Acidifying drinking water supports performance

Treating water can be a good way to improve animal performance, quickly treat diseases, or improve litter quality. Adding organic acids to drinking water can deliver health benefits for birds, while also helping to keep water pipelines free from bacteria.

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We sometimes tend to forget that drinking water has a big impact on the health and performance of farm animals. Water is the most important nutrient, and healthy animals consume twice as much water as solid feed. Water intake is even higher when temperature rises and becomes more important when animals face periods when their feed intake is reduced (see box).

Critical periods

Under normal circumstances, inorganic and organic components will deposit on surfaces inside water pipelines. This will promote the growth of naturally-occurring micro-organisms and result in so-called 'biofilm'. Biofilm is formed when bacteria 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 buildup 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.

When feed consumption is low, 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.

Critical low feed intake periods

- First days.... very susceptible to environmental influences (from yolk to solid feed)
- Heat stress
- Mycotoxicosis
- Bacterial and viral infections
- After vaccination
- Feed transitions
- Pre-transport feed withdrawal

Organic acids can be provided in drinking water, providing health benefits for birds while helping to kill pipeline bacteria

Treating the drinking water of fast-growing animals such as broilers, or high-producing animals like breeders or layers, is helpful to ensure well-balanced flora in the digestive tract, especially when their feed intake in disturbed.

Sanitising is not enough

Regularly cleaning and sanitising the drinking water is one method for preventing 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 (above 8.5); 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 waterline. 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 of the best alternatives to AGPs. But what if animals eat less? Organic acids can also be delivered in the drinking water.

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

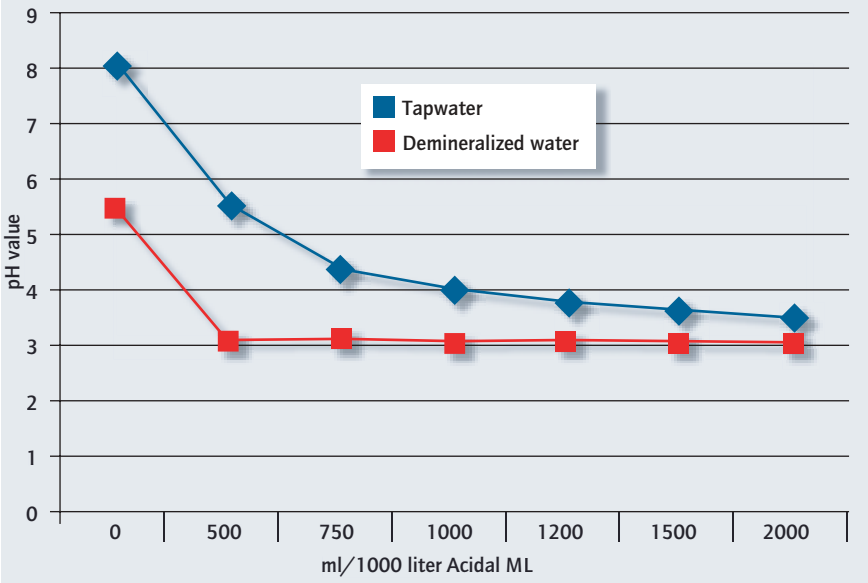
Organic Acid	pKa	ml/1000 l to pH 4	Result in practice
Formic acid	3.75	300 – 400	Low amount active ingredients per 1litre drinking water
Lactic acid	3.86	1000 -1200	Slime-blocked nipples
Acetic acid 80%	4.76	2600 -2800	Slime / bad taste; reduced water intake
Cooking vinegar	4.76	25000	This dosage is 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 2 – Performance of broilers with and without ACIDAL ML (1l/1000l)

Parameter	Control	Acidal ML	Difference
Initial drinking water pH	8.09	8.12	
Number of broilers	12,415 (9.853/m²)	10,346 (9.847/m²)	
Weight at 7 days (g)	140	140	+ 0.00%
Final weight at 55 days of age (g)	3,155	3,250	+ 3.01%
Feed consumption (g/bird)	6,374	6,490	+ 1.82 %
FCR	2.114	2.087	- 1.27%
Production factor (EPEF index)	264.18	275.35	+ 4.22%

Figure 1 – Buffering system of Acidal ML



Even in demineralised water with increased dosage the pH does not drop under pH 3

Indeed, organic acids in the pipeline help kill bacteria, both in the water and in the crop/proventiculus, increasing digestibility of proteins, stimulating the growth of lactobacilli in the crop and regulating the microflora in the gut. In order to achieve these benefits it is important to use a well-formulated combination of organic acids and salts. It is important to be aware that single organic acids can create severe problems in the waterline, as shown in *Table 1*.

Safety through buffering

Compared to feed, which usually a high buffer capacity (due to protein sources and minerals), water has a very low buffering effect. The only parameter which can have an effect is the hardness of water. Therefore, when applying single acids in drinking, water pH decreases quickly. If the dosage is too high, it can be fatal to the birds. Single acids, especially propionic and formic acids, are also 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 waterlines 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 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 (i.e. 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 bioflim 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 anti microbial spectrum.

Positive effects

Organic acids have their own pKa-value. The pKa value equals the pH value at which 50% of the organic acid is dissociated and 50% is undissociated. If the pH value is lower than the pKa value, then the undissociated form will be dominant. This undissociated organic acid molecule is the one that has the anti-microbial 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 the effects on poultry performance.

Table 2 shows performance of a broiler flock (Ross) with and without addition of Acidal ML. In this experiment, the product was used from 1-7 days of age and 43-55 days of age at a dosage of 0.1%. The feed was the same for both treatments and was supplemented with Olaquindox (40 ppm) and zinc bacitracin (50 ppm) for the first 43 days. After that stage (especially during feed transition), favorable effects were more obvious. Over the whole period, birds from the treatment group showed better growth and a slightly better feed conversion ratio. The production factor was improved by more than 4%.

Using plant extracts

To enhance the mode of action of organic acids at higher pH levels (>5.5), essential oils can be added. However, essential oils do not mix properly with organic acids, and in order to create a 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 homogenously with acids without the risk of separating in two different phases. 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. These products contain a combination of Wintergreen, Peppermint, Milk thistle, Thyme and Common juniper extracts.

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