A novel approach to pig nutrition

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Since January 1st, the ban of all antibiotic growth promoters (AGPs) is definitively effective in Europe. Over recent decades, antibiotics have been widely used in pig production to control health and performance, especially in young animals and during the critical perinatal period.

Previous experiences of the total and sudden withdrawal of AGPs have shown a negative impact on pig production.

For example, Sweden and Denmark anticipated the European regulations with complete withdrawal of AGPs in 1986 and 2000 respectively. As a result, farmers experienced significant losses of performances post-weaning, while morbidity, mortality and medication costs significantly increased.

Antibiotics used as growth promoters had an impact on the digestive functions of the animal by repressing the micro-organisms present in the feed and in the animal's digestive tract. Today, it is necessary to understand the interactions between those micro-organisms and the animal and to rediscover the importance of the flora, in order to face the new challenges of pig production.

Back to basics

We all live in perfect symbiosis with billions of 'good' bacteria that are essential to our survival.

This internal microbial world, called the microbiota, is unique and specific to each species and even every individual, depending on its age, genetic background, diet, environment and health status. Under normal, healthy conditions, the gut flora is well balanced and the symbiosis works beautifully, the good bacteria helping digestion and protecting the host from the 'bad guys' – the pathogens.

	Denmark	Sweden
Increase in mortality (%)	+0.6	+1.2
Pigs with post-weaning diarrhoeas	50% of herds with increased problems	From 3.5 to 17.5%
Growth rate	Increase of 2.7 days in age at 30kg	Increase of 5.2 days in age at 25kg

Table 1. The impact of the withdrawal of AGPs on Danish and Swedish pig production (British Pig Executive 2004).

In pigs, the number and diversity of micro-organisms increase along the digestive tract, as the pH increases, and microbial digestion is optimal in the colon, where most of the microflora lives. The metabolism of the pig microflora allows the release of many nutrients and makes them available for the animal, in particular volatile fatty acids.

These nutrients represent a form of energy that contributes to the animal's growth, muscle production and, for sows, milk production. This is the microbial digestion that reduces pig feed consumption rates by improving feed transformation.

The intestine microflora's critical role in pathogen control is the action of the 'barrier flora' that, under normal conditions, prevents the pathogens ingested with food from growing and colonising the digestive tract. This barrier effect is the result of different mechanisms – competition between endogen flora and pathogens for attachment sites on the gut surface: the pathogens pass through but do not colonise the gut; the inhibition of pathogens growth, either by competing for the same nutrients, or by creating a hostile environment for pathogens (for example production of lactic acid or antimicrobial substances).

In the newborn piglet, the intestine microflora is absent and the gut is immature, unable to digest solid feed. The establishment of the adult colonic microflora is a gradual, sequential process.

Studies have shown that, within the very first hours of life, micro-organisms start colonising the piglet gut. First facultative anaerobes, such as coliforms, rapidly supplanted by obligate anaerobes as soon as 48 hours after birth, which constitute over 90% of the microflora thereafter.

Bacteroides, the predominant species in the adult colon, start increasing only after weaning. A good balance of the gut microflora is critical to the health and growth of the animal. Nevertheless, in many stressful conditions, such as weaning, or in periods of heat, transport or dietary stresses, the animal's commensal microflora

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Fig. 1. The number of E. coli bacteria that have crossed the intestinal barrier (M. Lessard, Quebec, 2005).

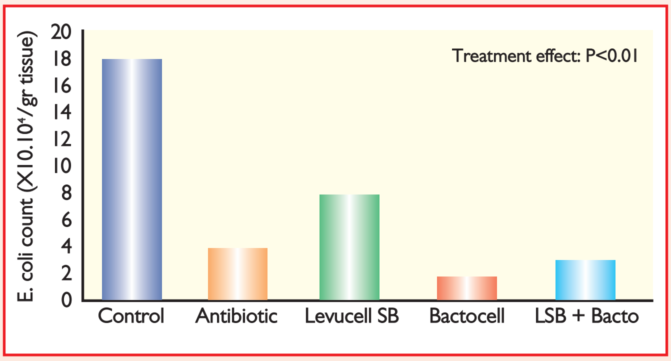
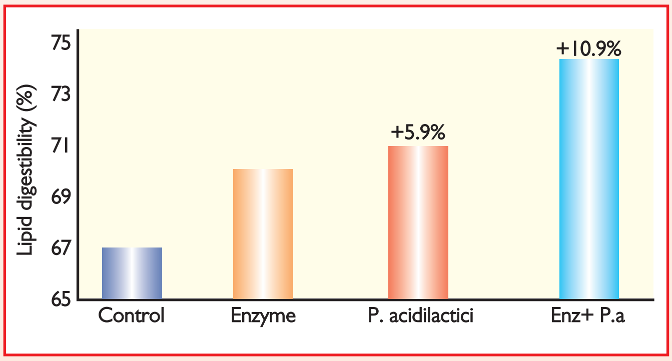


Fig. 2. Synergy enzyme/bactocell in digestibility trials (G. De Groote, Belgium, 1996).



