute to gastrointestinal inflammation.

Consequently, the weaned piglet is both vulnerable to infections and weaker to fight them. All this affects piglet health, leading to decreased performance and, in extreme cases, mortality. During the weaning process, a dysbiosis in the gut microbiota leads to post-weaning diarrhea and gastrointestinal infection where colibacillosis diarrhea is of greatest concern. Antibiotics are used in the swine industry for their growth promotion effects, prophylaxis or metaphylaxis and therapeutic purposes.

Regulation of antibiotic usage

Overuse of antibiotics is linked to an increase in antimicrobial-resistant agents which concerns animal and human health authorities. The use of antibiotics as growth promoter agents has been banned in Europe since 2006 and the ban is gradually being extended to other regions. Nevertheless, in-feed antibiotics are still used in some regions as a prophylaxis / metaphylaxis measure to prevent a drop in growth performance and health issues in weaned piglets. In the United States (USA), carbadox is commonly used in the weaner phase to control enteric disease (colibacillosis). It is usually alternated among dietary phases during the weaner period because it does not require veterinary feed directive. However, research suggests that carbadox inhibits bacteria by intercalating DNA and causing mutation in bacteria. This mutagenic property has led to its ban in Europe and Canada, and might influence the USA regulations in the near future. The combination of oxytateracycline and neomycin is used to treat bacterial enteritis and bacterial pneumonia. The use of sub-therapeutic doses of oxytateracycline and neomycin for growth promotion are banned in many countries including

Table 1.
Study design

Groups	Description
Control (C)	Standard Nursery Formulation (SNF) no additives included
Positive control (PC)	SNF + Carbadox (50 ppm) in phase 1 and Neomycin (50 ppm) + Oxytetracycline (50 ppm) in phase 2
Treatment 1 (C-OA)	SNF + Carbadox (50 ppm) in phase 1 and Biotronic® Top3 (1000 ppm) in phase 2
Treatment 2 (OA-EO)	SNF + Biotronic® Top3 (1000 ppm) + Digestarom® P.E.P. (125 ppm) in both phases

Table 2.
Diet composition

Calculated composition	Phase 1 (D0-8)	Phase 2 (D9-22)
ME Mcal/kg	3.45	3.42
SID Lys, %	1.50	1.40
g SID Lys/Mcal ME	4.35	4.10

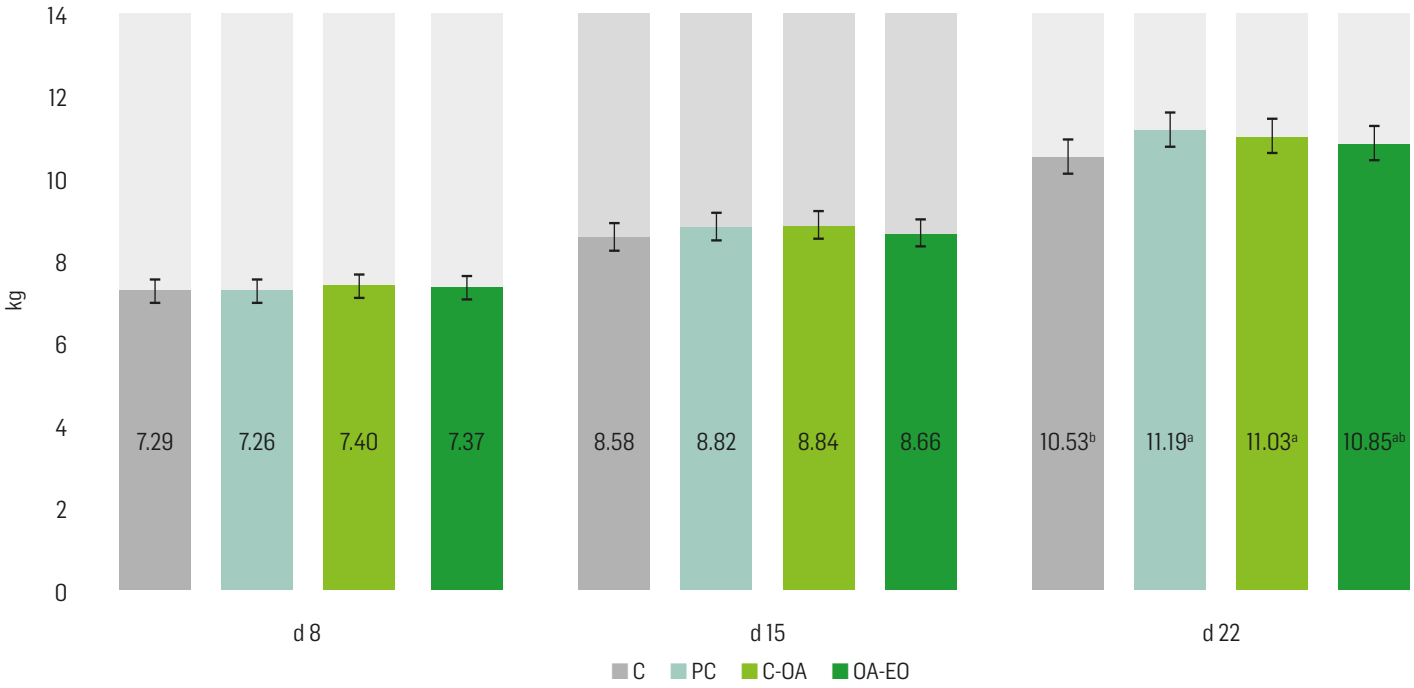
Analyzed composition	Phase 1 (D0-8)	Phase 2 (D9-22)
Crude Protein, %	21.81	22.52
Crude Fat, %	4.73	4.43
Crude Fiber, %	2.55	2.12
Ash, %	5.57	6.49
Moisture, %	11.14	10.34

