



Improving Feed and Nutrient Utilization by Optimizing Diet Energy and Nutrient Levels: Fiber

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Introduction

Global meat production is expected to rise by 12% from 2023 to 2032, with pork production growing from 117 to 129 million metric tons per year (OECD and FAO). Most of the environmental impact in pig farming comes from the feed system, which includes crop cultivation, feed manufacturing, and transportation. Improving pig health, management, and feed efficiency, as well as better handling of swine waste, can help meet the growing demand for pork while reducing its environmental impact (Andretta et al., 2021). Fiber is an important dietary component that influences nutrient digestibility and the form of nitrogen (N) excretion in pigs. While high fiber diets often reduce energy density and digestibility, they can also provide environmental benefits by shifting N excretion from urine (as urea) to feces (as bacterial protein). This shift slows the release of N into the environment, reducing emissions from manure and improving the sustainability of swine production (Nahm, 2003; Zervas and Zijlstra, 2002).

Fiber

Fiber characteristics such as viscosity and fermentability play a key role in nutrient utilization. High-viscous, low-fermentable fibers can increase small intestinal digestibility by slowing digesta passage (Dikeman and Fahey, 2006; Hooda et al., 2011). Adding fermentable fiber sources like sugar beet pulp or soybean hulls has been shown to reduce urinary N and increase fecal N without altering total N excretion, thereby improving N retention (Zervas and Zijlstra, 2002; Patrás et al., 2012).

	Low Crude Protein, AA supplemented	Low Crude Protein, AA Supplemented + 15% Beet Pulp	High Crude Protein	High Crude Protein + 15% Beet Pulp
Urinary N excretion, % of intake	25.7	22.9	36.3	28.9
Fecal N excretion, % of intake	15.3	18.3	12.7	14.6
N retention, % absorbed	69.4	71.9	60.6	66.1

Adapted from Patrás et al., 2012.

In gestating sows, feeding higher-fiber diets (e.g., with inulin and cellulose) increased fecal N, lowered urinary N, and improved overall N retention (Yang et al., 2022).

	Low Dietary Fiber	High Dietary Fiber
Urinary N excretion, % of intake	71	65
Fecal N excretion, % of intake	29	35
N retention, % absorbed	56.2	63.1
Adapted from Yang et al., 2022.		

From an environmental perspective, shifting N from urine to feces is beneficial because fecal N decomposes more slowly, reducing the risk of ammonia volatilization and nitrate leaching (Nahm, 2003). A review by Jha and Berrococo (2016) quantified this effect, showing that the urinary-to-fecal N ratio can be predicted from dietary non-starch polysaccharide (NSP) content: $\text{urine N/fecal N} = 178.1 \times \text{NSP}^{-0.83}$ ($R^2 = 0.79$).

Overall, strategic use of dietary fiber can alter N partitioning, enhance retention, and reduce the environmental footprint of pork production, though it must be balanced with its tendency to lower energy density and performance if not carefully formulated.

Summary

- Fiber affects nutrient digestibility and N excretion depending on its viscosity and fermentability
- Fermentable fiber sources shift N excretion from urine to feces without changing overall N output
- Shifting N from urine (urea) to feces (bacterial protein) is environmentally beneficial because fecal N decomposes more slowly, reducing NH₃ volatilization and nitrate leaching

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