

Editorial

Insights on the Health Benefits and Functional Potential of Food Bioactive Compounds

Diego Morales 

Departmental Section of Galenic Pharmacy and Food Technology, Veterinary Faculty, Complutense University of Madrid, 28040 Madrid, Spain; diego.morales@ucm.es

In recent decades, the global scientific community has shown a growing interest in the field of functional foods and bioactive compounds, spurred by a confluence of public health challenges and emerging nutritional strategies. The rising prevalence of chronic non-communicable diseases such as cardiovascular disease, cancer, and neurodegenerative disorders has positioned diet as a central pillar of both prevention and intervention [1,2]. There is also increasing societal awareness of the link between diet and health, driven by a surge in scientific evidence demonstrating how dietary patterns and specific food molecules influence the onset and progression of chronic diseases. As academic dissemination, health campaigns, and media coverage continue to increase public knowledge, individuals are recognizing more and more the role of nutrition in reducing the risk of certain disorders and promoting overall well-being and quality of life [3–5], thereby boosting consumer demand for functional foods and nutraceuticals [6,7].

Targeting these desirable bioactive compounds, which may help reduce the aforementioned risks and alleviate certain signs and symptoms, researchers have explored a plethora of natural sources and food matrices to develop novel functional foods. In this context, green and advanced extraction technologies are commonly employed to obtain enriched fractions or isolated/purified bioactive ingredients. In this vein, the use of supercritical fluids, pressurized liquids, deep eutectic solvents, and ionic liquids, along with extraction protocols assisted by microwaves, ultrasound, and pulsed electric fields, is increasingly prevalent in both food research and the food industry [8,9]. Additionally, methodologies such as microbial fermentation and enzymatic hydrolysis are often used to enable molecular transformation, synthesis, and/or the release of bioactives [10,11].

Furthermore, the extracts and fractions obtained need to be thoroughly characterized, and their biological activities must be evaluated both in vitro and in vivo—not only using animal models but also through clinical trials. The most widely studied bioactivities include antioxidant, anti-inflammatory, anti-proliferative, hypolipidemic, hypocholesterolemic, hypoglycemic, antihypertensive, antimicrobial, and prebiotic properties [12,13]. Two limitations in functional food research worth emphasizing are the limited number of published clinical trials and the lack of correlation studies linking specific molecules to health outcomes. Surprisingly, there is also a dearth of sensory analyses and consumer acceptance studies, which are essential to ensure that these potentially health-promoting products can be successfully integrated into the food market [14,15]. Therefore, further investigation along these underexplored lines should be strongly encouraged.

Consequently, the main aim of this Special Issue (SI) is to present the latest findings and insights related to the health benefits and functional potential of food-based bioactive compounds. This SI comprises two review articles and nine original research papers that collectively address current knowledge, existing limitations, recent advances, and future perspectives within this field.



Received: 15 May 2025

Accepted: 23 May 2025

Published: 4 June 2025

Citation: Morales, D. Insights on the Health Benefits and Functional Potential of Food Bioactive Compounds. *Foods* **2025**, *14*, 1984. <https://doi.org/10.3390/foods14111984>

Copyright: © 2025 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

One of the review articles in this SI surveyed the literature on the promising anti-cancer bioactive ingredients found in food, such as thymoquinone, allicin, resveratrol, parthenolide, epigallocatechin gallate, and piperine, targeting specific cancer hallmarks, such as sustained proliferation, apoptosis inactivation, the stimulation of angiogenesis, immune evasion, and altered metabolism [16]. The other reviewed the published articles evaluating the potential health effects of strawberry tree (*Arbutus unedo*) fractions and extracts, considering their biological activities, the parts of the plant used (fruit, leaves, flowers, honey, roots, wood, etc.), the experimental models, the target compounds, and the extraction methods applied [17].

