

Importance of Prebiotic Supplementation in Swine Health and Production

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Introduction

Swine production is a one of the vital components of global agriculture sector, providing a significant source of protein for human consumption. Ensuring the health and productivity of pigs is crucial for sustainable and profitable farming. Among various nutritional strategies, prebiotics have gained considerable attention due to their ability to improve gut health, enhance immunity, and promote growth performance.

What are Prebiotics?

Prebiotics are non-digestible feed ingredients that selectively stimulate the growth and activity of beneficial gut bacteria, such as *Lactobacillus* and *Bifidobacterium*. Unlike probiotics, which introduce beneficial microbes into the gut, prebiotics serve as a food source for the existing beneficial bacteria, thereby improving gut microbiota balance.

Commonly used prebiotics in swine diets are like Inulin, Fructooligosaccharides (FOS), Mannan-oligosaccharides (MOS), and β -glucans.

Mechanisms of Action

Prebiotics exert their beneficial effects through several mechanisms:

- 1. Modulation of Gut Microbiota:** Prebiotics promote the proliferation of beneficial bacteria while inhibiting the growth of harmful pathogens, leading to a more balanced and stable gut environment.
- 2. Enhancement of Immune Function:** By interacting with gut-associated lymphoid tissue (GALT), prebiotics enhance the immune response and improve disease resistance.

- 3. Improvement of Nutrient Absorption:** A healthy gut microbiome enhances the digestion and absorption of essential nutrients, such as vitamins and minerals, leading to improved feed efficiency.
- 4. Reduction of Pathogens:** Certain prebiotics can prevent the adhesion of pathogenic bacteria like *Escherichia coli* and *Salmonella* to the intestinal lining, reducing the risk of infections and diarrhea.

Benefits of Prebiotics in Swine Production:

1. Enhanced Gut Health:

A stable and diverse gut microbiota is essential for proper digestion and overall health. Prebiotics contribute to a healthy gut environment by fostering beneficial microbes and reducing harmful bacteria. Studies have demonstrated that supplementation with prebiotics such as inulin and MOS leads to increased populations of *Lactobacillus* and *Bifidobacterium*, which play key roles in maintaining intestinal homeostasis and preventing colonization by pathogens (Patel and Goyal, 2019). Additionally, prebiotics enhance the production of short-chain fatty acids (SCFAs), which serve as an energy source for intestinal epithelial cells and contribute to improved gut integrity (Huaman et al., 2024). Research conducted by Menegat *et al.* (2023) also highlights the role of prebiotics in reducing incidences of post-weaning diarrhea by modulating gut microbiota and improving mucosal immunity. These factors collectively lead to better digestion, fewer digestive disorders, and lower mortality rates in piglets, making prebiotics a valuable tool in modern swine production.

2. Improved Growth Performance:

Several studies have shown that prebiotics improves growth rates and feed conversion efficiency in pigs. Prebiotics enhance gut health by promoting the growth of beneficial bacteria, which play a key role in breaking down feed components and improving nutrient utilization. This results in better digestion and increased absorption of essential amino acids, vitamins, and minerals, ultimately leading to improved weight gain. Supplementation of prebiotics in diet of pig with such as fructo-oligosaccharides (FOS) and mannan-oligosaccharides (MOS) can significantly enhance average daily gain (ADG) and feed conversion ratio (FCR) (Patel and Goyal, 2019). Moreover, studies indicate that prebiotic supplementation reduces intestinal inflammation and improves gut morphology, including increased villus height and crypt depth, which are critical for efficient nutrient uptake (Huaman *et al.*, 2024). These improvements not only lead to higher growth performance but also contribute to lower production costs by maximizing feed efficiency and minimizing the need for antibiotic growth promoters (Menegat *et al.*, 2023).

3. Enhanced Immune System:

Prebiotics boost immune function by stimulating the production of antimicrobial peptides, such as defensins and cathelicidins, which help in neutralizing pathogenic microorganisms. Additionally, prebiotics enhance the gut barrier function by increasing mucus production and strengthening tight junctions between intestinal epithelial cells, thereby reducing the translocation of harmful bacteria into the bloodstream (Huaman *et al.*, 2024). Prebiotics interact with gut-associated lymphoid tissue (GALT), stimulating the production of immunoglobulins (IgA) and cytokines that play a crucial role in enhancing disease resistance in pigs (Patel and Goyal, 2019). This immune-boosting effect reduces the incidence of common swine diseases, such as post-weaning diarrhea and respiratory infections, thereby minimizing the reliance on antibiotic treatments. Menegat *et al.*, (2023) suggested that reduction in antibiotic uses is particularly important in addressing antibiotic resistance concerns in livestock production, ensuring safer meat products for human consumption and promoting sustainable farming practices.

4. Reduction of Post-Weaning Stress:

Weaning is a critical period in pig production, often associated with severe physiological and psychological stress. This stress manifests as reduced feed intake, weight loss, impaired gut development, and increased susceptibility to infections. The abrupt transition from milk to solid feed disrupts gut microbiota, leading to an imbalance that can cause post-weaning diarrhoea, a major economic concern in swine farming.

Supplementing piglet diets with prebiotics has been shown to mitigate these effects by promoting beneficial bacteria such as *Lactobacillus* and *Bifidobacterium*, which help maintain gut stability. Prebiotics also enhance intestinal morphology by increasing villus height and crypt depth, which improves nutrient absorption and overall gut integrity. Moreover, studies indicate that prebiotic supplementation stimulates the production of short-chain fatty acids (SCFAs), such as butyrate, which serve as an energy source for gut epithelial cells and strengthen the intestinal barrier (Huaman *et al.*, 2024). These mechanisms collectively reduce post-weaning stress, enhance feed intake, and promote better weight gain, thereby improving overall piglet health and performance.

5. Environmental Benefits:

By improving feed efficiency and reducing digestive disorders, prebiotics contribute to lower nitrogen and phosphorus excretion in manure, which is a significant environmental concern in large-scale pig farming. The improved nutrient absorption associated with prebiotics leads to better utilization of dietary proteins and minerals, reducing waste output.

Patel and Goyal, (2019) suggested that prebiotics can influence the composition of gut microbiota in ways that decrease methane and ammonia emissions from pig manure, contributing to a reduction in greenhouse gas emissions from pig farms. By supporting a more balanced microbial ecosystem in the gut, prebiotics also play a role in minimizing the presence of harmful bacteria metabolites that can lead to environmental contamination. These benefits make prebiotics an essential component of sustainable livestock production systems, helping to align swine farming with environmental conservation goals while maintaining productivity and profitability.

Conclusion:

Supplementation of prebiotics into swine diets can be achieved through various feed formulations. It's essential to consider the type and dosage of prebiotics to ensure optimal benefits in terms of health and overall production.

References:

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