

*The gut microbiome is fundamental to good health.*

TECHNICAL

# Piglet health starts in the gut

**Intestinal health comprises a wide range of areas, but in this technical article ANNAFE PERINO\* focuses creating a good balance in the gut microbiome of young pigs.**



**A**t a time where there is a scarcity of pork meat in Asia due to African Swine Fever, every kilogram of meat is important to ensure profitability for swine producers. Achieving a high meat yield starts with ensuring piglets are born live, increasing overall piglets born per sow per year, and having more piglets survive the nursery stage and eventually reach a desirable market weight at a certain age. But many producers still struggle to manage the young animal stage due to its complexity and multifactorial variability in nutrition, health and management.

## **Development of the gastrointestinal tract and gut microbiome**

There are several aspects that need to be examined in the young animal stage, one of the most important is the intestinal health of piglets. In the early growth stage, the gastrointestinal tract of a young piglet is not yet fully developed. Many studies have shown that this stage is the perfect time to establish a well-balanced gut microbiota as it will affect the growth performance as the piglet reaches market age. The gut of the piglet prior to birth is essentially a germ-free state but after birth and weaning rapidly

undergoes a microbial shift to an extremely dense microbial population and establishes an adult-like microbial community.

This significant microbial shift is affected by several factors such as dietary change, feed additives used and supplementation of in-feed antibiotics. Feed influences the gut microbiota as the piglets move from a diet of sow's milk to a plant-derived non-starch polysaccharides diet. Once the piglets start to eat solid feeds, their microbiome shifts and produces more bacteria that can breakdown protein and carbohydrates into simpler forms (i.e. *Prevotellaceae*, *Ruminococcaceae*) which can also be food for bad bacteria. The alpha diversity indices of the piglet gut microbiota increases while the variability of the microbiota among individual piglets decreases as the piglets age (Figure 1). Therefore, it is important to influence and create a good balance in the gut microbiome as early as the piglet stage.

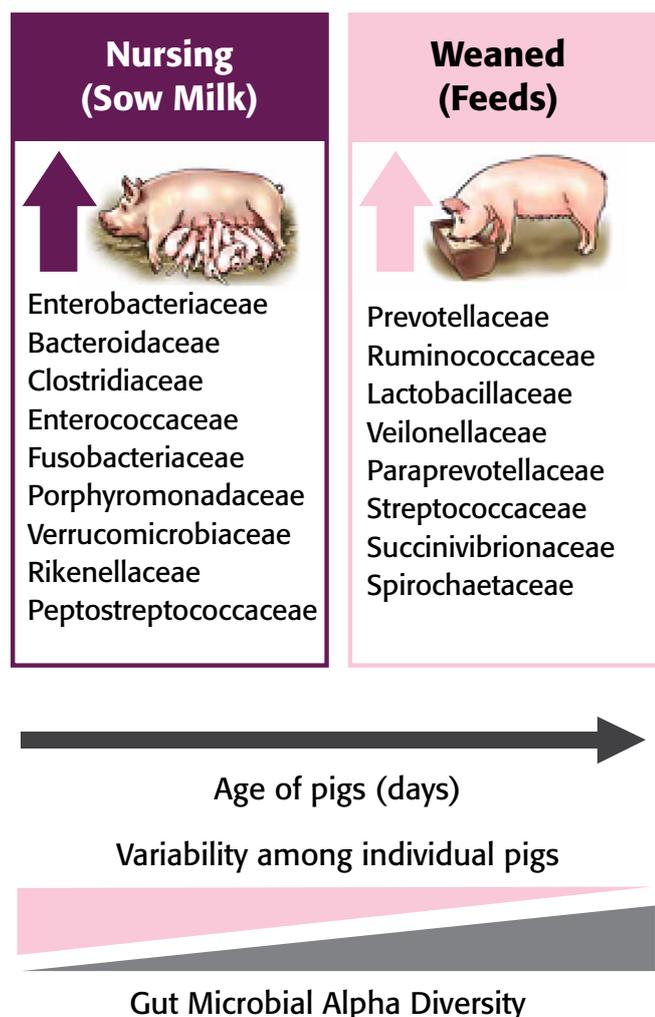
### Organic acids and the gut

There are several feed additives that can support a good balance of gut microbiota in the piglet, one of which being organic acids. Based on their physical and chemical properties, not all organic acids are the same thus each will have its own strengths and weaknesses. Organic acids will act in two ways:

- Reduce gut pH to encourage enzyme production
- An antibacterial agent to minimize or kill pathogens

Organic acids, in their undissociated form, have the ability to cross the lipid cell wall of a microbe. Once inside the cell, the organic acid starts to dissociate and release H<sup>+</sup> ions

**Figure 1: Gut microbiota development in piglets.**



Source: Guevarra et al., 2018

thus reducing the pH inside the cell. Lowering the pH has a harmful effect on the microbe cell as it uses a lot of energy to keep the pH neutral and thus leads to cell death. For this reason, an organic acid's antibacterial activity will depend on the site and pH in the gastrointestinal tract.

