



OPEN ACCESS

EDITED AND REVIEWED BY
Rosane Freitas Schwan,
Universidade Federal de Lavras, Brazil

*CORRESPONDENCE
Nassim Naderi,
✉ nassim.naderi@gmail.com

RECEIVED 17 September 2025
ACCEPTED 13 October 2025
PUBLISHED 23 October 2025

CITATION

Naderi N (2025) Editorial: Optimizing nutrition from the inside out: innovations in digestion, fermentation, and functional food processing. *Front. Food Sci. Technol.* 5:1707788. doi: 10.3389/frfst.2025.1707788

COPYRIGHT

© 2025 Naderi. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](#). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Editorial: Optimizing nutrition from the inside out: innovations in digestion, fermentation, and functional food processing

Nassim Naderi *

Independent Researcher, Montreal, QC, Canada

KEYWORDS

fermentation, valorization, bioaccessibility, sustainability, personalized nutrition strategies

Editorial on the Research Topic

Optimizing nutrition from the inside out: innovations in digestion, fermentation, and functional food processing

The nutritional value of food extends far beyond its basic composition of macronutrients and micronutrients. It is increasingly recognized that the true impact of food on human health is governed by the bioaccessibility and bioavailability of its bioactive compounds, how effectively these compounds are released from the food matrix, digested, absorbed, and ultimately metabolized by the body. This intricate journey from ingestion to cellular utilization is shaped by a multitude of factors, including the physical and chemical structure of the food, the methods used in its processing, and its dynamic interactions with the gastrointestinal tract and resident microbiota.

Understanding and optimizing these processes is critical in the pursuit of sustainable nutrition and personalized health strategies. As global challenges such as food security, chronic disease, and environmental sustainability converge, innovative approaches to food digestion and fermentation are emerging as powerful tools to enhance nutrient delivery and functional benefits.

The nutritional value of food is not solely determined by its composition, but by how effectively its bioactive compounds are digested, absorbed, and metabolized. This journey from matrix to metabolism is shaped by food structure, processing techniques, and interactions with the gastrointestinal tract and microbiota. As global challenges such as food waste, nutrient deficiencies, and sustainability converge, innovations in digestion and fermentation are emerging as powerful tools to unlock the full potential of food.

The Research Topic “[Innovations in Food Digestion and Fermentation Strategies](#)” brings together four pioneering studies that explore the multifaceted journey of nutrients from ingestion to absorption, and ultimately, to their biological impact. The digestion and fermentation of foods play critical roles in determining their nutritional quality and subsequent health benefits. Central to this process is the concept of bioaccessibility (the release of nutrients from the food matrix), and bioavailability (their absorption and utilization by the body). These factors are influenced by a complex interplay of food composition, structural properties, processing techniques, and interactions with the gastrointestinal tract, microbiota, and liver metabolism. Despite significant advancements, many bioactive compounds still exhibit low bioaccessibility, and the

Optimizing Nutrition from the Inside Out: Innovations in Digestion, Fermentation, and Functional Food Processing



Valorization of By-Products

Repurposing food waste into valuable nutritional ingredients



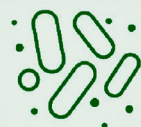
Digestion and Bioavailability

Enhancing the absorption and utilization of nutrients



Encapsulation Technologies

Improving the stability and delivery of bioactive compounds



Microbiota Modulation

Influencing gut health through dietary interventions

GRAPHICAL ABSTRACT

mechanisms governing their metabolic fate remain incompletely understood. This gap underscores the urgent need for innovative strategies that can optimize food processing and digestion to enhance nutrient uptake and improve health outcomes.

In response to this challenge, the Research Topic aims to explore cutting-edge approaches that enhance the effectiveness of natural bioactive compounds through improved digestion and fermentation strategies. These include enzyme and probiotic supplementation, novel processing technologies such as High-Pressure Processing (HPP) and Pulsed Electric Fields (PEF), and nanotechnology-based delivery systems. By integrating these methodologies, the featured studies offer a holistic and interdisciplinary perspective on how food science can evolve to meet the nutritional demands of diverse populations.

The first study by [Vichare and Morya](#) exemplifies the principle of resource valorization by investigating the nutritional potential of oilseed cakes—by-products of oil extraction often discarded as waste. Through enzymatic treatment and fermentation, these protein- and phytochemical-rich materials can be transformed into digestible, nutrient-dense ingredients, contributing to both environmental sustainability and improved dietary quality. This approach aligns with circular economy principles and sets the stage for rethinking food waste as a source of functional nutrition.

Building on this, [Wang et al.](#) explore how fermentation can preserve essential micronutrients in plant-based materials. Their study on *Leymus chinensis* demonstrates that silage fermentation retains significantly higher levels of B vitamins and α -tocopherol compared to natural drying. While primarily focused on forage crops, the implications extend to human nutrition, suggesting that

similar fermentation techniques could be applied to vegetables and herbs to maintain nutrient integrity during storage and transport.

To ensure that preserved nutrients are effectively delivered to the body, [Memon et al.](#) present clinical evidence on the superior bioavailability of Sucrosomial® vitamin B12, an encapsulated formulation designed to bypass gastrointestinal degradation. This technology is particularly beneficial for individuals with malabsorption conditions, such as pernicious anemia or age-related decline in intrinsic factor production and highlights the potential of nanotechnology in targeted nutrient delivery.

Finally, [Afifah et al.](#) combine fermentation with plant-based innovation by developing a novel tempe product from *Plukenetia volubilis* (sacha inchi), a legume rich in polyunsaturated fatty acids. Their findings show that fermentation enhances protein and monounsaturated fat content, while steaming preserves PUFA levels, offering a non-soy alternative to traditional tempe. This study not only broadens the scope of functional foods but also demonstrates how fermentation can be tailored to improve both nutritional and sensory attributes.

Together, these studies illustrate a cohesive narrative in which fermentation, encapsulation, and valorization are not isolated innovations, but interconnected strategies aimed at optimizing nutrition from the inside out. They reflect a forward-thinking vision of food science one that bridges sustainability, technological advancement, and human health. As research continues to evolve through dynamic digestive models and precision processing, the goal remains clear: to transform everyday foods into powerful tools for wellbeing, efficiently, effectively, and responsibly.

In this context, the Research Topic not only showcases scientific progress but also highlights the broader implications of these innovations. By tackling the persistent challenges of low bioaccessibility and limited understanding of metabolic pathways, the featured studies contribute to a growing body of knowledge that seeks to make nutrition more functional, inclusive, and sustainable. The integration of novel technologies such as enzyme supplementation, advanced fermentation techniques, and nanotechnology-based delivery systems demonstrates how interdisciplinary collaboration can lead to breakthroughs that benefit both individual health and global food systems.

Moreover, the emphasis on valorizing underutilized resources and tailoring food processing to preserve and enhance nutrient profiles aligns with urgent environmental and public health priorities. These approaches support the development of resilient food systems that can adapt to changing dietary needs, resource constraints, and consumer preferences. As we look ahead, continued exploration of unconventional food sources, microbiota modulation, and personalized nutrition strategies will be essential to fully realize the potential of these innovations.

Ultimately, this Research Topic serves as both a foundation and a catalyst inviting researchers, technologists, and policymakers to reimagine how we produce, process, and consume food. By embracing a holistic and systems-based approach to food digestion and fermentation, we move closer to a future where nutrition is not only optimized for health but also harmonized with sustainability and equity.

Author contributions

NN: Writing – original draft, Writing – review and editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Generative AI was used in the creation of this manuscript.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.