PRACTICE TIP PEER REVIEWED

Feed additives for swine: Fact sheets – prebiotics and probiotics, and phytogenics

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This is the last in a series of five peer-reviewed Practice tip articles, each including two or three fact sheets. Previous practice tips included fact sheets on acidifiers and antibiotics in the September-October issue (*J Swine Health Prod*. 2009;17:270–275); on carcass modifiers, carbohydrate-degrading enzymes, and proteases, and anthelmintics in the November-December issue (*J Swine Health Prod*. 2009;17:325–332); on flavors and mold inhibitors, mycotoxin binders, and antioxidants in the January-February issue (*J Swine Health Prod*. 2010;18:27–32); and on high dietary levels of copper and zinc for growing pigs and phytase in the March-April issue (*J Swine Health Prod*. 2010;18:87-91).

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FACT Sheet: Prebiotics and probiotics

There is increasing pressure for livestock producers to minimize the use of antibiotics as growth promoters in food animals. Supplementing beneficial microorganisms in the gastrointestinal tract is one potential alternative. A diverse population of beneficial and potentially harmful microorganisms exists in the gastrointestinal tract of the pig. In a healthy animal, a delicate balance between these two groups of organisms is maintained. However, during times of stress, such as during weaning in the case of piglets, this balance may be affected and can lead to a rapid growth of harmful microorganisms. This may result in poor performance or disease. Thus, prebiotics and probiotics have been the subject of much research over the years as potential replacements for antibiotic growth promoters in pigs.

Fast facts

Prebiotics are nondigestible food substances that selectively stimulate the growth of favorable species of bacteria in the gut, thereby benefitting the host.

Probiotics are live cultures of beneficial organisms.

Results of growth performance trials with prebiotics and probiotics have been inconsistent.

More studies are needed to justify their use in pig diets.

What are prebiotics?

Prebiotics have been described as nondigestible food substances that selectively stimulate the growth of favorable species of bacteria in the gut, thereby benefitting the host.[1] These substances are primarily derived from nondigestible oligosaccharides.[2] Because they are not digested and absorbed by the pig, they provide readily available substrates for the normal bacteria to grow.[2] Oligofructose, fructooligosaccharide, and inulin are examples that have been used as prebiotics.[3-5] However, consistent beneficial effects on pig growth performance are yet to be demonstrated with prebiotics.

What are probiotics?

Probiotics are live cultures of organisms supplemented in pig diets that can beneficially affect the host animal by improving the microbial balance in the gut.[6] Organisms commonly used include *Lactobacillus acidophilus*, *Enterococci faecium*, *Bacillus* species, *Bifidobacterium bifidum*, and the yeast *Saccharomyces cerevisiae*.[7] As feed additives, they are supplemented in diets to improve the balance of bacteria in the gut. To be effective, a probiotic must have the following traits:[8]

- Stability and ability to survive in feed.
- Ability to replicate after passage through the stomach.
- Ability to block the effects of harmful microorganisms or excrete metabolites that can inhibit growth of harmful bacteria.

The proposed benefits from probiotics are improved digestion, stimulation of gastrointestinal immunity, and increased resistance to infectious diseases of the gut.[9] Another possible mechanism by which a probiotic may exert its beneficial effect is through its effect on the permeability of the gut, which may increase nutrient uptake and thus improve growth performance. Unfortunately, research results have failed to consistently demonstrate beneficial effects.[9-11]

What are synbiotics?

The combination of a prebiotic and probiotic is referred to as a synbiotic.[12-13] It has been proposed that synbiotics are strategically beneficial for the pig by improving the survival rate and colonization of the introduced probiotic microorganisms in the gastrointestinal tract. At the same time, the presence of prebiotics provides a readily available substrate for probiotic growth and may promote the metabolism of the beneficial bacteria. However, research trials that show consistent beneficial effects in pigs are limited.[14,15]

Why the inconsistent results in research on probiotics and prebiotics?

The variability in responses suggests several possibilities. The fact that these feed additives improved pig performance in some studies,[11] but not in others,[10] indicates the influence of environment and production practices, which may differ from one setting to another. It may also be possible that the number of viable organisms in each dose of probiotic was insufficient to be able to survive and become established in the gastrointestinal tract. Another factor might be that the microorganisms included in the probiotic product were not isolated from pigs but from other animal species.

Summary

Prebiotics and probiotics do not provide essential nutrients for normal growth. Potential advantages to using probiotics and prebiotics from a health and growth-promotion standpoint include partial replacement of antibiotic growth promoters. However, studies showing more consistent results are needed to justify prebiotic and probiotic use as additives to pig diets. For all the claimed beneficial effects and studies conducted, a consensus has yet to be reached by the scientific community that prebiotics and probiotics consistently provide benefits in commercial settings. Moreover, their addition in the diet entails additional cost and thus must be evaluated thoroughly.

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FACT Sheet: Phytogenic feed additives (phytobiotics or botanicals)

Restriction on the use of in-feed antibiotics in many countries has fueled the interest in alternative products. A group of natural products known as phytogenics has been the focus of several studies in recent years.[1] Also referred to as phytobiotics or botanicals, phytogenics are plant-derived products used in feed to potentially improve pig performance. Aside from having antimicrobial activity, these products potentially provide antioxidative effects, enhance palatability, improve gut functions, or promote growth.[1] However, there is limited research validating their potential benefits for pigs.