ME = metabolizable energy, SID Lys = standardized ileal digestible lysine.

IN BRIEF

- Intensive pig production adds stress to piglets, especially at the time of weaning.
- This stress causes a period of fasting after weaning, meaning the piglet is weaker for fighting off infections.
- It is possible to reduce or replace in-feed antibiotics with natural alternatives such as acidifiers and phytogenics, which enhance performance parameters in weaned piglets.

Figure 1.
Average body weight (kg)



Superscripts in the same sampling period indicate statistically significant differences.
Average daily gain (ADG) data is displayed in *Figure 2*. Pigs fed the PC (226 g/d) and C+OA (215 g/d) diets had higher ADGs compared to the C (193 g/d, $P \leq 0.024$), but they did not differ from pigs fed the OA+EO diet (210 g/d, $P \geq 0.101$).

Source: BIOMIN

the USA, because the overuse has led to higher antibiotic resistance gene levels and prevalence.

Antibiotic alternatives

Therefore, it has become critical to find antibiotic alternatives to support growth performance and maintain piglet health during the weaning period. Producers are opting for the use of natural feed additives to prevent bacterial infections such as organic acids and phytogenics. However, the alternatives are evaluated directly against the effects of antibiotics on growth performance as a benchmark to overcome. The effect of antibiotics on growth performance enhancement is linked to their antimicrobial and anti-inflammatory effects.

It is possible to reduce or replace in-feed antibiotics with natural alternatives and enhance performance parameters in weaned piglets.

The aim of this article is to present the results of a study where weaners were fed different antimicrobial programs (*Table 1*): a control diet (C) containing no antibiotic or antimicrobial feed additives, a positive control (PC) with antibiotic added to promote growth, an antibiotic reduction treatment (C-OA) containing antibiotics for the first phase and a natural feed additive for the second phase, and a holistic approach (OA-EO) where only natural feed additives were added to the diet.

