Maintaining performance without growth promoters

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Antibiotic growth promoters have been used to improve the efficiency of pig performance for over 50 years but, surprisingly, their mode of action remains unclear.

The benefits of growth promoters have been well documented and an increase in growth rate of 13 and 6% and an improvement in FCR of 7 and 4% have been reported in piglets and finisher pigs respectively.

It may be calculated that the value of growth promoters to the UK industry is approximately £1.70 per finished pig, however this value will alter depending upon the health status of the unit concerned.

The use of antibiotic growth promoters was challenged by the Swann report in 1969 due to the concern over the development of antibiotic resistant bacteria.

This concern has now led to the withdrawal of antibiotic growth promoters from the EU market and the remaining three, Maxus, Flavomycin and Salocin, cannot be fed after 31st December 2005.

The recent reduction in the level of copper was associated with large losses in pig performance by many producers and it is feared that the loss of growth promoters will have a significant impact on pig performance on many units unless action is taken.

Management improvements

Improving the management of the pig herd is the most important area to examine to reduce the effect of the removal of antibiotic growth promoters.

The majority of producers have reassessed their management in light of the issues created by PMWS and PDNS which will undoubtedly help minimise any loss in performance caused by the withdrawal of antibiotic growth promoters.

Methods of increasing pig performance through dietary means, which do not rely on the use of antibiotic growth promoters, have been examined. These generally involve changes to the composition of the diet and the use of additives.

The use of additives may:

- Adjust the microflora.
- Influence the immune response.
- Increase nutrient digestibility.

Many aspects of the diet can have an impact on pig performance and the microbial flora.

Reducing the dietary protein level generally leads to an increase in its digestibility and reduces the amount of protein entering the large intestine.

Bacterial fermentation of protein leads to the production of amines which cause an increased fluid secretion and a reduction in faecal dry matter.

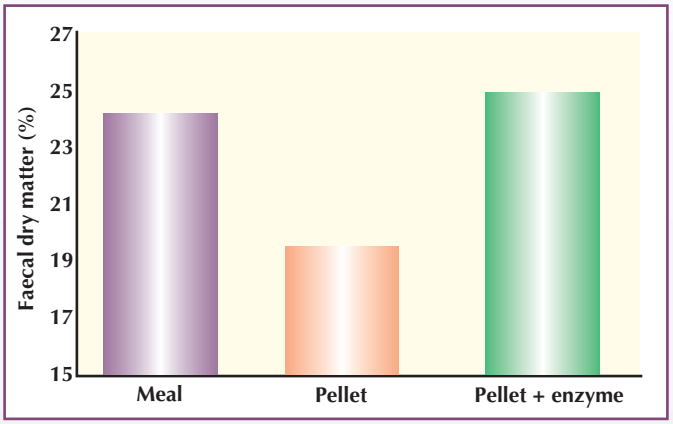

Fig. 1. Effect of enzyme on faecal dry matter.

Reducing dietary protein can, therefore, help reduce diarrhoea without a loss of performance when the diet is formulated using digestible amino acid values.

The incorporation of fermentable substrates, such as fibre or starch resistant to endogenous enzymes, in diets will supply energy to the microflora in the hind gut and enable protein to be utilised for bacterial growth rather than fermented and used as a bacterial energy source.

Thus fewer digestive problems are encountered due to the reduction in the bacterial fermentation of protein when fermentable substrates are available.

Fatty acids are known to affect the immune system with omega 3 fatty acids, for example, reducing the inflammatory response.

In addition, polyunsaturated fatty acids may be toxic to bacteria which appears to be the case in ruminants.

Therefore, utilising the effects of essential fatty acids may have a positive effect on animal health, but further work is required to confirm this in the pig.

Interest is now being shown in determining the balance of essential amino acids required to optimise the immune system.

Work was conducted some time ago by Stahly (1998) who examined the effect of immune stimulation on amino acid requirement but more recent work has been undertaken on the importance of tryptophan.

Consequently, formulating to a particular amino acid balance, for an optimum immune response, may well be possible in the future.

The buffering capacity of the diet may also be an important factor to consider. The buffering capacity is the amount of acid required to achieve a particular pH value usually 4.

It is considered beneficial to use diets with low buffering capacity to allow the pH in the stomach to de-crease rapidly thus ensuring a rapid reduction in bacteria and an efficient protein digestion.

This can be achieved by reducing dietary minerals and protein and by acidifying the feed.

Many non-antibiotic additives can give improvements in pig performance. These include:

- Enzymes.
- Immune stimulants.
- Probiotics.
- Prebiotics.
- Acids.
- Plant extracts.

Enzymes are widely used in animal production. The use of phytase is well established.

It increases the digestibility of dietary minerals which helps further reduce the buffering capacity of the diet. Enzymes, which break down non-starch polysaccharides, have been demonstrated to improve growth and efficiency in the pig, although the results obtained appear to be more variable than those obtained in broiler production.

