DESTROY PHYTATE TO INCREASE PIG PRODUCTION PROFITABILITY

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How can pig producers increase profitability while maintaining quality?

Phytase is commonly used in animal feed to improve phosphorus availability from phytate. However, the efficacy of phytase is dependent on its ability to rapidly and thoroughly degrade phytate in the stomach and upper part of the digestive tract. This has the effect of eliminating more anti-nutritional effects of phytate, and releasing phosphorus and other phytate binding nutrients. An efficacious phytase can improve digestibility of amino acids, energy and minerals, the main drivers for improved growth performance and feed efficiency in pigs.

Many pig producers use a phytase dose of 500 FTU/kg. However, research shows that this only partially degrades phytate in the gastrointestinal tract (GIT) of animals. Using a higher dose and a highly effective phytase will degrade phytate more thoroughly in the upper part of the GIT, resulting in extra phosphoric effects and improved performance.

Academics and practitioners agree that Buttiauxella phytase has the highest activity at pH 3.0, showing high efficacy in degrading phytate. Studies have demonstrated that using Buttiauxella phytase at 1000 to 2000 FTU/kg can improve feed intake and body weight gain, as well as feed and energy efficiency, leading to higher economic benefits.

Phytase mode of action: Phytate degradation rate

A phytase dose of 500 FTU/kg only degrades 30-50% of the phytate (Dersjant-Li et al., 2015), depending on the type of phytase and the dietary phytate sources (Selle, 2012). Thus using higher doses of a more efficient phytase that is highly active at low pH, will enable thorough degradation of phytate and reduce anti-nutritional effects.

Not all phytases have the same *in vivo* activity. Standard phytase activity is determined at pH 5.5 while the pH in the pig stomach is typically around pH 3.0. Menezes-Blackburn et al. (2015) reported that the activities of different commercial phytase products varied significantly at pH 3.0, 12 to 235%, a 20 fold difference in activity. And that Buttiauxella phytase showed the highest activity, 235% of its activity at pH 5.5. This superior activity translates directly into high IP6 degradation rates when using both phytic acid or phytic acid-soy protein complex as substrates (Yu et al., 2014).

Extra-phosphoric effects in pigs

A recent study in piglets showed that Buttiauxella phytase used at 500 to 2000 FTU/kg degraded 67 to 83% of the dietary phytate, leading to linearly improved ileal amino acid digestibility (Fig 1).

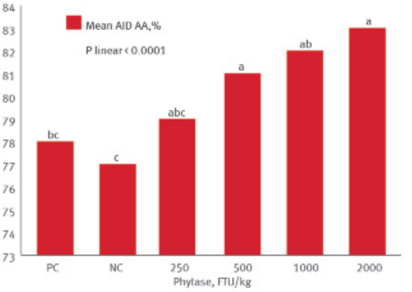

Fig 1. Effect of increasing Buttiauxella phytase dose on apparent ileal digestibility

The improved ileal amino acid digestibility was correlated to the ileal phytate degradation rate (Fig 2). Increasing phytate degradation with Buttiauxella phytase results in a positive effect on bone trace mineral content and performance in piglets (Zeng et al., 2015). In growing pigs, Buttiauxella phytase improves nitrogen, dry matter and mineral digestibility (Adedokun et al., 2015; Lizardo et al., 2015). These results demonstrate the extra phosphoric effects of phytate degradation. Based on typical diets today, the economic benefits of increased dosing at 1000 and 2000 FTU/kg are compelling, and can be 20 to 30% of additional feed cost savings above the 500 FTU/kg dose.

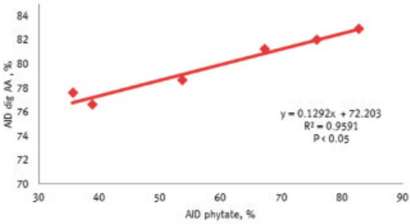

Fig 2. Correlation between ileal digestibility (AID) of phytate and amino acids.

First published in International Pig Topics volume 31.3

GUT HEALTH - THE KEY TO MAXIMIZING SWINE PRODUCTIVITY

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As the industry's search for the most effective alternatives to in-feed antibiotics continues, and the body of research in this area continues to grow, one thing seems abundantly clear: achieving gut health in the animal is essential to achieving optimal cost and performance.

But what exactly is gut health? Stephan Bischoff has described it as a balancing act that involves achieving homeostasis in interactions between the animal's gut microbiome, immune function and nutritive processes – a definition endorsed by eminent swine scientists such as John Pluske. While we know that stress can negatively impact this balance, as Marcus Kehrli, Director at National Animal Disease Center-USDA-ARS pointed out at DuPont's Maximizing Swine Productivity Conference, little has been known about the make-up of the swine microbiome because, until recently, less than 1% of the various bacteria – good and bad – found in a pig's gut could be cultivated in a lab. With genome sequencing costs dropping, we are starting to learn more.