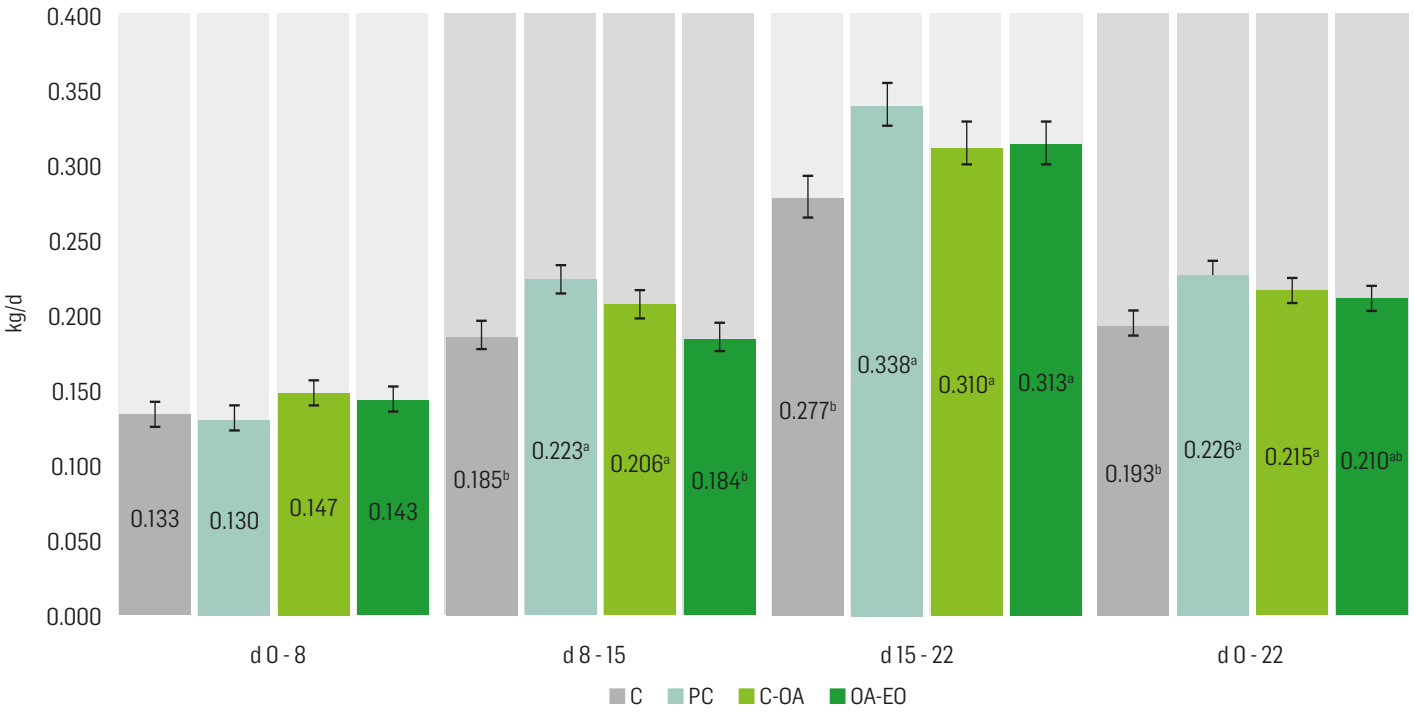
Study design

A total of 480, 22-day-old weaned piglets (body weight (BW) = 6.22 ± 1.4 kg) of PIC 280 X 1050 breed were used. Pigs were allocated to one of 48 pens (ten animals per pen) and assigned within weight blocks to one of four dietary treatments (12 pens per diet) as described in *Table 1*.

The pigs were fed a corn-soybean meal based diet formulated in two phases as described in *Table 2*.

Body weight (*Figure 1*) and feed intake were measured at day 8, 15 and 22. Average daily gain (*Figure 2*), average daily feed intake (*Figure 3*) and gain:feed ratio (*Figure 4*) were calculated. A mixed model was used to examine the effect of diet, weight block was used as the random effect, and multiple comparisons were evaluated using a t-test method.

