Acidification of drinking water with organic acids – a solution for post weaning diarrhoea

by Bart Danneels, product manager, CID LINES NV, Waterpoortstraat 2, Ieper 8900, Belgium.

Health and performance of the pigs is what drives profits in pig production. Therefore, farmers want to build the most modern animal houses, to have a quality feed and to select pigs with the best genetics. It is easy to forget that drinking water is the most important nutrient for farm animals and that the animals drink at least twice as much as they eat solid feed.

Acidifying the drinking water can help to improve the quality of the 'forgotten nutrient'. Increasing the quality of the drinking water can result in improved performance of the animals, with lower bacterial load in the water and less chance of the formation of 'biofilm' (an organic layer of 'slime' in the pipes, in which bacteria and fungi grow).

This article describes the benefits of acidification of drinking water with organic acids and the special importance that it can have for piglets in the post weaning period.

Lowering the pH

Compared to feed, which usually has a high buffering capacity (due to protein sources and minerals), water has a very small buffering effect. The only parameter which can have an effect is the hardness of water.

When applying a product which has one single acid ingredient in drinking water, the pH decreases very quickly and if the dosage is too high, the pH can lower too much, leading to a negative result (lower water intake with decreased performance).

Therefore, choosing a product which has a synergistic formulation of organic acids is more favourable to these single acid products.

These organic acids have a buffering effect which makes the pH decrease slowly. A synergistic mix of organic acids also has a greater antibacterial effect, is more palatable, and is less corrosive compared with a single acid.

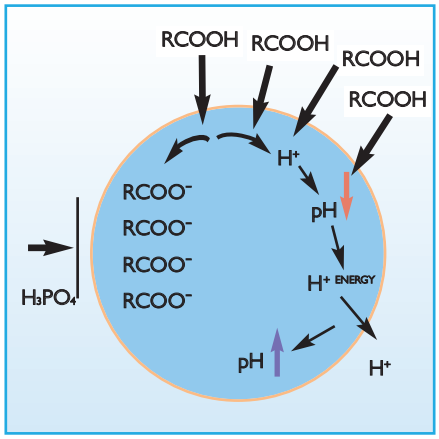

Fig. 1. Antibacterial activity of organic acids.

How do organic acids work?

The general chemical formula of an organic acid is R-COOH (undissociated form). In this form they have the ability to split off a proton (H^+), which lowers the pH of the environment.

The pKa value is the pH at which 50% of the organic acids have split off their proton, and is different for each organic acid.

Due to the lower pH the growth of pathogenic bacteria (for example E. coli, salmonella and campylobacter) is inhibited and the growth of beneficial bacteria (for example lactic acid bacteria) is stimulated.

This pH effect is the only effect that single acids have, on the other hand organic acids also have an antibacterial activity.

The antibacterial activity of organic acids is related to the reduction of pH, as well as their ability to dissociate, which is determined by the pKa-value of the respective acid, and the pH of the surrounding environment. The antibacterial activity increases with decreasing pH-value.

Organic acids are lipid soluble in the undissociated form, in which they are able to enter the microbial cell (see Fig. 1).

Once in the cell, the acid releases the proton in the more alkaline environment, resulting in a decrease of the pH in the cell.

This influences microbial metabolism inhibiting the action of important microbial enzymes and forces the bacterial cell to use energy to release protons, leading to an intracellular accumulation of acid anions.

This accumulation depends on the pH difference across the membrane. Generally, the antimicrobial effect of organic acids increases with increasing concentrations.

Organic acids exert their antimicrobial action both in the water and in the gastrointestinal tract of the animal. If the water is acidified, the pH in the digestive tract of the pigs will be lowered. This has a positive effect on digestion, especially in the stomach and the small intestines.

Control weaning diarrhoea

Weaning is a complex step involving dietary, environmental, social and psychological stresses which interfere deeply with feed intake, gastrointestinal tract development and adaptation to the weaning diet.

