

Acidifying the pigs' drinking water

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We sometimes tend to forget that drinking water has a large impact on the health status and performance of farm animals.

Water is indeed the most important nutrient and healthy animals drink twice as much water than they eat solid feed. Water intake is even higher when temperature rises.

Furthermore, animals face critical periods (weaning, stress, etc) when their feed intake is reduced.

Treating water can, therefore, be a good way to improve animal performance, quickly treat disease, or improve litter quality. It is, of course, crucial to use the right product(s) with an appropriate protocol.

When developing products based on (organic) acids for application in the drinking water, specific requirements must be taken into account. This article describes and emphasises the importance of correct drinking water treatment.

Decreased intake

Under normal circumstances, inorganic and organic components will deposit on surfaces inside the pipeline. This will promote the growth of naturally occurring micro-organisms and result in the so-called 'biofilm'. Biofilms are defined as matrix enclosing microbial populations with adherent to surfaces of interfaces.

This definition includes microbial aggregates and flocules, and also adherent populations within the pore spaces of porous media. Biofilm is formed when bacteria

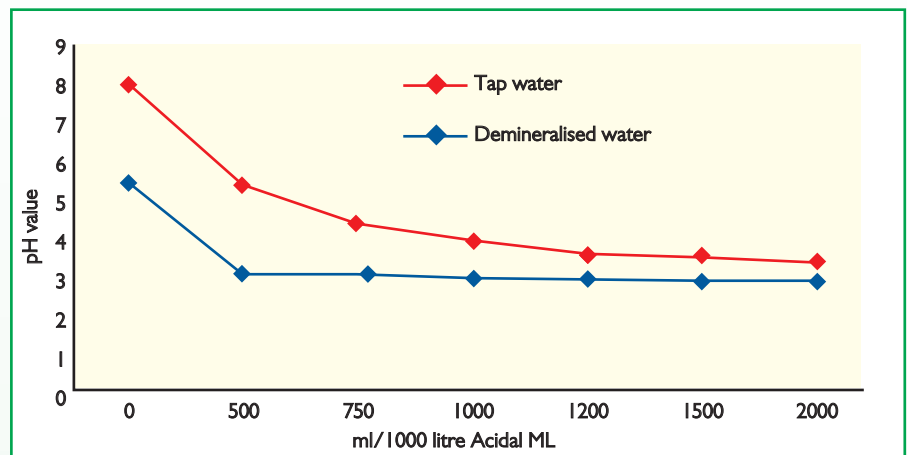


Fig. 1. Buffering system of Acidal ML. Even in demineralised water with increased dosage the pH does not drop under pH 3.

adhere to surfaces in aqueous environments and begin to excrete a slimy, glue like substance that can anchor them to all kinds of material.

The build up of biofilm is accelerated when vitamins and medications are administered via the water line, because their sugar based carriers become ideal substrates for microbes to proliferate. As a result, the drinking water is often a source of contamination to the animals.

On the other hand, when feed consumption is depressed because of stress, the intake of in-feed health enhancers such as antibacterial growth promoters (AGPs) and organic acids intake is reduced. The animals must then cope with a high bacterial load with little or no support, which results in digestive disorders and impaired performance.

Therefore, treating the drinking water of fast growing and young animals such as nursing piglets and growers is helpful to ensure a well balanced flora in the digestive tract, especially when their feed intake is disturbed.

Critical periods in a pig's life, during which it may be difficult to maintain a sufficient feed intake, include:

- After vaccination.
- Feed transitions.
- Post weaning period.
- Moving from pen to pen (maternity unit to battery unit to finisher unit).
- Heat stress.

- Digestive disorders like diarrhoea.
- Mycotoxicosis.
- Bacterial and viral infections.

Sanitising is not enough

Regularly cleaning and sanitising the drinking water is one method to prevent contamination, but it has limitations.

Disinfectants based on chlorine and hydrogen peroxide are the most commonly used, but they are only effective at a high dosage and preferably not during production.

Chlorides do not work efficiently when pH is too high; also, these disinfectants react with the organic pollution present in the water line and lose their efficacy.

The consequence is that the effective dosage of such products is often too toxic and/or negatively influences the crop/gut microbial flora.

Another recommendation is to remove the biofilm by increasing the pressure in the water line. But in many cases the mineral deposit in the biofilm remains after flushing, leaving a shelter for micro-organisms.

