The use of acidified liquid feed to improve pig health and performance

The use of antibiotics as growth promoters, at a subtherapeutic dose, is on its way out in animal production worldwide; the European Union banned that use in 2006, and there are new cases of antibiotic free animal production every day.

by Cinta Sol, Technical Department; Mónica Puyalto, Product Manager; Juan José Mallo, Technical and Commercial Director, Norel SA. www.norel.net

This has a positive effect on human health, as it is less probable that bacteria develop resistance to antibiotics used as medicines, however, animal performance is not at its maximum yet. There is an increased interest for alternative ways to improve pig performance, mainly by improving animal health, and hence reducing the energy, protein and resources used by the animal to face infections and health problems, by using different kinds of functional ingredients, additives and even alternative feed management.

Liquid and fermented liquid feed

Among the alternatives proposed, feed management such as liquid feed (LF) and fermented liquid feed (FLF) are the most widespread around Europe.

LF consists of feed (for example cereal grains, co-products, vitamins and minerals) and water in a ratio 1.5:1 to 4:1 (kg of feed:kg of water) mixed in a central tank just before delivery to pigs. These systems were basically promoted in areas where there was availability of several by-products from the food industry, in order to reduce feed costs and thus production costs.

On the other hand, in FLF, the mixture is soaked in a tank at a certain temperature and for the length of time required to achieve the steady state that produces a reduction of pH to 4, a high concentration of lactic acid and lactic acid bacteria (LAB) and a decrease of Enterobacteria.

Interest in the fermentation of feed for improving gut health and the performance of piglets and pigs increased dramatically after the announcement of the ban in the European Union on the use of antibiotics as antimicrobial growth promoters for swine.

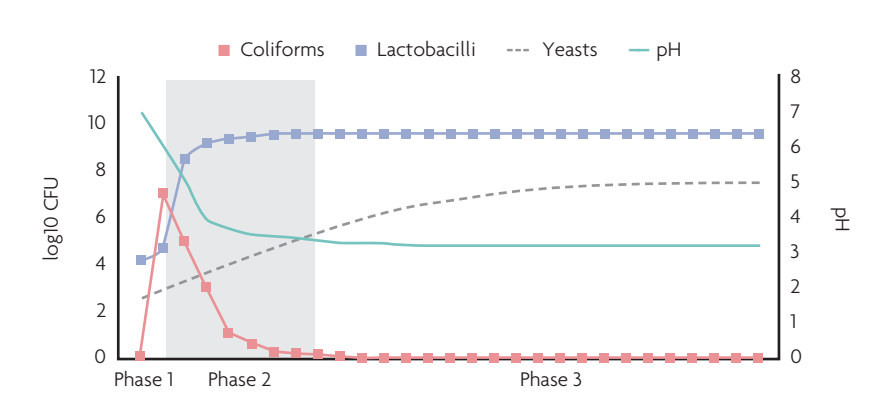

Fig. 1. Phases in fermentation of FLF (Brooks et al., 2008).

Properties of FLF

In FLF, fermentation of cereal grains, or complete pig feeds, characteristically progresses through three phases (Fig. 1).

In Phase 1, feed materials are mixed with water, and pH is normally higher than 6; coliform bacteria can proliferate rapidly in these conditions, which makes Phase 2 essential for a correct preparation of the ratio: LAB fermentation. It inhibits the growth of pathogenic bacteria by the production of organic acids (particularly lactic acid), hydrogen peroxide and bacteriocins, as well as by lowering the pH and oxidation reduction potential.

As pH is reduced to pH 4, proliferation of Enterobacteriaceae in the mixture is prevented and as the acid concentration increases further, such bacteria are excluded.

The last phase (Phase 3), in which a steady state is reached, is characterised by high levels of LAB population, yeasts and lactic acid and low pH with low counts of Enterobacteria. High concentrations of lactic acid and low pH in feed are desirable properties that prevent the proliferation of pathogenic micro-organisms.

Those characteristics in FLF are the reasons why this system has established itself as an alternative to the use of antibiotic growth promoters in pig production, especially in countries of Northern Europe.

Organic acids in liquid feed

Acidifiers, such as organic acids, can be used when the pH is still high in the early stages of fermentation in order to:

- Speed up the first phase of fermentation.
- Reduce or avoid the development of undesired fermentations and control the quality of by-products.
- Prevent the growth of undesirable bacteria.

Organic acids are widely distributed in nature as components of plants or animals. They have been used for decades in commercial compound feeds as effective preservatives of feedstuff due to their ability to acidify feed and digesta and their ability to inhibit the growth of pathogenic micro-organisms. The addition of acidifiers to liquid feed or drinking water is a rather common practice in production units. Acidifiers can be administered individually or as a mix in the feed or the drinking water.

