Food Science & Applied Microbiology Reports
Vol. 3(1),2024; 33-36
ISSN (Online) 2958-0684
https://finessepublishing.com/fsamr

# An interconnected triad of dietary fiber, gut microbiome, and health: A perspective

**Muhamad Suhail Ibrahim[a]* and Wajahat Azeem[b]**

**a.** Institute of Food and Nutritional Sciences, PMAS Arid Agriculture University, Rawalpindi, Pakistan
**b.** Department of Plant Pathology, PMAS Arid Agriculture University, Rawalpindi, Pakistan

The gut microbiome has emerged as a key player in the fight against metabolic diseases. The effectiveness of this defense depends on the diversity of the microbiome and the unique characteristics of the host; short-chain fatty acids (SCFA), one of the key metabolites generated by the microbiome, are crucial for preserving human health. Dietary fiber functions as a prebiotic, influencing the microbiota and encouraging the synthesis of SCFA. Dietary fiber, the gut microbiota, and general health are related in ways that have significant effects on a variety of functions, including immunity, food digestion, and promoting health. Understanding these interactions is important for health prevention and disease control. Dietary fiber is a carbohydrate obtained from plants and cannot be digested by human enzymes. It is divided into groups that are soluble and insoluble. Soluble fiber-rich foods, such as oats, legumes, and fruits, dissolve in water to form a gel-like substance that reduces cholesterol and blood sugar levels (Anderson et al., 2009; Slavin, 2008). According to McRorie Jr and McKeown (2017), insoluble fiber, which is present in whole grains and vegetables, helps digestion and microbial diversity (Conlon & Bird, 2014). By offering a substrate for fermentation, fiber affects the makeup and activity of the gut microbiome, which in turn affects general health (Makki et al., 2018).

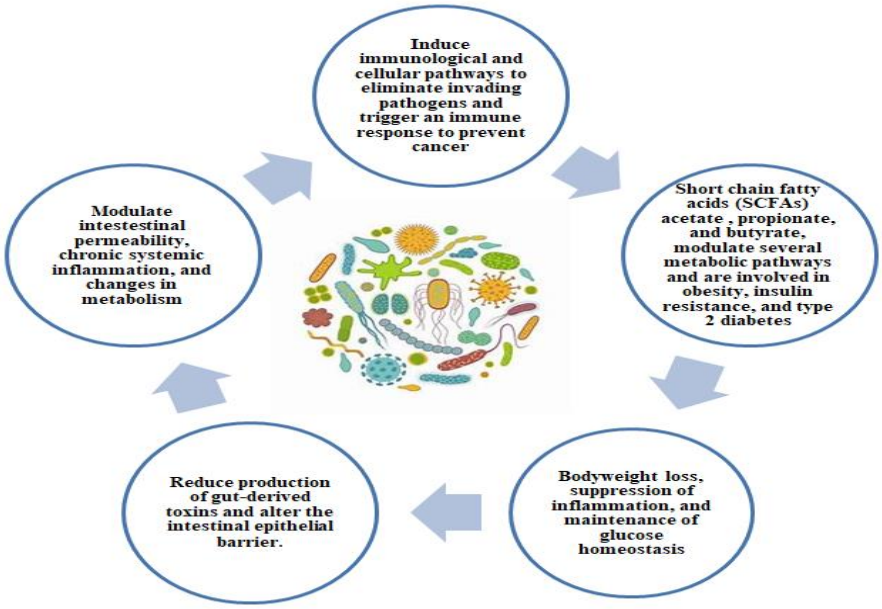


**Figure 1:** Potential health benefits of Gut Microbiome

[Received] 10 Apr 2024; Accepted 15 June 2024; Published (online) 20 June 2024]
Finesse Publishing stays neutral about jurisdictional claims published maps.