Incorrect acidifying

The benefits of organic acids in feed are proven. They are today recognised as one

Continued on page 25

Organic acid	pKa	ml/ 1000 l to pH 4	Result in practice
Formic acid	3.75	300-400	Low amount active ingredients per one litre of drinking water
Lactic acid	3.86	1000-1200	Slime blocked nipples
Acetic acid 80%	4.76	2600-2800	Slime/bad taste; reduced water intake
Cooking vinegar	4.76	25000	This dosage is never applied*
Propionic acid	4.88	3000-3300	Slime/bad taste; reduced water intake

* The active components in cooking vinegar are diluted. A low dosage of vinegar will give slime and a high dosage to get pH 4 will decrease water intake drastically.

Table 1. Effect of dosing single acids to the drinking water.

Continued from page 23

of the best alternatives to AGPs. But what if pigs eat less? They can also be delivered in the drinking water. Indeed, adding organic acids to the drinking water allows killing bacteria in the water line and, at the same time, killing bacteria in the stomach, increasing digestibility of proteins and regulating the microflora in the gut.

In order to get all these benefits it is important to use a well formulated combination of organic acids and salts.

Otherwise, it can do more harm than bring the expected benefits. In this respect, it is important to know that single organic acids can create severe problems in the water line, as shown in Table 1.

Safety through buffering

Compared to feed, which usually has a rather high buffer 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.

Therefore, when applying single acids in drinking water the pH decreases quickly. If the dosage is too high, it can be fatal. One should also know that single acids, especially propionic and formic acids, are corrosive.

When using acidifiers in drinking water, the target acidity, as a general rule, is pH 4. This is because under this pH, pathogenic bacteria cannot develop and water intake is not yet impaired. But animal producers who only take into account this pH target often face problems such as blocked water lines and nipples due to 'slime formation'.

This is because using single acids will have an effect on only a limited spectrum of microbes. For example, lactic acid has a strong bactericidal effect against *E. coli*, but only weak activity against salmonella, moulds and yeasts.

Some microbes produce a diffuse layer around their cell wall in order to protect themselves against disinfectants or acids and also to provide them with the possibility to attach to surfaces. Mostly these water enriched layers (slime) consist of polysaccharides or polypeptides.

When applying single acids to the drinking

water, these acidophilic bacteria start to produce slime as a direct mechanism of protection. With the slime, the bacteria attach to the biofilm in the pipelines and can easily multiply, thus producing more slime. This causes blocked waterlines and nipples.

A properly formulated combination of acids will offer a broad antimicrobial spectrum. Slime forming bacteria cannot survive Acidal ML.

Synergy by combining

Organic acids have their own pKa-value. The pKa value equals to the pH value at which 50% of the organic acid is dissociated and 50% undissociated. If pH is lower than the pKa value, then the undissociated form will be dominant.

This undissociated organic acid molecule is the one that has the antimicrobial effect, because it can diffuse through the bacterial cell wall, then dissociate and disturb the electron balance inside the cell.

The right combination of acids with different pKa values results in a synergistic product that always provides undissociated molecules, even at a higher pH.

During the development of its drinking water supplement range Acidal ML, Impextraco in Belgium researched all aspects important for a safe and effective drinking water treatment using natural ingredients without any withdrawal period.

Many objectives were taken into account during this development – effect on water intake, stability during storage and on the farm, antimicrobial properties, biodegradability, and of course, a positive effect on the performance of pigs.

Power of plant extracts

To enhance the mode of action of organic acids at higher pH (>5.5), essential oils can be added. However, essential oils do not mix properly with organic acids, and, in order to create an homogenous drinking water supplement, emulsifiers are required.

Still, when farmers make a pre-solution of this product (diluting with water to get the recommended dosage level), in many cases, the essential oil will float on the surface, and appears as an oily layer. Plant extracts are obtained by maceration of plants or spices. Unlike essential oils, plant extracts can be mixed homogeneously with acids without the risk of separating in two different phases.

With this type of preparation, real extract of plants, still active after long storage times, are obtained. Building further on the proven synergistic effect of essential oils and organic acids, Impextraco designed Acidal ML Botanical, a combination of organic acids and plant extracts. Acidal ML Botanical contains a combination of wintergreen, peppermint, milk thistle, thyme and common juniper extracts.

Chemical components in the plant extracts show antibacterial effect, but also have immunostimulating, anti-oxidative, hepatoprotecting and carminative properties.

The benefits of Acidal ML Botanical are especially interesting in newly weaned piglets. This is a crucial stage where the animals build up their immunity for the rest of their production lives and, therefore, need extra support.

With its Acidal ML range, Impextraco offers new solutions to pig producers. They can now take advantage of the benefits of the combination of different organic acids, together with plant extracts, not only to improve their technical results, but also to enjoy economical benefits. ■