



The impact of dietary fiber on gut health and performance in swine production

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Introduction. In livestock production, pig breeding occupies one of the leading positions in many countries and globally (Petrescu-Mag et al 2017; Proorocu et al 2021). Dietary fiber is a crucial component of swine diets, influencing gut health, nutrient utilization, and overall performance. Recent research has delved into the specific effects of dietary fiber sources, composition, and levels on gastrointestinal physiology, microbial populations, and production outcomes in pigs (Yang & Zhao 2021; Li et al 2021; Luo et al 2022; Hu et al 2023). This essay explores the latest findings on the impact of dietary fiber on gut health and performance in swine production, highlighting key insights and practical implications for optimizing swine diets.

Dietary fiber composition and sources. Dietary fiber encompasses a diverse array of plant-derived carbohydrates resistant to enzymatic digestion in the small intestine. Common sources of dietary fiber in swine diets include cereal grains, soybean hulls, beet pulp, and by-products such as distillers' grains and wheat bran. Each fiber source varies in composition, including soluble and insoluble fiber fractions, non-starch polysaccharides (NSPs), and fermentable substrates.

Recent studies have emphasized the importance of fiber composition in modulating gut microbiota composition, fermentation patterns, and nutrient utilization in pigs. For instance, soluble fibers such as pectin and fructo-oligosaccharides (FOS) promote the growth of beneficial bacteria like *Lactobacillus* and *Bifidobacterium*, contributing to improved gut health and immune function (Zhang et al 2022; Williams et al 2019). Conversely, insoluble fibers like cellulose and lignin provide bulking effects and regulate transit time in the gastrointestinal tract, influencing fecal consistency and nutrient digestibility (Hussein et al 2021).

Impact on gut health and function. Dietary fiber plays a pivotal role in maintaining gut health and function by stimulating microbial fermentation, promoting mucosal integrity, and regulating immune responses in the gut. Recent research has highlighted the effects of fiber-rich diets on the modulation of gut microbiota diversity and metabolic activity in pigs (Pu et al 2020).

Studies have demonstrated that high-fiber diets promote the proliferation of fiber-degrading bacteria such as *Prevotella* and *Fibrobacter*, leading to increased production of short-chain fatty acids (SCFAs) such as acetate, propionate, and butyrate (Gardiner et al 2020; Cao et al 2023). SCFAs serve as energy substrates for intestinal epithelial cells, exert anti-inflammatory effects, and enhance nutrient absorption and immune function in the gut (Liu et al 2021; Yao et al 2022).

Furthermore, dietary fiber promotes the secretion of mucin (Luo et al 2022) and the development of mucosal-associated lymphoid tissue (MALT) (Geervliet 2021), contributing to enhanced gut barrier function and defense against pathogens. These mechanisms collectively support gut health and integrity, reducing the risk of digestive disorders and improving overall performance in swine production systems.

Performance implications. The inclusion of dietary fiber in swine diets can have significant implications for production performance, including growth performance, feed efficiency, and carcass quality. Recent meta-analyses and feeding trials have investigated the dose-response relationships between dietary fiber levels and production outcomes in pigs (Rodrigues et al 2022).

Optimal dietary fiber levels and sources vary depending on factors such as pig age, genetics, and environmental conditions. However, research suggests that moderate levels of dietary fiber (about 15% inclusion) improve growth performance and feed efficiency in growing-finishing pigs without compromising carcass characteristics (Do et al 2023).

Moreover, the strategic use of dietary fiber in gestation and lactation diets has been shown to enhance sow gut health, reduce constipation, and improve reproductive performance (Liu et al 2021; Martinez Padilla 2022). Fiber-rich diets during gestation may alleviate the incidence of constipation, while postpartum diets high in fermentable fibers can stimulate lactation feed intake and milk production (Tan et al 2018; Liu et al 2021; Martinez Padilla 2022).

Conclusions. Recent research in porcine nutrition has elucidated the intricate relationship between dietary fiber, gut health, and performance in swine production. Understanding the impact of fiber composition, sources, and levels is crucial for formulating diets that promote optimal gut function, microbial balance, and production efficiency in pigs. By integrating the latest scientific findings into dietary management practices, swine producers can optimize feeding strategies, improve animal welfare, and enhance profitability in modern pork production systems.

Conflict of interest. The authors declare that there is no conflict of interest.