Corresponding email: drsuhailibrahim@outlook.com (Muhamad Suhail Ibrahim)
DOI: 10.61363/ytnwmf69

## 1. The Gut Microbiome: The Body's Microbial Ecosystem

Trillions of species, including bacteria, viruses, fungi, and archaea, make up the gut microbiome. These microorganisms are crucial for bodily functions such as immunity, digestion, and nutrient absorption (Shoubridge et al., 2022). Numerous factors, including nutrition, genetics, age, and lifestyle choices, impact the makeup of the gut microbiome. SCFAs, including acetate, propionate, and butyrate, are produced by intestinal bacteria through fermentation of fiber after it reaches the colon (Ríos-Covián et al., 2016). According to Koh et al. (2016), SCFAs offer several health advantages, including supplying gut bacteria with energy, lowering inflammation, enhancing gut health, and preventing infections and illnesses of the intestines.

## 2. Future Health Implications of Fiber-Microbiome Interactions

The gut microbial ecosystem influences the immune system, immunity, and energy harvesting, as well as the gut-host interface (Puljiz et al., 2023). There are significant health consequences from the relationship between the gut microbiota and dietary fiber. Numerous ailments, such as heart disease, type 2 diabetes, obesity, and cancer, are prevented by eating a diet high in fiber (Reynolds et al., 2019).

Health Benefits: Because soluble fiber binds to bile acids, it lowers blood cholesterol. Bile acids are released rather than reabsorbed. This process causes the liver to use cholesterol to produce more bile, thus reducing cholesterol in the blood (Ioniță-Mîndrican et al., 2022). Additionally, short-chain fatty acids produced through fiber fermentation further support cardiovascular health by helping to control blood pressure and inflammation (O'Keefe et al., 2015).

**Metabolic health:** Dietary fiber helps control blood sugar by speeding up the absorption of sugar and preventing diabetes. SCFA produced during fermentation can improve insulin sensitivity and energy metabolism, lower the chance of developing type 2 diabetes, and aid in weight control (Weickert & Pfeiffer, 2018).

**Intestinal health:** Fiber increases stool volume and prevents constipation by promoting digestion (Slavin, 2008). Short-chain fatty acids produced by fiber fermentation stimulate colonocytes and protect the intestinal environment, reducing the risk of cancer and intestinal diseases such as Crohn's disease and ulcerative colitis (O'Keefe et al., 2015).

**Immune function:** The gut microbiome is crucial for the development and function of the immune system. SCFAs have anti-inflammatory properties and influence the immune system, supporting a balanced immune system. This interaction may help control autoimmune diseases and allergies. The gut microbiome not only aids in the removal of nutrients but also calibrates the immune system (Shi et al., 2022). It mediates host-microbiome interactions, alters drug metabolism, removes toxins, and produces bioactive compounds (Wang et al., 2023).

**Brain health:** The gut-brain axis, which describes the connection between the gut microbiota and the brain, is demonstrated by research. SCFA may influence brain function and behavior by regulating neurotransmitter levels and inflammation. A diet high in fiber may reduce the risk of depression and anxiety (Sonnenburg & Sonnenburg, 2019).

**Liver health:** In metabolic liver disease, the relative numbers of Ruminococcaceae and Bacteroidetes often decrease, while the relative numbers of Escherichia, Lactobacillus, Streptococcus, Blautella, and Prevotella increase. The microbiome shows therapeutic potential in reducing liver disease (Shalaby et al., 2023).

## 3. Conclusion

Including a range of foods high in fiber in the diet is a useful and efficient strategy to improve the health of the gut flora and general well-being. Fruits, vegetables, whole grains, legumes, nuts, and seeds are good sources of dietary fiber. Many people do not consume the recommended 25–30 grams of fiber per day as recommended by the current dietary recommendations (Dahl & Stewart, 2015). Expanding our knowledge of the connection between gut microbiota, dietary fiber, and health emphasizes the importance of dietary choices in preventive

healthcare. By fostering a diverse and healthy gut flora, a high-fiber diet can significantly improve people's long-term health outcomes.

## CRediT authorship contribution statement

Samra Munir conceptualized and wrote the manuscript, and other authors drafted and revised the manuscript.

## Funding

This work was not financially supported by any funding agency.

## Declaration of Competing Interest

The authors declared no conflict of interest.

## Acknowledgments

The author(s) acknowledge that they did not receive any financial support from any funding agency, whether public, private, or non-profit. The study was conducted independently without external funding.

## References

Anderson, J. W., Baird, P., Davis Jr, R. H., Ferreri, S., Knudtson, M., Koraym, A., Waters, V., & Williams, C. L. (2009). Health benefits of dietary fiber. *Nutrition reviews*, *67*(4), 188-205.