Fast facts

Phytogenic feed additives are substances derived from plants.

The potential benefits of phytogenics in pig diets have not been fully substantiated.

Current research data show that growth responses to phytogenic feed additives are still inadequate compared to responses obtained with the use of in-feed antimicrobials.

What products are being used as phytogenic feed additives?

Phytogenics comprise a wide range of substances and thus have been further classified according to botanical origin, processing, and composition. Phytogenic feed additives include herbs, which are non-woody flowering plants known to have medicinal properties; spices, which are herbs with intensive smell or taste, commonly added to human food; essential oils, which are aromatic oily liquids derived from plant materials such as flowers, leaves, fruits, and roots; and oleoresins, which are extracts derived by non-aqueous solvents from plant material.[1] Two of the most common phytogenic substances evaluated in swine include the spices oregano and thyme.[1-5]

How do phytogenic feed additives exert their claimed effects?

The mode of action of most phytogenic feed additives is still not fully understood. However, the following are some of the potential mechanisms by which they may improve performance.

Increased feed intake. The stimulatory effect of phytogenics on feed intake is due to the claimed improvement in palatability of the diet resulting from the enhanced flavor and odor, especially with the use of essential oils.[6] However, the effect on feed intake of adding essential oils to pig diets is highly variable. In some phytogenic feed-additive studies,[1] the increased feed intake was found to be also influenced by the antibiotic supplemented in the diet. Other studies reported decreased feed intake with increasing inclusion levels of the phytogenic substance used.[4,7] The addition of phytogenic feed additives to pig diets may not affect feed intake in some instances[8,9] and even resulted in better feed efficiency in one study.[8] Increased palatability of the diets associated with the addition of phytogenics also may be due to their anti-oxidative effects,[10] which might contribute to preserving the desired organoleptic qualities of the diet.

Improved gut function. Improvement in gut function is mainly attributed to the possible stimulatory effect of phytogenic substances on digestive secretions, such as digestive enzymes, bile, and mucus.[11] However, limited evidence in pigs[12,13] exists to support this hypothesis, which is generally based on experiences derived from the use of spices in human nutrition. Phytogenic substances from certain herbs, spices, and their extracts have also been shown to have pharmacologic actions within the digestive tract, as evidenced by their relaxant and spasmolytic effects.[14-16]

Anti-oxidative effects. Anti-oxidative properties of some phytogenic substances have been attributed to the phenolic terpenes in the essential oils.[17,18] Essential oils of plants belonging to the Labiatae family have been widely used as antioxidants in human and pet foods with high fat content.[10] Plants high in terpenes include rosemary, oregano, and thyme.[1,10] However, whether they can be added in amounts sufficient to replace the effects of antioxidants commonly used in pig diets, such as ethoxyquin and butylated hydroxytoluene, remains to be seen.

Antimicrobial effect. The medicinal or antimicrobial properties of plant-derived substances have been well known for centuries.[19,20] This property is mainly attributed to the essential oils of these plants. Oregano and thyme are among those which have received a great deal of interest. These plants contain the monoterpenes carvacrol and thymol, respectively, and have demonstrated high efficacy in vitro against several pathogens found in the intestinal tract.[4,21,22] This suggests that phytogenic feed additives may be suitable replacements for in-feed antibiotics to improve pig health and growth performance, particularly during the first few weeks post weaning.[23] However, available research data[24,25] appear to be insufficient to support the claimed beneficial effects on health and pig performance. In one study,[8] the addition of a commercial product containing a proprietary blend of phytogenic substances was associated with higher postweaning growth performance in nursery pigs than that observed in controls. However, growth performance was better in pigs fed diets containing antibiotics than in those fed the phytogenic test diets. In other studies[2,26] that evaluated the effects of oregano oil on nursery pig performance, pigs fed diets supplemented with oregano oil did not perform as well as pigs fed diets containing antibiotics.

Do phytogenics interact with other substances or compounds added to the diets?

While possible drug-herb interactions have been reported in humans,[27] most studies that evaluated the use of phytogenic feed additives in swine did not indicate any negative interaction with other supplements in the diets, such as antibiotics or organic acids.[1] However, negative interaction of phytogenic substances

having astringent properties has been reported in one study, specifically due to partial denaturation of proteinaceous feed additives.[1]

Are phytogenic feed additives totally safe?

Even though a product is said to be of natural origin, it is not necessarily better or safer than antibiotics or other synthetic feed additives. It is important to note that various antibiotics also are of natural origin. The fact that some herbs and spices also exhibit antimicrobial properties suggests that phytogenic feed additives may pose similar risks to producers and meat consumers. Similarly, potential overdose that may be harmful to the pig also is possible. All of these considerations warrant further investigation into the safety of phytogenic feed additives both for humans and animals.

Summary

Most beneficial effects claimed from using phytogenic feed additives are based on experience from the field of human medicine. Phytogenic feed additives, according to current research, will not replace the response observed with in-feed antibiotics during the nursery phase. Additionally, responses to feeding phytogenic additives have not been consistent among trials. Hence, more evidence is needed to confirm the apparent beneficial effects on pig performance before these products are added to swine diets on a regular basis. Finally, although these additives are considered "natural" products, they need to be carefully evaluated for potential interactions with other ingredients or other potentially negative effects.

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