References

- Cao G., Yang S., Wang H., Zhang R., Wu Y., Liu J., et al, 2023 Effects of *Bacillus licheniformis* on the growth performance, antioxidant capacity, ileal morphology, intestinal short chain fatty acids, and colonic microflora in piglets challenged with lipopolysaccharide. *Animals* 13(13):2172. doi: 10.3390/ani13132172.
- Do S., Jang J. C., Lee G. I., Kim Y. Y., 2023 The role of dietary fiber in improving pig welfare. *Animals* 13(5):879. doi: 10.3390/ani13050879.
- Gardiner G. E., Metzler-Zebeli B. U., Lawlor P. G., 2020 Impact of intestinal microbiota on growth and feed efficiency in pigs: a review. *Microorganisms* 8(12):1886. doi: 10.3390/microorganisms8121886.
- Geervliet M., 2021 A window of opportunity: modulation of the porcine gut microbiota and immune system by feed additives in early life. Doctoral dissertation, Wageningen University and Research. doi: 10.18174/553257.
- Hu R., Li S., Diao H., Huang C., Yan J., Wei X., Zhou M., He P., Wang T., Fu H., Zhong C., Mao C., Wang Y., Kuang S., Tang W., 2023 The interaction between dietary fiber and gut microbiota, and its effect on pig intestinal health. *Frontiers in Immunology* 14:1095740. doi: 10.3389/fimmu.2023.1095740.
- Hussein S., Xiaoying Y., Farouk M. H., Abdeen A., Hussein A., Hailong J., 2021 The role effects of dietary fiber on intestinal microbial composition and digestive physiological functions of pigs: a review. *Indian Journal of Animal Research* 55(7):737-743.
- Li H., Yin J., Tan B., Chen J., Zhang H., Li Z., Ma X., 2021 Physiological function and application of dietary fiber in pig nutrition: a review. *Animal Nutrition* 7(2):259-267.

- Liu B., Zhu X., Cui Y., Wang W., Liu H., Li Z., Guo Z., Ma S., Li D., Wang C., Shi Y., 2021 Consumption of dietary fiber from different sources during pregnancy alters sow gut microbiota and improves performance and reduces inflammation in sows and piglets. *MSystems* 6(1): e00591-20. doi: 10.1128/mSystems.00591-20.
- Luo Y., Liu Y., Li H., Zhao Y., Wright A. D. G., Cai J., Tian G., Mao X., 2022 Differential effect of dietary fibers in intestinal health of growing pigs: outcomes in the gut microbiota and immune-related indexes. *Frontiers in Microbiology* 13:843045. doi: 10.3389/fmicb.2022.843045.
- Martinez Padilla G. E., 2022 Using fermentable fiber during gestation and early lactation to improve reproductive performance of sows. North Carolina State University ProQuest Dissertations Publishing 29781185. <https://www.lib.ncsu.edu/resolver/1840.20/39912>.
- Petrescu-Mag I. V., Stoian R. O., Todoran C., 2017 Pork production in Romania. *Porc Res* 7(1):32-38.
- Proorocu M., Petrescu D. C., Burny P., Petrescu-Mag R. M., 2021 Pork meat consumption, from statistics to consumer behavior: a review. *Porc Res* 11(1):2-8.
- Pu G., Li P., Du T., Niu Q., Fan L., Wang H., Liu H., Li K., Niu P., Wu C., Zhou W., Huang R., 2020 Adding appropriate fiber in diet increases diversity and metabolic capacity of distal gut microbiota without altering fiber digestibility and growth rate of finishing pig. *Frontiers in Microbiology* 11:514929. doi: 10.3389/fmicb.2020.00533.
- Rodrigues L. A., Koo B., Nyachoti M., Columbus D. A., 2022 Formulating diets for improved health status of pigs: current knowledge and perspectives. *Animals* 12(20):2877. doi: 10.3390/ani12202877.
- Tan C. Q., Sun H. Q., Wei H. K., Tan J. J., Long G., Jiang S. W., Peng J., 2018 Effects of soluble fiber inclusion in gestation diets with varying fermentation characteristics on lactational feed intake of sows over two successive parities. *Animal* 12(7):1388-1395.
- Williams B. A., Mikkelsen D., Flanagan B. M., Gidley M. J., 2019 "Dietary fibre": moving beyond the "soluble/insoluble" classification for monogastric nutrition, with an emphasis on humans and pigs. *Journal of Animal Science and Biotechnology* 10:45. doi: 10.1186/s40104-019-0350-9.
- Yang P., Zhao J., 2021 Variations on gut health and energy metabolism in pigs and humans by intake of different dietary fibers. *Food Science & Nutrition* 9(8):4639-4654.
- Yao Y., Cai X., Fei W., Ye Y., Zhao M., Zheng C., 2022 The role of short-chain fatty acids in immunity, inflammation and metabolism. *Critical Reviews in Food Science and Nutrition* 62(1):1-12.
- Zhang Y., Mu C., Liu S., Zhu W., 2022 Dietary citrus pectin drives more ileal microbial protein metabolism and stronger fecal carbohydrate fermentation over fructo-oligosaccharide in growing pigs. *Animal Nutrition* 11:252-263.

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