Alternatives to antibiotics as growth promoters

What are growth promoters?

Growth promoters are compounds that are added to feeds to improve feed utilization and the growth of farm animals. All non-nutrient feed additives that improve animal growth can, in principle, be described as growth promoters, antibiotics and chemotherapeutics being widely used examples. In countries such as the USA, hormones and beta-blockers are also used as growth promoters, but the use of these compounds is forbidden in the EU.

Antibiotic growth promoters

In earlier years, antibiotics were widely used as growth promoters in pig production. They are added to the feed to improve the digestibility and uptake of nutrients along the alimentary canal, and to reduce the opportunity for harmful bacteria to establish themselves in the gut. The increased use of antibiotics has, however, given rise to a fear of the development of resistant bacteria which, directly or via the meat, could be transferred from the alimentary canal of the animal to humans. This would cause a reduction in the options for using valuable antibiotics to fight diseases in both animals and humans. For this reason, the use of many antibiotic growth promoters is prohibited in the EU.

Alternatives to antibiotic growth promoters

In recent years there has been considerable interest in finding or developing alternatives to antibiotic growth promoters. Many types have been examined: probiotics (bacterial cultures), oligosaccharides and yeast, other carbohydrates, ethereal oils, taste and aromatic compounds, plant extracts, yucca products, clay minerals, organic acids/salts, and fermented mash. In general, all these products have produced variable results in pig production, best results being obtained with the probiotics, organic acids and fermented mash.

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▪ Organic acids/salts

Research into the use of organic acids has produced many interesting findings, although variations in the results obtained probably reflect the fact that in many studies these acids were used in too low concentrations. Additions of organic acids in the following concentrations have produced positive effects: Acetic acid 2.7%, citric acid 1.5 - 2.0%, fumaric acid 1.5 - 2.0%, lactic acid 1.5 - 2.0%, and formic acid 1.2%. The results suggest that the more acid is used the better the result. Formic acid is the only exception, and one should take care not to feed too much. The salts of different organic acids have also given positive results. In general it can be concluded that organic acids are currently a realistic alternative to antibiotic growth promoters.

▪ Fermented mash

An alternative to organic acids is fermented mash. This is characterised by a low pH (<4.5), and high densities of lactic acid bacteria (> 10^9 organisms/g) and yeast cells (> 10^7 organisms/g). The investigations show that pigs which received fermented mash had lower microbial activity in the stomach and small intestine. A similar result was found earlier when pigs were fed growth promoter antibiotics. The results also show that the number of coliform bacteria was markedly reduced in the alimentary canals of pigs fed on fermented mash, suggesting a more healthy gut environment. On the other hand no significantly better animal growth or feed utilisation was observed. The same has been found in English studies. Selection for particularly effective lactic acid bacteria and/or yeast cells appears to hold great potential to optimize this response.

▪ Probiotics

Over the last 10 - 15 years, probiotics (living microbial cultures) have often been proposed as an alternative to antibiotics. General opinion is that for a bacterial culture to produce a probiotic effect it should a) be able to establish itself in the alimentary canal, b) excrete metabolites that prevent the growth of disease-promoting micro-organisms, and c) be amenable to cultivation under industrial conditions, the product being well defined and durable. The concept has been that a probiotic should be given once or twice, after which the bacterium should establish itself in the alimentary canal, replacing any disease-promoting micro-organisms. Furthermore, it has proved practically impossible to get probiotic bacteria to establish themselves in a stable alimentary canal system. Most research scientists thus agree that in order for these bacteria to have any effect they must be added to the food on a daily basis. Moreover, the use of probiotic bacterial cultures is expected to have greatest effect when the alimentary flora of pigs are unstable, that is, at birth, after weaning and subsequent to an extended period of treatment with antibiotics.

▪ Diet Acidification

Acids generally lower the pH and buffering capacity of the diet, reduce the pH within the stomach, increase nutrient digestibility, promote the growth of beneficial bacteria and decrease intestinal bacterial growth. The benefits of using acids include an improvement in gastrointestinal health, enhanced growth performance and improved feed efficiency. The growth-promoting effects of acids are most prominent in the first few weeks after weaning.

▪ Oligosaccharides

An essential step in the development of intestinal illness is the binding of the pathogenic bacteria to the surface of the intestine. Bacteria have glycoproteins on their surface which can recognize and combine with the sugars on the surface of the gut wall. However, if the bacteria attach to a sugar or oligosaccharide which is not part of the gut wall, but is an indigestible component of the feed, then they are excreted from the animal without causing the animal any digestive problems. Mannose and fructose oligosaccharides are being investigated for this purpose. Studies to date have shown that

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oligosaccharides can improve the growth rate of weaned piglets, reduce the FCR and reduce scouring.

▪ Enzymes

Enzymes have been shown to improve growth rates, for a range of pig diets, due to an improvement in nutrient digestion and absorption (Partridge and Hazzledine, 1997). Enzymes have also reduced scouring, since less undigested material passes into the large intestine, thereby reducing the substrate available for the bacterial growth. In addition, enzymes, such as ß-galactosidases, pentosanases and proteases, can specifically target antinutritional factors which impair digestion.

▪ Minerals

The role of copper sulphate as a growth enhancing agent is well established. Similarly, zinc oxide at pharmacological levels in piglet diets is reported to have therapeutic effects that improve performance and reduce the incidence and intensity of diarrhoea/colitis in the post-weaned piglet. However, concern about the high rate of excretion of these elements into the environment has created interest in the potential role of organic minerals. Organic minerals are more biologically active and bio-available which means more is utilized by the animal, less is excreted and the potential for environmental pollution is reduced. Organic minerals are more stable, do not react adversely with other dietary nutrients and do not compete with other minerals for the same uptake mechanisms or sites. This provides a metabolic advantage to the animal.

▪ Probiotics / Yeasts

Unlike antibiotics, probiotics introduce live beneficial bacteria into the intestinal tract. Several authors have assessed the efficacy of probiotics as growth promoters for pigs. Most concluded that when results are averaged over several trials, there is an improvement in growth rate and in the efficiency of feed utilization. However, the results are highly variable. The effects of the probiotics may be more consistent and positive in piglets than in growing / finishing animals. Current research at the University of Alberta on genetically improved lactic acid bacteria holds considerable promise. These enhanced probiotics can be used to specifically target and inhibit intestinal pathogens such as E. coli.

▪ Non-Starch Polysaccharides (NSP) (Digestible fibre)

Bolduan (1988) showed that the addition of 5% straw to a piglet starter diet reduced the transit time of digesta through the gut. This led to a reduction in the percentage of days with diarrhoea from 6.0 to 3.5. Since then, work with other sources of digestible fibre, such as sugar beet feed, have shown an improved overall NSP digestibility of the diet and reduced incidence of post-weaning diarrhoea.

Conclusions

Antibiotic growth promoters are very cost-effective and efficient in improving pig performance and health. However, if they become unavailable for use in animal feed and no alternative strategy is in place, it is possible that the therapeutic administration of antibiotics will increase, because of large-scale herd infections and increased incidences and severity of diarrhoea. However, alternative strategies can be used to effectively replace antibiotics in pig diets without loss of performance. It is likely that a combination of the alternatives presented in this paper, as well as changes in husbandry and management, can efficiently reduce or replace the use of antibiotic growth promoters.

References

Bent B. J., Danish Institute of Agricultural Sciences, Department of Animal Nutrition and Physiology.

William H. C., Close Consultancy, Wokingham, UK and summarized by Michelle Follensbee Alberta Agriculture, Food and Rural Development.

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