Nutrition and gut health

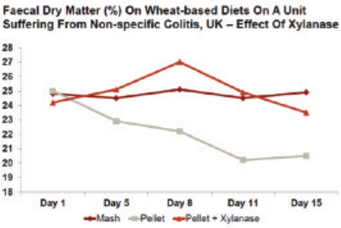
An increasing number of trials demonstrate the impact nutrition has on the animal's health and performance. Non starch polysaccharide (NSP) content in pig feed is one key variable as it affects satiety, gut motility, nutrient digestion and absorption, as well as changes in gut microbiota. Arabinoxylan is a key component of the NSP in many raw materials, and its varying solubility influences the amount of undigested substrate left to encourage microbial overgrowth. Higher concentrations of both NSP and starch substrates have been associated with an increased incidence of swine dysentery (Pluske et al, 1996), and trials have illuminated the correlation between a diet high in NSPs and non-specific colitis. Even simple corn diets contain arabinoxylans, with levels varying according to harvest and other conditions, so this is an issue for swine producers feeding high fibre diets.

The part enzymes and other additives can play

We know that feed enzymes such as xylanase help break down the insoluble arabinoxylans (hemicellose) in both corn- and wheat-based diets (Myers and Patience 2013, Kiarie et al, 2014). In addition to reducing digesta viscosity through the hydrolysis of soluble arabinoxylans in the small intestine, certain xylanase generates arabino-xylo-oligosaccharides, which act as prebiotics, selectively stimulating the growth of beneficial bacteria. They also produce short chain fatty acids in the intestine, which can be used as an energy source by the animal.

Adding a fungal xylanase to pelleted wheat-based diets for pigs suffering with non-specific colitis resulted in a significant improvement in dry faecal matter content without resorting to a mash feed (Figure 1). The same xylanase has been shown to improve digestibility of cheaper raw materials such as corn DDGS (Kiarie et al 2013), and a xylanase/beta-glucanase combination has been shown to support piglet gut health and growth (Jiang et al, 2015).

Figure 1



There is still much to learn about pig gut health. Research continues to better understand the value other additives such as probiotics and essential oils can deliver, especially when feed antibiotics are reduced or eliminated. However, it is certain that nutrition will have a large part to play in meeting increased demand without reliance on in-feed antibiotic use.

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First published in International Pig Topics volume 31.4

TACKLING THE ENVIRONMENTAL IMPACT OF PIG MANURE

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Intensive indoor pig production is the most productive and economic means of raising pigs; however, large quantities of manure produced as part of this intensive farming practice raises environmental concerns. Pig production is responsible for approximately 15% of total atmospheric ammonia emissions associated with livestock production (Olivier et al., 1998).

The build-up of noxious gases such as ammonia in confined conditions can lead to adverse effects on the growth, health and welfare of the animal. The reduction of ammonia production has been shown to promote a healthier and more productive growth environment.

Historically, producers have used management practices such as ventilation or cost effective antibiotic use to manage or reduce the production of these harmful gases. However, government regulations have focused on the withdrawal of in-feed antibiotics in some countries and consumer pressure is accelerating this withdrawal in others.

Direct-fed microbials that influence the availability of substrate for gut microbiota within the pig's intestinal tract have the potential to reduce the production of noxious gases from pig manure offering an alternative approach to addressing environmental concern associated with pig manure.

A study conducted by Prenafeta-Boldú et al. (2016) explored the potential of a 3-strain Bacillus spp. (direct-fed microbial product) to reduce the emission of environmentally harmful gases from pig manure (such as methane, ammonia and hydrogen sulphide) when included in pig diets.

The inclusion of this Bacillus product (3×10^8CFU/g) at 250mg/kg and 500mg/kg significantly decreased methane and ammonia volatilisation (conversion from liquid to gas) by 40% and 50% respectively, compared to the control ($P<0.05$).

In this study, the dietary supplementation of Bacillus spp. had minor effects on the microbial composition of manure; however, there was a significant reduction in the organic matter and in particular protein in the manure as a result of the direct-fed microbial treatment ($P<0.05$).

The fibre content of the manure also decreased upon direct-fed microbial supplementation by 21% and 31% respectively when the direct-fed microbial was added at 250 and 500mg/kg, while volatile fatty acids concentration tended to increase.

These findings indicate that the direct-fed microbial product was able to enhance fibre degradation in the animal's gut and increase the production of volatile fatty acids which can be used as an energy source by the animal as well as conferring other health benefits.

This research demonstrates the additional benefits that direct-fed microbials offer within animal nutrition.

Their ability to influence substrate availability for microbial fermentation can lead to a variety of benefits for pig production including the reduction of emissions of harmful gases into the atmosphere.

Direct-fed microbials are becoming increasingly more important today in markets where there is great pressure to remove antibiotic supplementation in animal diets while still maintaining performance and managing the environmental impact.

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First published in International Pig Topics volume 31.5