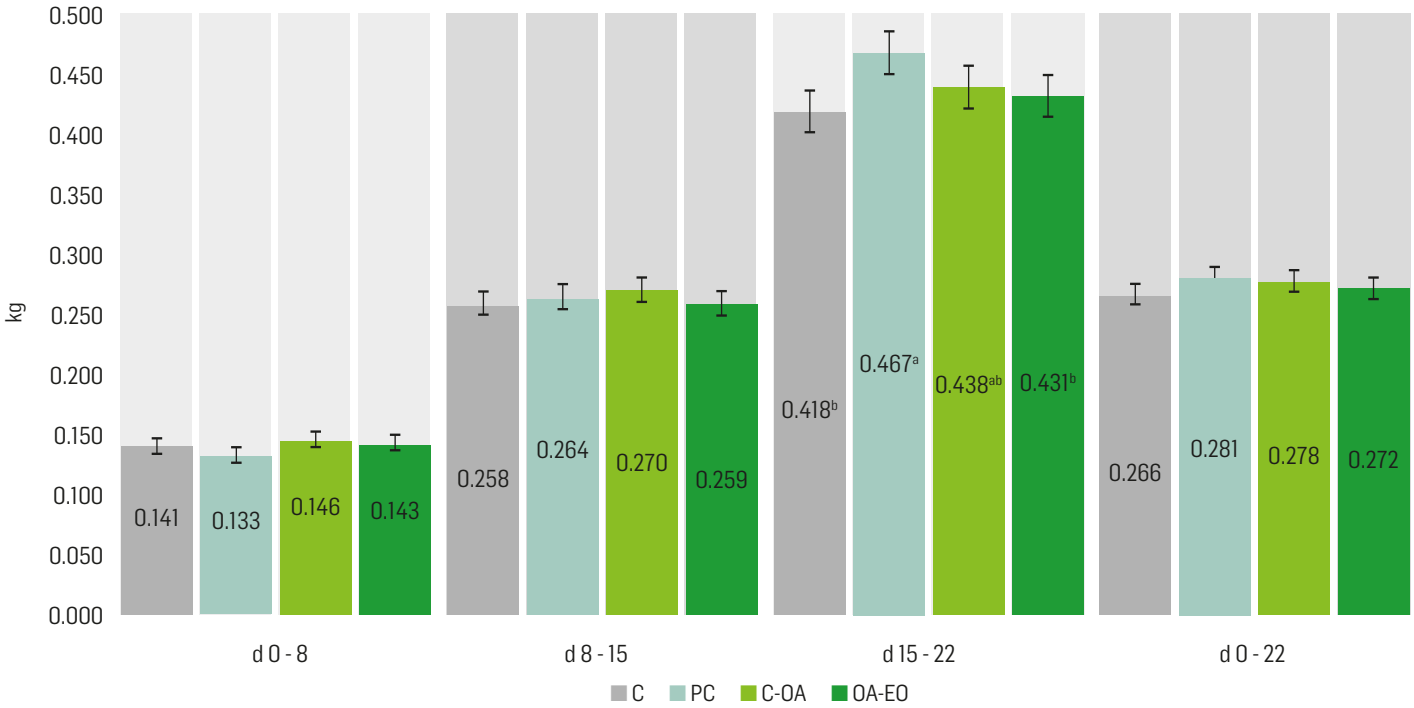
Figure 2.
Average daily gain (kg/d)



Superscripts in the same sampling period indicate statistically significant differences.
Feed intake was not significantly different among the groups (P=0.242) as displayed in *Figure 3*.

