

Editorial

Personalized nutrition and microbiome innovation: Shaping the future of precision health

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1. Introduction

In the current era, scientific research extends beyond understanding the mechanisms and functional principles of biological pathways, focusing increasingly on their practical applications and translational potential. Currently, it is employed in biomedical fields, facilitating the discovery of novel therapeutic compounds and the development of modern technologies, thus helping researchers across the globe. These advancements occur rapidly and have a greater impact on both individual and societal lives. Likewise, the multidisciplinary approach that integrates different areas is currently essential for the management and treatment of disorders and individual lifestyles. These integrated strategies have the potential to enhance disease prevention, improve therapeutic outcomes, and ultimately promote human health and well-being [1]. Food and nutrition have remained an important area of human interest since the beginning. Transformation from nutrient enrichment to personalized nutrition is currently underway in the area of food science and therapeutic physiology. The choice of an individual's lifestyle and other contributing factors have a great impact on the physiological functions of the person [2,3]. Recent scientific discoveries have identified a complex relationship among genetics, lifestyle, environment, and the gut microbiome, which influences human health. These findings have given rise to a new paradigm—personalized nutrition—where dietary interventions are tailored to an individual's biological characteristics and health needs. Microbiota represents a dynamic ecosystem of different microorganisms, can influence various functions and overall well-being [4–6].

1.1. The human microbiome

The microbiome is the collection of all microorganisms associated with a particular place, such as the gastrointestinal tract (GIT) of animals. Human GIT harbors trillions of microbes, which contribute significantly to different functions and influence the immune system and gut homeostasis [7,8]. These microbes also influence the interaction with host cells, disease progression, and health status. Advances in genomic technologies help to explore these intricate interactions and provide insight to decipher such phenomena for different pathophysiological functions. The consideration of the microbiome as a hidden organ reflects its critical role in maintaining physiological homeostasis [9–11].

1.2. Personalized nutrition

Traditional nutrition is designed for general populations rather than specific individuals' needs. Despite having valuable insights, these traditional guidelines fail to account for interindividual differences in genetics, metabolism, lifestyle, and microbial composition [12]. To overcome these limitations, the discipline of personalized nutrition was introduced. In personalized nutrition, different biological and environmental factors, such as genetic differences, metabolic biomarkers, dietary habits, etc., are integrated to develop a person-specific nutritional requirement [13,14].

1.3. The probiotics and postbiotics

Microbiome innovations can be extended beyond the characterization of targeted modulation of microbial ecosystems and their implications. Probiotics, postbiotics, and other substances are influencing these intricate ecosystems and offer a way to be targeted for disease prevention and microbiome restoration. Probiotics, which are live microorganisms that confer health benefits when taken in adequate amounts, remain the widely studied microbiome-based interventions in dietary and personalized nutrition [15,16]. However, recent research highlights that future microbial therapeutics may take advantage of more sophisticated approaches, including the next-generation probiotics, which offer promising opportunities for disease prevention and personalized health development. Likewise, the postbiotics—preparations of inanimate microorganisms and their components that confer a health benefit to the host—have attracted increasing attention due to their non-living nature, stability, and therapeutic potential [17]. Progress in comparative genomics and probiogenomics (genomic investigation of probiotics) is helping researchers to identify microbial strains with specific functional properties. Integrating these technologies with probiotic-based science can accelerate the development of precision probiotics tailored for individual health and nutritional requirements [18].

1.4. Multi-omics technologies

The emergence of multi-omics technologies has transformed the potential to investigate complex biological data and has led to meaningful observations. Genomics, transcriptomics, proteomics, metabolomics, and metagenomics collectively provide comprehensive insights into host and microbial functions, and can decipher the understanding of the impacts of dietary components to influence the biological pathways. These approaches can also help to identify novel biomarkers and therapeutic targets that might be used for the prevention and treatment of different diseases [19,20]. Integrating microbiome data with host omics insights offers a promising way to formulate and develop a personalized dietary plan [21].