One of the properties attributed to these acids is the avoidance of problems due to the overgrowth of yeasts such as: energy and dry matter losses, reduction of the palatability or foaming; since these yeasts mainly produce acetic acid, off-flavours in

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feed and ethanol. In pig diets, some organic acids, and their salts show effects in the gastrointestinal tract. Their most important quality is to inhibit the growth of micro-organisms through a decreased pH in the stomach, but they also stabilise the hygiene of liquid feeding systems, as well as the feed quality, as mentioned above. They also reduce the buffering capacity of the feed and improve the intestinal flora of pigs.

Organic acids consist of one proton and one anion. The effect of the proton of an organic acid is an acidification of the feed and digesta, while the anion inhibits the growth of microbes. Besides all this, organic acids can also stimulate exocrine pancreatic secretion of enzymes and bicarbonate, which will improve the protein and fat digestion.

Several authors have observed that the use of formic acid has positive effects on microbial characteristics of the liquid feed, as it prevents the proliferation of Enterobacteria in the early hours of fermentation.

In another study, Plumed Ferrer and von Wright (2011) indicated that the addition of weak acids during fermentation could successfully reduce yeast growth without interfering with the development of lactic acid bacteria. Other acids that also achieved an acidified liquid feed with good results were potassium sorbate, benzoic acid, lactic acid and their mixtures.

Beneficial effects

The potentially beneficial effects of feeding weaners with LF or FLF are related to feeding behaviour and gastrointestinal health.

Piglets fed liquid diets have simultaneous provision of feed and water which may result in an easier transition from the sow's milk to solid feed, which can help prevent dehydration and a drastic drop of feed intake.

Avoiding a drastic decrease in feed and water intake after weaning is believed to ameliorate the post-weaning lag period in piglets. Growth performance of animals fed with FLF compared to those fed with LF or dry feed has been shown to be variable.

The benefits of FLF compared to dry feed or LF mainly come from a reduction of the pH in the gut. As mentioned above, a pH below 4.5 achieved in FLF, strengthens the potential of the stomach as the first line of defence against several pathogens, in the gastrointestinal tract of the animals.

It also increases pepsin activity, and also nutrient digestibility through changes in villus height and crypt depth in the small intestine in piglets. Finally, the food remain longer in the stomach and allows more time for digestion.

Efficacy of Gustor Liquid in piglets

Combinations of acids are generally giving better results than single acids, when used as acidifiers, since they broaden the antimicrobial activity spectrum. This is due to the different dissociation properties of these acids at various locations in the pig's digestive tract.

Acids can be in a solid or a liquid phase. Solid acidifiers are easier to handle, whereas the liquid forms may be volatile during spraying (up to 20%), but allows their administration in liquid feeding in an easier way.

An experimental trial was conducted under field conditions in order to evaluate the effect of Gustor Liquid (combination of free organic acids and salts with sodium butyrate) on piglet performance fed with liquid diets. A total of 1865 piglets were allocated into two groups:

- T1, control diet.
- T2, control diet with Gustor Liquid at 1kg per 1000 litres.

The results of the experiment showed that piglets receiving 1kg of Gustor per ton had higher body weight (+3.4%) when compared to the control (25.90kg vs. 25.06kg) and higher average daily gain (+9.8%; 447.25g/day vs. 407.47g/day).

The feed conversion ratio improved by 6.2% (Fig. 2) with less days of raising (45.26 vs. 42.73) and less % of mortality and cull (4.52% vs. 1.93%). The economic calculation, taking into account the higher feed costs due to the addition of Gustor, revealed that adding 1kg per ton of Gustor, results in more efficient and cost effective animal production. Those results in performance are in accordance with other authors that used acidified liquid feed.

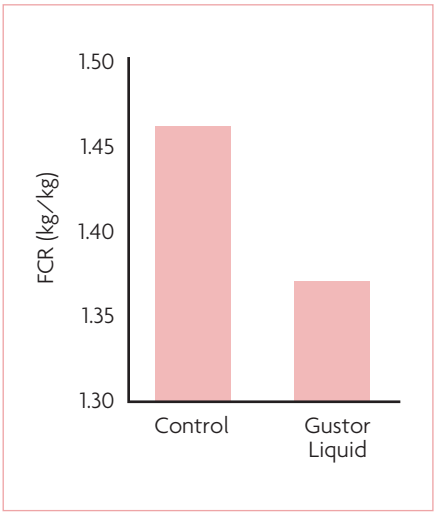

Fig. 2. Results of feed conversion ratio.

Conclusions

The use of organic acids in liquid diets has been shown to be a good alternative to antibiotics as growth promoters. Organic acids avoid the first phase of fermentation when pH is still high and undesirable bacteria starts to proliferate.

The reduction in the pH of the mixture prevents the blooming of pathogenic micro-organisms, stabilises the hygiene of the system and also improves pigs' intestinal health. Moreover, piglet performance is also improved using a combination of organic acids (Gustor Liquid) in liquid feeding systems. ■

References are available from the author on request