The first organ suffering from nutrient shortage immediately after weaning is the gastrointestinal tract and this has dramatic consequences on its anatomy and functions, including barrier function against harmful antigens and pathogens.

Therefore, the addition of organic acids to the drinking water is critical for solving post weaning disorders.

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Table 1. Characteristics of the organic acids in Agrocid Super Oligo.

Acid	Molecular weight	pKa	Function
Formic	46	3.75	Effect on growth and feed conversion
Propionic	74	4.88	Inhibit growth of fungi
Sorbic	112	4.76	Inhibit growth of fungi and yeasts
Lactic	90	3.83	Positive effect on taste
Citric	192	3.13	Has the widest buffering capacity (pH 2.5-6.5) of all organic acids

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The morphology of the piglet's gastrointestinal epithelia drastically changes at weaning. Villous height decreases and crypt depth increases; these changes appear to be induced by weaning and not by the creep feed offered at weaning.

At the same time, there is a transient decrease in intestinal lactobacilli and an increase in coliforms.

Malabsorption syndrome

A lot of just weaned piglets usually show a malabsorption syndrome known as non-infectious diarrhoea, which is characterised by increased excretion of fatty acids and carbohydrates in the faeces, watery stools and degenerative changes in the villi of the small intestine.

In the majority of these cases, opportunistic pathogens take advantage of the presence of non-infectious diarrhoea and cause the post-weaning diarrhoea syndrome (PWDS).

The most important pathogens are:

- **TGE (transmissible gastroenteritis):**
  - Caused by virus that belongs to a group called coronaviruses and destroys digestive cells (villi) in the pig's intestines, thus no digestion/absorption, which can lead to diarrhoea.
  - The most deadly and the most feared by producers.
- **Rotaviral diarrhoea:**
  - Caused by groups of rotavirus (groups A, B and C) and destroys the lining of the small intestine.
  - Rotaviruses are resistant to lipid solvents and many disinfectants and they can survive for a long time.
- **Colibacillosis (E. coli):**
  - Caused by certain E. coli strains that are classified as enteropathogenic and which can propagate rapidly, and produce toxins (enterotoxin).
  - Toxins can cause massive fluid and electrolytes losses from the body, the result being a large amount of pale yellow, watery faeces.
  - Its effects might be secondary to the damage caused by TGE or rotavirus.

This major cause of these post-weaning disorders is that the weaned piglet lacks sufficient capacity to acidify its own stomach content by hydrochloric acid.

Addition of organic acids with a dosing pump.

Weaned piglets.

Thus, the pH value in the stomach may stay at 4-5 for at least two hours after feeding, leading to suboptimal protein digestion and insufficient killing of microbes by low pH value. During this period, more than half of the dry matter has already been transferred from the gastric lumen to the duodenum; the resulting poor digestion and high bacterial count can easily lead to weaning diarrhoea.

Organic acids can simply be added to the drinking water with a dosing pump. The addition of organic acids to the drinking water increases the speed at which stomach contents reaches the optimal pH value of around three, where the proteolytic enzyme pepsin has its optimum efficacy.

Acidification also leads to lower gastric emptying which further contributes to an optimal digestion process. These mechanisms support the piglets in the stressful post weaning period and reduce the risk of having the post weaning diarrhoea syndrome.

Conclusion

It is clear that the addition of organic acids in the post weaning period supports the piglets and has beneficial effects on their health and performance.

It is favourable to use a mix of organic acids for the acidification of drinking water, because they have a better buffering capacity and antibacterial activity, and are more palatable and less corrosive when compared with single acids.

CID LINES offers Agrocid Super Oligo, a synergistic formulation of organic acids that improves the health and performance of piglets. Agrocid Super Oligo is an additional feed and is made according to GMP+ regulations. It is part of their Bioprotexion program for pig farms. Further information can be found on www.cidlines.com/pigs by selecting hygiene plan water treatment. ■