Enzymes influence the composition of the bacterial flora within the gut, probably by altering the chemical composition of the material entering the hindgut, and they have been shown to reduce diarrhoea when used in conjunction with wheat based diets (see Fig. 1).

Stimulation of the immune system is widely used in fish production using beta-glucans from yeast cell walls. This effect also occurs in pigs which may be of benefit when fed over stress periods but further work is necessary to clearly demonstrate the financial benefit to the producer.

Probiotics, which are live microbial feed supplements that have a beneficial effect on the intestinal balance of the host animal, have given significant benefits in pig performance. Their activity includes:

- Competitive exclusion of other organisms.
- Inhibition of bacteria.
- Production of enzymes.
- Stimulation of the immune system.

In house trials have shown an average improvement in growth and feed conversion ratio of 11.0 and 6.5% respectively in piglets from 8-20kg live weight when compared with a negative control diet.

Prebiotics are non-viable feed components which evade digestion by enzymes in the upper regions of the digestive tract and are fermented by resident beneficial bacteria in the large intestine.

These products are usually oligosaccharides and include lactulose, galacto-oligosaccharides, fructo-oligosaccharides, malto-oligosaccharides, xylo-oligosaccharides and soyabean oligo-

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	Weight in (kg)	Weight out (kg)	Gain (g/day)	FCR	P2 (mm)
Control	36.4	90.9	884	2.56	11.0
Acid	36.8	93.0	958	2.51	11.5

Table 1. The effect of acid on finishing pig performance.

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saccharides. Fermentation of certain oligosaccharides in the large intestine increases the beneficial bacteria, lactobacilli and bifidobacteria and favourable effects on animal performance have been reported.

Fructo-oligosaccharides have been shown to increase growth in the weaned pig by over 5% and to improve FCR by 2% due to the beneficial effects in the hindgut.

Older pigs have shown a more variable response possibly due to a more stable bacterial flora.

Organic acids are a definite alternative to antibiotic growth promoters. They are generally considered more effective in the younger pig but recent data has challenged this view (Table 1).

They reduce bacteria and have additional effects:

- Increased protein digestibility.
- Increased growth of gut epithelium.
- Reduced immune stimulation.

It is understood that acids must be in an undissociated form to have a bacteriocidal effect which generally requires an environment with a low pH.

Consequently, reducing the buffering capacity of the diet helps improve the efficacy of acids. Organic acids have different properties, some being more active against yeast, others moulds or bacteria, hence choosing the correct acid is important.

Performance results are far more variable than those produced using antibiotic growth promoters but reproducible results can be obtained.

Plant oils, extracts and spices have been associated with many activities including antibacterial and antioxidant properties.

Tests against Gram positive and Gram negative bacteria have found that oil from thyme, oregano, clove and nutmeg had a wide range of antimicrobial activity.

Positive effects on feed conversion ratio and liveweight gain have been observed, particularly in the young pig, but results are inconsistent as shown in a recent review where 57% of trials showed a beneficial effect.

Antibiotic growth promoters have been under challenge for a long period and now the industry must consider alternative methods to reduce the loss of efficiency without them.

Careful attention must be given to management to reduce bacterial infection paying particular attention to health management protocols. This process can be assisted by nutrition.

The use of diets that favour beneficial bacteria through careful formulation, complemented by the selection of a suitable additive, can significantly improve growth rate and feed conversion ratio in a cost effective manner. ■

References

- Eidelsburger, U., Kirchgessner, M. and Roth, F. X., (1992) Influence of formic acid, calcium formate and sodium hydrogen carbonate on dry matter content, pH value, concentration of carbonic acids and ammonia in different segments of the gastrointestinal tract. Journal of Animal Physiology and Animal Nutrition Zeitschrift fur Tierphysiologie Tierenahrung und Futtermittelkunde, **68**, 20-32.
- Fuller, R. (1989) Probiotics in man and animals. Journal of applied bacteriology. **66**, 365-378.
- Gibson, G., R. and Roberfroid, M., B. (1995) Dietary modulation of the human colonic microbiota: introducing the concept of prebiotics. Journal of nutrition. **125**. 1401-1412.
- Hillman, K. (2001) Recent Advances in Animal Nutrition: Bacteriological aspects of the use of antibiotics and their alternatives in the feed of non-ruminant animals. Ed. Garnsworthy, P. C. and Wiseman, J., Nottingham University Press. 107-134.
- Le Floc'h, N., Melchior, D. and Seve, B., 2005, Effet de la deterioration du statut sanitaire et de la teneur en tryptophane de l'aliment sur les performances de croissance des porcelets apres le sevrage, 37emes Journees de la Recherche Porcine, 37, 231-238.
- Stahly, T. S., 1998, Impact of immune system activation on growth and optimal dietary regimens of pigs, Pig Journal, 65-74.
- Swann, M. M. (1969) Use of antibiotics in animal husbandry and veterinary medicine. UK Joint Committee Report London: H. M. Stationery Office.