



Functional Foods: Bioactive Compounds, Mechanisms and Therapeutic Potential in human health

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Abstract: Functional foods enriched with bioactive compounds have gained significant attention for their role in promoting human health and preventing chronic diseases. These foods contain physiologically active components such as polyphenols, flavonoids, omega-3 fatty acids, probiotics, prebiotics and other phytochemicals that exert beneficial effects through multiple biological mechanisms. This article explores the major classes of bioactive compounds present in functional foods and highlights their antioxidant, anti-inflammatory, gut microbiota-modulating and enzyme-inhibitory activities. These mechanisms contribute to reducing oxidative stress, regulating inflammatory responses, improving digestive health and controlling disease-related metabolic pathways. Furthermore, the therapeutic potential of functional foods in preventing chronic conditions such as cardiovascular diseases, diabetes, cancer and neurodegenerative disorders is discussed. The role of these foods in enhancing immune function and overall well-being is also emphasized. However, factors such as processing methods, storage conditions, bioavailability and consumer acceptance can influence the effectiveness of bioactive compounds.

Keywords: Functional foods, bioactive compounds, polyphenols, omega-3 fatty acids, probiotics, phytochemicals

Introduction:

Functional foods, enriched with bioactive compounds, have emerged as a significant area of interest in promoting human health and preventing chronic diseases. These foods contain non-essential but beneficial compounds such as polyphenols, carotenoids, omega-3 fatty acids, probiotics and prebiotics, which exert therapeutic effects through various mechanisms. The integration of these compounds into everyday diets can modulate metabolic processes, enhance immune function and reduce the risk of diseases like cardiovascular disorders, diabetes and cancer. The therapeutic potential of functional foods is supported by scientific evidence, highlighting their role in public health initiatives. The following sections explore the bioactive compounds, their mechanisms and the therapeutic potential of functional foods.

Bioactive Compounds in Functional Foods

i) Polyphenols and Flavonoids

These compounds are known for their antioxidant properties, which help in reducing oxidative stress and inflammation, thereby lowering the risk of chronic diseases (Vignesh et al., 2024). Incorporating polyphenols and flavonoids into functional foods enhances their health-promoting properties and contributes to the prevention of chronic diseases by modulating inflammatory responses. However, the efficacy of these bioactive compounds is influenced by factors such as processing techniques and storage conditions, which can impact their stability and bioavailability (Singh, 2024). A clear understanding of these factors is essential for maximizing the health benefits of functional foods.

ii) Omega-3 Fatty Acids

Found in fish oils and some plant sources, omega-3 fatty acids are crucial for cardiovascular health and have anti-inflammatory effects (Fazal et al., 2025). Research suggests that omega-3 fatty acids play an important role in lowering the risk of serious

cardiovascular conditions, including myocardial infarction and stroke, while supporting overall heart health (Sharma *et al.*, 2023). Their inclusion in functional foods further improves the health-promoting potential of these products, particularly by enhancing cardiovascular function and helping to reduce inflammation (Singh, 2024).

iii) Probiotics and Prebiotics

These compounds support gut health by modulating the microbiota, enhancing immune function and potentially reducing the risk of gastrointestinal diseases (Fazal *et al.*, 2025). The synergistic effects of probiotics and prebiotics can lead to improved gut health and overall well-being, emphasizing their importance in functional food formulations (Rasool *et al.*, 2023). Incorporating these bioactive compounds into daily diets not only promotes individual health but also plays a vital role in public health strategies aimed at reducing chronic disease prevalence.

iv) Phytochemicals

Naturally occurring in plants, these compounds have attracted considerable attention for their potential in preventing and managing oxidative stress-related and inflammatory disorders (Mondal *et al.*, 2021; Aathithya, 2024). Phytochemicals, particularly flavonoids and carotenoids, are widely recognized for their diverse biological activities and their significant contribution to human health. These compounds act as powerful antioxidants by neutralizing free radicals, thereby reducing oxidative damage to cells and tissues.

In addition to their antioxidant capacity, phytochemicals exhibit strong anti-inflammatory properties by modulating key signalling pathways and reducing the production of pro-inflammatory mediators. This dual action plays a crucial role in lowering the risk of chronic diseases such as cardiovascular disorders, diabetes and certain types of cancer. Furthermore, regular consumption of phytochemical-rich foods, including fruits, vegetables and whole grains, is associated with improved immune function and overall well-being.

Mechanisms of Action

- **Antioxidant Activity:** Bioactive compounds scavenge free radicals, reducing oxidative damage and preventing cellular damage (Rafaqat *et al.*, 2025). This protective mechanism is essential for maintaining cellular integrity and function, ultimately

contributing to the prevention of chronic diseases linked to oxidative stress.