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can be disrupted or repressed and pathogen bacteria present in the gut are able to develop in this less competitive environment.

This shift in the gut microbial balance will at first lead to a decrease in growth and production performances. If the stress becomes more intense or lasts longer, the consequences for the animal become more important and can result in diarrhoeas for example, which, if not properly controlled can be lethal for the animal.

On the other hand, nutritionists and producers can take advantage of the importance of the microflora and play with it.

A good understanding of the interactions between micro-organisms, the host, nutrients and other micro-organisms will enable producers to affect the flora in a positive way and optimise it for better performance, health and feed valourisation.

Controlling gut microflora

Antibiotics, when used regularly in the feed as growth promoters had a repressive role on the animal's microflora – pathogens were eliminated, preventing infection and diarrhoea outbreaks, but all the 'good' bacteria were also inhibited.

By limiting the metabolism of live micro-organisms in the gut, they could increase feed efficiency, but important nutrients were also lost for the pig since the digestion process was not completed.

Today, many solutions are available to influence the microflora. The only acceptable ones are the natural solutions that meet consumers' expectations in terms of safety, traceability and environmental concerns, such as probiotics, prebiotics and enzymes.

In pig nutrition, probiotics play an important role at various levels (the feed itself, the feeding equipment and the animal gut), improving feed efficacy and sanitary conditions.

First, the probiotic will contribute to the digestive comfort of the pig, decreasing both the effects of stress and diarrhoea risks by its positive effect on the natural flora balance.

It also takes part in the development of the gut by favouring the implantation of the 'good' digestive flora and the proper development of microvilli, which enable optimal absorption of the nutrients (Table 2).

Probiotics have always been claimed to enhance the immune system. Today, this has been scientifically proven in pigs. Martin Lessard and colleagues, in Lennoxville, Canada, have shown the positive impact of two probiotic strains (Pediococcus acidilactici MA 18/5M and Saccharomyces boulardii I-1079) on relevant immunological parameters (production of CD8+ lymphocytes in the ileum and mesenteric nodes and bacteria translocation in mesenteric nodes) in piglets (Fig. 1). Prebiotics such as inulin, FOS (fructo-oligosaccharides) and MOS (mannano-oligosaccharides) are currently used in pig nutrition. Inulin and FOS mainly act as substrates for the 'desired' autochthonous micro-organisms.

	Control (n=10)	Levucell SB (n=10)
Villi height (mm)	194 ± 3.19	243 ± 3.19
Crypts depth (mm)	133 ± 2.14	177 ± 2.14
Villi:crypt ratio	1.48 ± 0.02	1.39 ± 0.02

Table 2. The effects of live yeast strain S. cerevisiae ssp. boulardii CNCM I-1079 on morpho-functional aspects of piglets gut during the first month after weaning (Di Giancamillo et al., 2003).

Far from excluding each other, the pre- and probiotic concepts can act in synergy.

Today, works are in progress, both in vivo and in vitro to find new combinations that will maximise the efficacy of both approaches at a limited cost.

By combining probiotic and prebiotic, we can ensure a better control over the host microflora – the prebiotic can act as a good 'starter' to speed up the growth of a selected flora, the probiotic, that in turn, will be more effective (for example, Inulin has the ability to stimulate lactobacillus population, associated to a specific strain, such as the homofermentative strain L. acidilactici, and will enhance its activity).

Enzymes are usually used to improve digestibility and feed efficiency. Again, their synergy with probiotics can be very interesting. Using P. acidilactici MA 18/5M (Bactocell), a synergistic effect has been shown in broiler digestibility trials (another monogastric, similar results can be expected with pigs). The probiotic enhances the enzyme impact on both the metabolic energy of the feed and the lipid digestibility (Fig. 2).

Finally, we must keep in mind the role of the feed and micro-organism interactions. In fact, the nature and composition of the feed plays a role as it is the main substrate for the digestive flora, but it has also been demonstrated that technological aspects such as process and granularity of the feed have an impact.

The digestibility of the feed will depend on these parameters (in particular starch digestibility), affecting the type of micro-organisms that will grow first.

Recent research on the correlation of pellet size and salmonella contamination are very explicit and demonstrate the influence of the feed form on its microbiology.

In conclusion, the pig's internal microbial world is critical, influencing both its health and performance and must not be neglected.

We can say that pigs literally live around their flora, and must keep this in mind at the time when we are opening Pandora's box by removing all pharmacological antimicrobials used as growth promoters. ■