Conlon, M. A., & Bird, A. R. (2014). The impact of diet and lifestyle on gut microbiota and human health. *Nutrients*, *7*(1), 17-44.

Dahl, W. J., & Stewart, M. L. (2015). Position of the Academy of Nutrition and Dietetics: health implications of dietary fiber. *Journal of the Academy of Nutrition and Dietetics*, *115*(11), 1861-1870.

Ioniță-Mîndrican, C.-B., Ziani, K., Mititelu, M., Oprea, E., Neacșu, S. M., Moroșan, E., Dumitrescu, D.-E., Roșca, A. C., Drăgănescu, D., & Negrei, C. (2022). Therapeutic benefits and dietary restrictions of fiber intake: A state of the art review. *Nutrients*, *14*(13), 2641.

Makki, K., Deehan, E. C., Walter, J., & Bäckhed, F. (2018). The impact of dietary fiber on gut microbiota in host health and disease. *Cell host & microbe*, *23*(6), 705-715.

McRorie Jr, J. W., & McKeown, N. M. (2017). Understanding the physics of functional fibers in the gastrointestinal tract: an evidence-based approach to resolving enduring misconceptions about insoluble and soluble fiber. *Journal of the Academy of Nutrition and Dietetics*, *117*(2), 251-264.

O'Keefe, S. J., Li, J. V., Lahti, L., Ou, J., Carbonero, F., Mohammed, K., Posma, J. M., Kinross, J., Wahl, E., & Ruder, E. (2015). Fat, fibre and cancer risk in African Americans and rural Africans. *Nature communications*, *6*(1), 6342.

Puljiz, Z., Kumric, M., Vrdoljak, J., Martinovic, D., Ticinovic Kurir, T., Krnic, M. O., Urlic, H., Puljiz, Z., Zucko, J., & Dumanic, P. (2023). Obesity, gut microbiota, and metabolome: from pathophysiology to nutritional interventions. *Nutrients*, *15*(10), 2236.

Reynolds, A., Mann, J., Cummings, J., Winter, N., Mete, E., & Te Morenga, L. (2019). Carbohydrate quality and human health: a series of systematic reviews and meta-analyses. *The Lancet*, *393*(10170), 434-445.

Ríos-Covián, D., Ruas-Madiedo, P., Margolles, A., Gueimonde, M., De Los Reyes-gavilán, C. G., & Salazar, N. (2016). Intestinal short chain fatty acids and their link with diet and human health. *Frontiers in microbiology*, *7*, 185.

Shalaby, N., Samocha-Bonet, D., Kaakoush, N. O., & Danta, M. (2023). The role of the gastrointestinal microbiome in liver disease. *Pathogens*, *12*(9), 1087.

Shi, H., Ter Horst, R., Nielen, S., Bloemendaal, M., Jaeger, M., Joosten, I., Koenen, H., Joosten, L. A., Schweren, L. J., & Vasquez, A. A. (2022). The gut microbiome as mediator between diet and its impact on immune function. *Scientific Reports*, *12*(1), 5149.

Shoubridge, A. P., Choo, J. M., Martin, A. M., Keating, D. J., Wong, M.-L., Licinio, J., & Rogers, G. B. (2022). The gut microbiome and mental health: advances in research and emerging priorities. *Molecular psychiatry*, *27*(4), 1908-1919.

Slavin, J. L. (2008). Position of the American Dietetic Association: health implications of dietary fiber. *Journal of the american dietetic association*, *108*(10), 1716-1731.

Sonnenburg, E. D., & Sonnenburg, J. L. (2019). The ancestral and industrialized gut microbiota and implications for human health. *Nature Reviews Microbiology*, *17*(6), 383-390.

Wang, Q., Li, D., Sun, J., Yan, J., Wang, Y., Yang, J., & Zhang, F. (2023). Gut microbiota and cancer-associated malnutrition. *Precision Nutrition*, *2*(1), e00033.

Weickert, M. O., & Pfeiffer, A. F. (2018). Impact of dietary fiber consumption on insulin resistance and the prevention of type 2 diabetes. *The Journal of Nutrition*, *148*(1), 7-12.