Source: BIOMIN

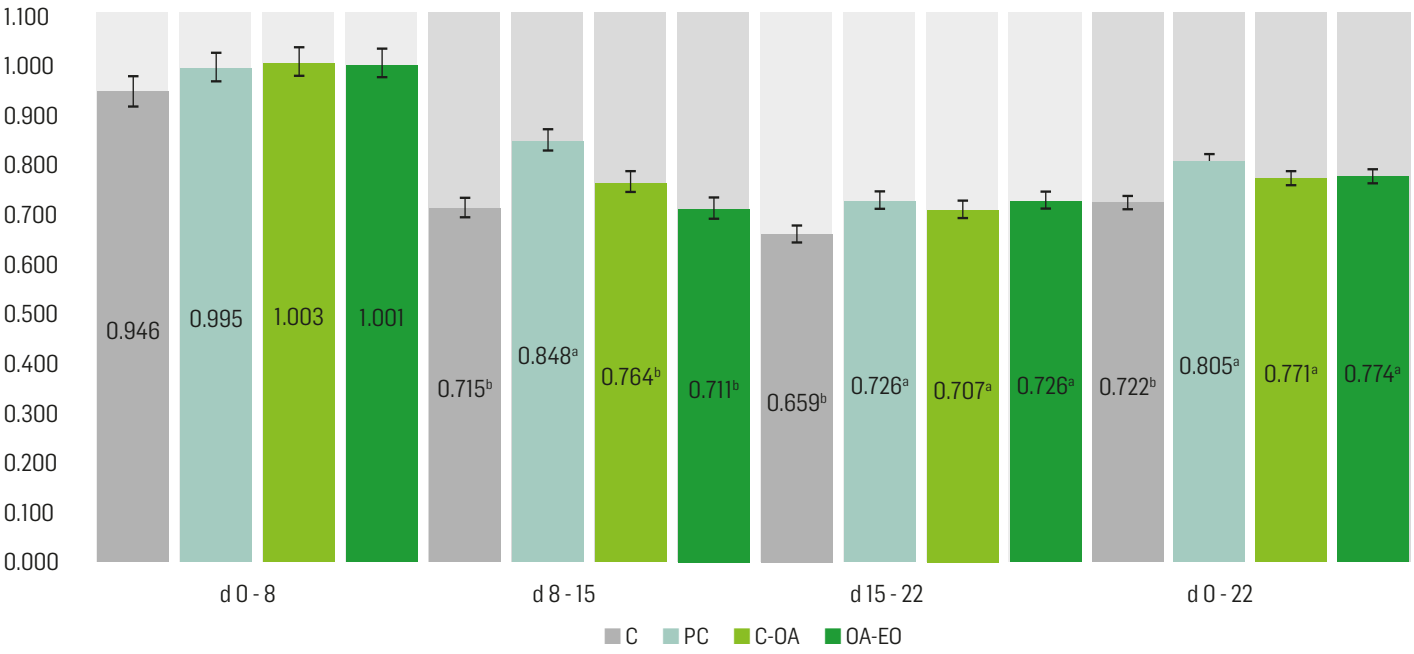
Figure 3.
Average daily feed intake (kg/d)



Superscripts in the same sampling period indicate statistically significant differences.
Gain:feed increased with the addition of antibiotics and/or natural antimicrobials compared to the C (PC: 0.805, C+OA: 0.771, OA+EO: 0.774, C: 0.722, $P \leq 0.01$; *Figure 4*).

Source: BIOMIN

Figure 4.
Gain:feed ratio data



Superscripts in the same sampling period indicate statistically significant differences.

Source: BIOMIN

Results

Pigs in the PC group had a greater BW (11.19 kg, *P*=0.001) compared to the C group (10.53 kg), but it did not differ between the C-OA group (11.03 kg, *P*=0.382) or the OA-EO group (10.85 kg, *P*=0.074). Body weight did not differ between the OA-EO and C groups (*P*=0.100).