1.5. Artificial intelligence in precision nutrition

The role of artificial intelligence (AI) in science is growing rapidly. Currently, AI tools are used across food, biotechnology, health, agriculture, and related fields and have the potential to be employed in personalized nutrition development. Artificial intelligence and machine learning are emerging tools that help to analyze large datasets generated during microbiome and multi-omics research [22]. These AI-based

models identify patterns, predict dietary responses, and support personal nutritional requirements [23,24]. These innovations develop opportunities to optimize nutritional interventions according to the individual's health status [25,26].

1.6. Current challenges

Despite remarkable progress in the field of personalized nutrition, several challenges, such as standardization of protocols, data reproducibility and harmonization, and regulatory frameworks, still exist and require attention. Ethical considerations in AI tools, including data privacy and responsible use, also need to be considered [27]. Translating these findings to practical implementation remains another challenge [28]. Interdisciplinary research and collaboration among microbiologists, nutritionists, clinicians, computational scientists, policymakers, and industry stakeholders are anticipated to overcome existing limitations and help to translate these findings to real-life solutions [29].

2. Conclusion

Personalized nutrition is a field of interest among researchers due to its potential to impact a person's lifestyle; thus, a deeper understanding of its components, i.e., contributing factors, guidelines, advanced technologies, etc., remains important. Probiotics and postbiotic-based intervention and the use of multi-omics technologies are promising avenues to advance the discipline and optimize its parameters.

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References

1. Betz UAK, Arora L, Assal RA, et al. Game changers in science and technology-now and beyond. *Technological Forecasting and Social Change*. 2023; 193: 122588. doi: 10.1016/j.techfore.2023.122588
2. Vandeputte D. Personalized nutrition through the gut microbiota: Current insights and future perspectives. *Nutrition Reviews*. 2020; 78(Supplement_3): 66–74. doi: 10.1093/nutrit/nuaa098
3. Sarfraz MH, Shahid A, Asghar S, et al. Personalized nutrition, microbiota, and metabolism: A triad for eudaimonia. *Frontiers in Molecular Biosciences*. 2022; 9: 1038830. doi: 10.3389/fmolb.2022.1038830
4. Yeşilyurt N, Yılmaz B, Ağagündüz D, et al. Microbiome-based personalized nutrition as a result of the 4.0 technological revolution: A mini literature review. *Process Biochemistry*. 2022; 121: 257–262. doi: 10.1016/j.procbio.2022.07.012
5. Bautista J, López-Cortés A. Biohacking the human gut microbiome for precision health and therapeutic innovation. *Frontiers in Microbiology*. 2026; 17: 1776983. doi: 10.3389/fmicb.2026.1776983
6. Plaza-Diaz J, Herrera-Quintana L, Olivares-Arancibia J, et al. Personalized nutrition through the gut microbiome in metabolic syndrome and related comorbidities. *Nutrients*. 2026; 18(2): 290. doi: 10.3390/nu18020290
7. Bagheri M, Zahmatkesh A, Hussain A, et al. Gut Microbiota: Role in Health and Disease. *Role of Gut Microbiota and Postbiotics for Colorectal Cancer: Advancing Therapeutic Strategies*. Cham: Springer Nature Switzerland; 2025. pp. 1–14.
8. Hou K, Wu ZX, Chen XY, et al. Microbiota in health and diseases. *Signal Transduction and Targeted Therapy*. 2022; 7(1): 135. doi: 10.1038/s41392-022-00974-4