- **Anti-inflammatory Responses:** Many bioactive compounds have the ability to suppress key inflammatory pathways in the body, thereby reducing the production of pro-inflammatory mediators. This action plays a significant role in managing chronic conditions such as arthritis and cardiovascular diseases, where persistent inflammation is a major contributing factor. By modulating these biological processes, bioactive compounds help alleviate symptoms, protect tissues from damage, and support overall health (Arshad *et al.*, 2025; Vignesh *et al.*, 2024).
- **Modulation of Gut Microbiota:** Probiotics and prebiotics play a vital role in maintaining gut health by supporting the growth and activity of beneficial intestinal bacteria. This positive modulation of the gut microbiota helps improve digestive efficiency, enhances nutrient absorption and contributes to a more balanced intestinal environment. In addition, a healthy gut microbiome strengthens immune function by stimulating protective responses and reducing the risk of infections and inflammation (Arshad *et al.*, 2025).
- **Enzyme Inhibition:** Certain bioactive compounds can interfere with the activity of enzymes that play key roles in disease-related pathways, including those associated with cancer and metabolic disorders. By inhibiting these enzymes, they can slow down or regulate abnormal cellular processes, such as uncontrolled cell growth or impaired metabolic function. This mechanism contributes to their therapeutic potential, helping to reduce disease progression and support overall metabolic and cellular health (Vignesh *et al.*, 2024).

Therapeutic Potential

- **Chronic Disease Prevention:** Functional foods have been linked to reduced risks of heart disease, diabetes, obesity, and cancer through their bioactive components (Aathithya, 2024).
- **Cognitive Health:** Some bioactive compounds support cognitive function and may reduce the risk of neurodegenerative diseases (Fazal *et al.*, 2025).
- **Immune System Enhancement:** By modulating immune responses, functional foods can help in preventing infections and

improving overall health (Chandran *et al.*, 2024).

Conclusion:

The benefits of functional foods are well-documented, challenges remain in terms of bioavailability, stability, and consumer acceptance. The variability in bioactive compound composition and the need for

standardized regulatory frameworks are significant hurdles. Additionally, while functional foods offer promising health benefits, it is crucial to consider the potential for adverse effects if bioactive compounds are consumed in excess. Therefore, ongoing research and innovation in delivery systems and personalized nutrition are essential to maximize the therapeutic potential of functional foods.

References:

- Aathithya, S. (2024). Functional foods and its role in human health-a review. *ComFin Research*, 12, 29-34.
- Sharma, A., Saniya, Kumar, S., Khadse, S. T., Keshamma, E., Minu, K. P., Kumar, R., Meena, M. K., Parasha, M., & Mandal, S. (2023). Cardiovascular Importance of Omega-3 Fatty Acids: A Depth Review. *International Journal of Current Pharmaceutical Review and Research*, 15(10), 325–338.
- Chandran, R., Obuliraj, S., Sundararajan, S., Baskaran, S., & Margabandhu, M. (2024). Bioactive Components in Functional Foods, Mechanism of Action and Impacts on Health with a Focus on COVID-19–A Review. *Current Research in Nutrition and Food Science Journal*, 12(3), 1035-1061.
- Fazal, M., Siddique, F., Saeed, A., Zahid, A., & Ali, Z. (2025). Functional Foods, Efficacy and Disease Prevention. Scientific Knowledge Publisher (SciKnowPub), USA.
- Arshad, Z., Shahid, S., Hasnain, A., Yaseen, E., & Rahimi, M. (2025). Functional foods enriched with bioactive compounds: therapeutic potential and technological innovations. *Food Science & Nutrition*, 13(10), e71024.
- Mondal, S., Soumya, N. P. P., Mini, S., & Sivan, S. K. (2021). Bioactive compounds in functional food and their role as therapeutics. *Bioactive Compounds in Health and Disease-Online ISSN: 2574-0334*, 4(3), 24-39.
- Rafaqat, S., Saqib, H. M. J., Yasir, M. H., Rasheed, M. M., Fatima, M. N., & Malik, F. (2025). A Comprehensive Review on the Sources, Stability, and Health Implications of Bioactive Compounds Present in Foods. *Indus Journal of Bioscience Research*, 3(8), 112-118.
- Rasool, A., Porteen, K., Sarath, T., & Joshy, K. (2023). Exploring the potential of probiotics and faecal microbiota in maintaining a healthy gut microbiota. *Journal of Scientific Research and Reports*, 29(7), 101-106.
- Singh, N. (2024). Functional foods. In *Edited book of dietary supplements and nutraceuticals* (Vol. 4, pp. 155–178). IIP Series.
- Vignesh, A., Amal, T. C., Sarvalingam, A., & Vasanth, K. (2024). A review on the influence of nutraceuticals and functional foods on health. *Food chemistry advances*, 5, 100749.