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

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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 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 and McKeown (2017), insoluble fiber, which is present in whole grains and vegetables, helps digestion and microbial diversity (Conlon and Bird, 2015). 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).

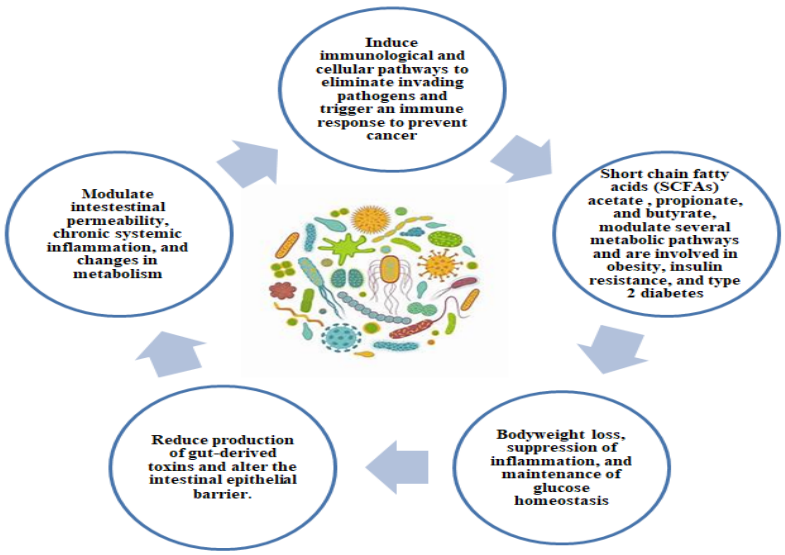

Figure 1: Potential health benefits of Gut Microbiome

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

Trillions of species, including bacteria, viruses, fungus, and archaea, make up the gut microbiome. These microorganisms are crucial for bodily functions as immunity, digestion, and nutrition absorption (Shoubridge et al., 2022). Numerous factors, including nutrition, genetics, age, and lifestyle choices, impact the makeup of the gut microbiome. SCFA 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 (IoniÈä-Måndrican 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 and 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 (Oâ€ 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 and 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 wellbeing. 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 and Stewart, 2015). By 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.

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