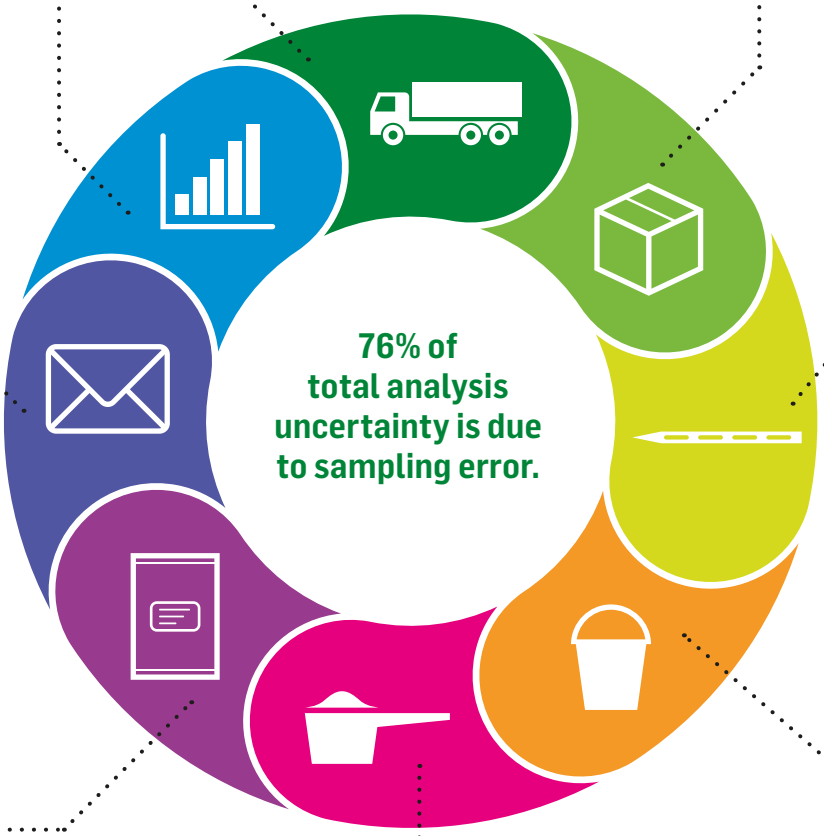
Conclusion

The results of this experiment showed that it is possible to reduce or replace in-feed antibiotics with natural alternatives and enhance performance parameters in weaned piglets. Pigs fed carbadox followed by a Biotronic® Top3 (C-OA) did not differ in performance compared to pigs fed carbadox followed by neomycin and oxytetracycline (PC). In addition, the combination of Biotronic® Top3 (a blend of formic, propionic, and acetic acids combined with cinnamaldehyde and Permeabilizing Complex™ mixture) and Digestarom® P.E.P. (a phytogenic blend of oregano, anise, and citrus oil, and fructo oligosaccharide with anti-oxidative and anti-inflammatory properties) provided a viable natural alternative to in-feed antibiotics.

A more extensive approach is necessary in order to replace antibiotics in animal production. Consideration has to be taken for improvements in production management and animal welfare, feeding systems and feed quality, biosecurity and vaccination programs, improvement of facilities and a more responsible use of the resources we have available.

8 steps for taking the perfect sample for mycotoxin analysis

Mycotoxins are naturally inhomogenous in their distribution. There will be hot-spots of mycotoxins in an otherwise 'clean' batch. To get a true analysis result, sampling is really important. Follow these steps to get your sampling right.



1

Assess the size of your batch and work out how many sub samples you need to take.

For example, 1 ton of raw material = 1 kg of aggregate sample (10 x 100 g samples). The exact amount of sample depends on lot type and size according to EC Regulation No 401/2006.

2

Check the sampling method according to the material being sampled.

Your BIOMIN representative can provide you with the best practices for each material, making sure you collect and store your sample correctly.

3

Use the right equipment for the job.

There are lots of tools out there so do your research and make sure you have the right tool for the job.

4

Take incremental samples and mix them together thoroughly to form an aggregate sample.

Make sure incremental samples are thoroughly mixed together so that all components are homogeneously distributed.

5

Take the samples you will send off for analysis from your aggregate sample.

The laboratory carrying out the analysis will tell you how much sample they need. The general recommendation is at least 1 kg. Make sure you send them at least this amount, if not more. And consider storing some material for future reference too.

6

Make sure the bag or container is well sealed, and labelled with all the necessary information.

Your BIOMIN representative can provide sampling bags or advise on other sample containers that avoid altering the quality of the sampled material.

7

Post your sample off to the laboratory the same day.

Try not to send samples late in the week as they might be stuck in the post office over the weekend. Instead, store samples in a fridge or freezer and post them the following week.

8

Enjoy the benefits of receiving accurate and reliable mycotoxin analysis results.

But your sampling journey doesn't end there. Take regular samples to stay well informed about the mycotoxins in your raw materials or finished feeds.

Biotronic® Top3

the breakthrough in pathogen control!

GUT PERFORMANCE MANAGEMENT

The **Permeabilizing Complex**™ blend in Biotronic® Top3 weakens the outer membrane of Gram-negative bacteria, thus boosting the synergistic effect of its components, the organic acids and the phytochemical.

biotronictop3.biomin.net

Naturally ahead

Biomin®