9. Wensel CR, Pluznick JL, Salzberg SL, et al. Next-generation sequencing: insights to advance clinical investigations of the microbiome. *The Journal of Clinical Investigation*. 2022; 132(7): 1–12. doi: 10.1172/jci154944
10. Baquero F, Nombela C. The microbiome as a human organ. *Clinical Microbiology and Infection*. 2012; 18: 2–4. doi: 10.1111/j.1469-0691.2012.03916.x
11. Filardo S, Di Pietro M, Sessa R. Current progresses and challenges for microbiome research in human health: A perspective. *Frontiers in Cellular and Infection Microbiology*. 2024; 14: 1377012. doi: 10.3389/fcimb.2024.1377012
12. Singh A, Banerjee P, Anas M, et al. Traditional nutritional and health practices targeting lifestyle behavioral changes in humans. *Journal of Lifestyle Medicine*. 2020; 10(2): 67. doi: 10.15280/jlm.2020.10.2.67
13. Donovan SM, Abrahams M, Anthony JC, et al. Personalized nutrition: perspectives on challenges, opportunities, and guiding principles for data use and fusion. *Critical Reviews in Food Science and Nutrition*. 2025; 65(30): 7151–7169. doi: 10.1080/10408398.2025.2461237
14. Roman S, Campos-Medina L, Leal-Mercado L. Personalized nutrition: the end of the one-diet-fits-all era. *Frontiers in Nutrition*. 2024; 11: 1370595. doi: 10.3389/fnut.2024.1370595
15. Hussain A, Ali SA. Probiotics and immunity: Exploring the development of probiotics concept. *EC Pharmacology and Toxicology*. 2024; 12(10): 01–06.
16. Hussain A, Mojjani N, Koser N, et al. Deciphering the anti-aging potential of probiotics: A narrative review on gerobiotics. *The Microbe*. 2025; 9: 100607. doi: 10.1016/j.microb.2025.100607
17. Hussain A, Shaheen A, Saleem N, et al. Postbiotics: A Promising Concept Beyond Pre-and Probiotics in Human Health. *Postbiotics in Metabolic Disorders*. CRC Press; 2026. pp. 1–13.
18. Verma I, Banerjee B, Singh A, et al. Exploring omics approaches in probiotics: Contemporary developments and prospective pathways. *Journal of Microbiological Methods*. 2025; 232: 107135. doi: 10.1016/j.mimet.2025.107135
19. Gutierrez Reyes CD, Alejo-Jacuinde G, Perez Sanchez B, et al. Multi omics applications in biological systems. *Current Issues in Molecular Biology*. 2024; 46(6): 5777–5793. doi: 10.3390/cimb46060345
20. Çelik E, Kocyigit E, Bingöl FG, et al. Multiomics: The intersection of personalized nutrition in cardiometabolic diseases. *Journal of Translational Medicine*. 2026; 24: 363. doi: 10.1186/s12967-026-07836-5
21. Thoniyot S, Balakrishnan V. Integrating multi-omics data for personalized nutrition using knowledge graphs and Graph Neural Networks: A Comprehensive Review. *Computational Biology and Chemistry*. 2025; 120: 108772. doi: 10.1016/j.compbiolchem.2025.108772
22. Hussain A, Alvi A, Qureshi SR, et al. Exploring the Role of Artificial Intelligence in Microbial Identification, Environmental Distribution, and Ecological Interactions. *Artificial Intelligence and Animal Ecology*. CRC Press; 2026. pp. 221–243.
23. Wu X, Oniani D, Shao Z, et al. A scoping review of artificial intelligence for precision nutrition. *Advances in Nutrition*. 2025; 16(4): 100398. doi: 10.1016/j.advnut.2025.100398
24. Mehta S, Huey S L, Fahim SM, et al. Advances in artificial intelligence and precision nutrition approaches to improve maternal and child health in low resource settings. *Nature Communications*. 2025; 16(1): 7673. doi: 10.1038/s41467-025-62985-3
25. Liu X, Xu M, Wang H, et al. Integrating precision medicine and digital health in personalized weight management: The central role of nutrition. *Nutrients*. 2025; 17(16): 2695. doi: 10.3390/nu17162695
26. Sharma R, Gaur SS, Ajay A, et al. Artificial intelligence and precision nutrition: Tailoring diets with data-driven insights. *Nutrire*. 2025; 50(2): 56. doi: 10.1186/s41110-025-00360-4
27. Brankovic A, Hendrie GA. Perspectives, challenges and future of artificial intelligence in personalised nutrition research. *Proceedings of the Nutrition Society*. 2025. pp. 1–9. doi: 10.1017/S0029665125100657
28. Fayyaz K, Khalid N. Precision nutrition: Paving the path from potential to practice through systems science and ethical translation. *Nutrition and Health*. 2025; 31(4): 1293–1296. doi: 10.1177/02601060251392227
29. Zhang J, Geng T, Wang Y, et al. Challenges, advances and future directions in nutritional epidemiology. *The Innovation Nutrition*. 2026; 1(1): 100009–73–100009–84. doi: 10.59717/j.xinn-nutri.2026.100009