Activate DA nutritional feed acid from Novus International, Inc., an organic acid blend containing fumaric

acid, benzoic acid and 2-hydroxy-4-methylthio-butanoic acid (HMTBa) provided during the piglet stage (day 1-28) showed an increase in average daily growth by 4.5% and decrease in feed-to-gain ratio by 3.4% vs. a single organic acid source (Table 1). Moreover, the organic acid blend was able to reduce *E. coli* proliferation and encourage growth of beneficial bacteria. Although both

**Table 1: Effect of Activate DA on piglets at day 1-28 of age.**

	Negative Control	Single acid (formic acid)	Activate DA
ADG (g/d)	323 <sup>b</sup>	354 <sup>ab</sup>	371 <sup>a</sup>
ADFI (g/d)	539	542	545
Feed: Gain	1.68 <sup>a</sup>	1.52 <sup>ab</sup>	1.47 <sup>b</sup>
D14: <i>Lactobacilli</i> (cfu/g)	6.81 <sup>b</sup>	7.03 <sup>a</sup>	7.01 <sup>a</sup>
D14: <i>E. coli</i> (cfu/g)	4.14	3.90	3.79
D7 IGF-1	123.9 <sup>b</sup>	168.0 <sup>ab</sup>	188.0 <sup>ab</sup>
D14 IGF-1	198.4	201.3	250.0

Li et al., 2008

acids were foregut acidifiers, the organic acid blend containing HMTBa proved to be more effective against formic acid due to the complementary individual characteristic of the organic acids in the blend (like lipophilicity (Pow), molecular weight, pKa).

### Zinc oxide alternatives

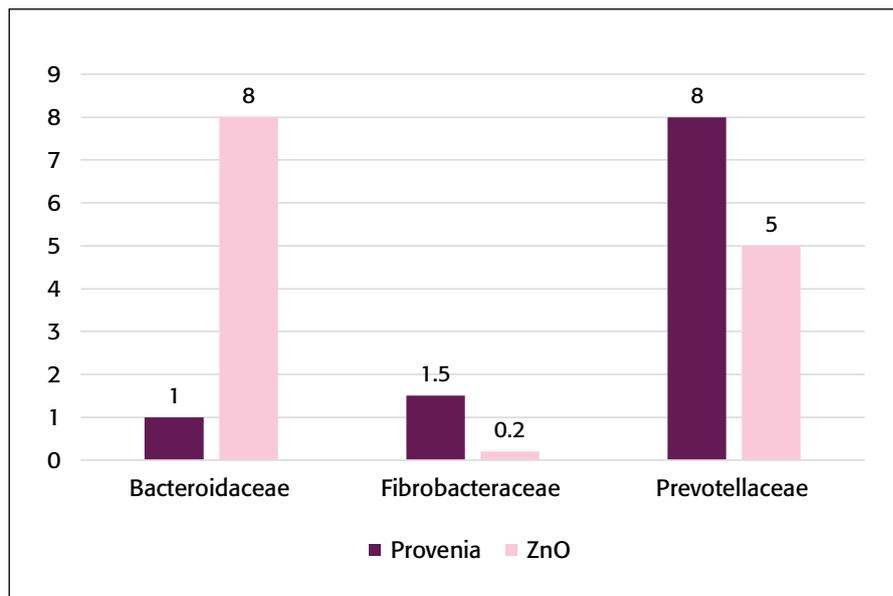
Zinc oxide, widely used in high doses as an antibacterial in piglets, is being evaluated globally for its adverse environmental impacts. Zinc levels over 150 ppm will be banned in the European Union starting in June 2022, which has sent producers there and in markets that export to the EU seeking alternatives.

#### Coated organic acid blend

In a recently published trial at four different commercial farms in Spain, a coated organic acid blend containing fumaric, benzoic and formic acid (Provenia feed supplement, Novus International, Inc.) and zinc oxide were compared. The trial was conducted with 2,610 piglets that were given zinc oxide at 2,500 ppm (Treatment 1) and 2.5kg/tonne of the coated organic acid blend (Provenia as Treatment 2) for 10 days post-weaning with no other antibiotics in the feed. At the end of the trial, the fecal samples were brought to Universita di Bologna in Italy for microbiological testing.

The results showed that at phylum level, the piglets fed with the coated organic acid blend had higher relative abundance of *Fibrobacteraceae* and *Prevotellaceae* group (Figure 2), which are both responsible for carbohydrate degradation and production of short-chained fatty acids such as butyrates, compared to the treatment with zinc oxide. Carbohydrate degradation is important because eventually, the

**Figure 2: Differences in microbiota composition: family level, Provenia versus zinc oxide.**



Correa et al., 2021

piglet diet would contain high level of carbohydrates as source of energy for growth and the production of butyrates as energy source for the gut cells. Moreover, the piglets with coated organic acid blend had lesser presence of *Bacteroidaceae* where pathogenic bacteria belong compared to the treatment with zinc oxide. This shows that the coated organic acid blend can be used in piglets for pathogen control, as it improves and/or protects beneficial bacterial population in the hindgut without contributing to environmental sustainability issues.

### Conclusions

Studies and evidence on the farm show that the use of organic acid blends is beneficial to piglets, especially during the young animal stage where nutritionists can still influence the microbiome that will colonize the piglet's gut. It must be noted that the site of action and the individual characteristics of the organic acids in the blend is an important factor to consider when choosing organic acids. Research has shown that a blend of fumaric, benzoic and HMTBa when used as a foregut acidifier can effectively improve performance (average daily growth, feed-to-gain ratio) and reduce pathogen contamination mainly in the foregut as compared to a single acid like formic acid. Moreover, a coated blend of organic acids

(fumaric, benzoic), can be consider an alternative to high doses of zinc oxide to control the incidence of piglet diarrhea. Both trials mentioned above reported showed reduction in diarrhea, reduction in medication costs and reduction in piglet mortality thereby improving overall profitability of the producer.

The young animal stage can deliver a huge impact to the producers' profitability despite the fact that piglets consume a small amount of feed. This stage is an important area to focus on, as it dictates how the young animal will perform as it grows older and, if managed properly, animal producers can expect a return on their gut health investment. **Ap**

\*Annafe Perino (annafe.perino@novusint.com), is Product Manager, Novus International Southeast Asia and Pacific. References are available on request to the author.