The original research articles investigated a wide range of natural and food sources, extraction methodologies, biological activities, and experimental models. For instance, Han et al. (2025) observed that naringenin—a food bioactive compound present in tomatoes and citrus fruits—exerted in vitro anti-inflammatory effects, as it was able to reduce oncostatin M release and mRNA expression in neutrophil-like differentiated HL-60 cells [18]. Jimenez-Pulido et al. (2024) also reported related activities, in this case synergistic anti-inflammatory and antioxidant properties in cereal (wheat and oat)-based nutraceutical formulas combining extracts and hydrolysates from sprouts and byproducts. Certain resulting mixtures exhibited in vitro radical-scavenging activity and inhibited pro-inflammatory cytokine secretion in murine macrophages. The total phenolic, β -glucan, and avenanthramide contents in the blends appeared to be crucial for their biological activities [19]. Cantero-Bahillo et al. (2024) applied hydrolysis strategies to obtain bioactive co-extracts from fenugreek seeds and quinoa husk, identified as steroidal- and terpenoid-rich saponins sources, respectively. Pancreatic lipase inhibition, interference with cholesterol bio-accessibility, and reductions in cytokine release were revealed through in vitro approaches [20]. Hypoglycemic and antidiabetic effects were likewise reported in two other contributions included in this SI: Tejedor-Calvo et al. (2023) applied pressurized liquid technology using different proportions of water and ethanol to obtain extracts from several truffle species. These fractions were rich in β -glucans, chitins, heteropolysaccharides, fatty acids, phenolic compounds, and other bioactives. Specific truffle extracts inhibited enzymes involved in type 2 diabetes; α -amylase and α -glucosidase activities were reduced by aqueous and ethanolic fractions, respectively [21]. Similar inhibitory effects on these enzymes were noticed in fractions collected by applying ultrasound-assisted extractions to the skin of different grapes of indigenous Croatian white grapevine varieties. The obtained extracts also showed antioxidant capacity against DPPH• [22]. Another relevant in vitro study was conducted by Gallegos-Alcalá et al. (2023), who found that glycomacropeptide, a milk-derived bioactive peptide, provided protection against inflammation and oxidative stress in an in vitro model of atopic dermatitis using human keratinocytes. It also promoted wound healing [23].

In addition to these in vitro findings, several studies validating biological activities in animal models are included in this SI. Liu et al. (2024) demonstrated that supplementation with procyanidin B1 and coumaric acid from highland barley alleviated high-fat-diet-induced hyperlipidemia in diabetic C57BL/6J mice. This supplementation regulated PPAR α -mediated hepatic lipid metabolism, resulting in reductions in total cholesterol, triglyceride, and LDL-cholesterol levels and increased HDL-cholesterol levels. Furthermore, an amelioration of gut microbiota dysbiosis was observed [24]. C57BL/6J mice were also used by Chu et al. (2023): glycated casein—produced via transglutaminase-type—exerted protective effects against dextran sulfate sodium (DSS)-induced intestinal inflammation. This intervention led to reductions in weight, disease activity index scores, colon length, colonic mucosal damage, and levels of pro-inflammatory markers in both serum and colons. Moreover, glycated casein modulated the expression of proteins involved in the TLR4/NF- κ B signaling pathway. The authors concluded that it showed a greater protective

effect against DSS-induced colitis than native casein [25]. Additionally, Min et al. (2023) investigated the effects of *Aquilaria sinensis* (a medicinal plant widely grown in South China) leaf supplementation on lipid metabolism in castrated male Chinese goats. The results revealed significant decreases in blood cholesterol levels along with increased HDL concentrations. Metabolomics analysis confirmed cholesterol levels had reduced in both serum and muscle tissue [26].

Before concluding this editorial, I would like to express my sincere gratitude to all the authors and reviewers who contributed to this SI as well as *Foods* and the entire MDPI team for their support and for granting me the opportunity to serve as Guest Editor. I hope this collection of studies helps increase knowledge in the field of functional foods and bioactive compounds and that it inspires further research in order to address existing gaps and advance scientific understanding in this relevant area.

Funding: This research received no external funding.

Conflicts of Interest: The author declare no conflicts of interest.

References

- Huang, Z.; Li, Y.; Park, H.; Ho, M.; Bhardwaj, K.; Sugimura, N.; Lee, H.W.; Meng, H.; Ebert, M.P.; Chao, K.; et al. Unveiling and Harnessing the Human Gut Microbiome in the Rising Burden of Non-Communicable Diseases during Urbanization. *Gut Microbes* **2023**, *15*, 2237645. [[CrossRef](#)] [[PubMed](#)]
- Yu, X.; Pu, H.; Voss, M. Overview of Anti-Inflammatory Diets and Their Promising Effects on Non-Communicable Diseases. *Br. J. Nutr.* **2024**, *132*, 898–918. [[CrossRef](#)]
- Viola, L.F.; Mandel, F.; Valerio, C.M.; Bernardini, M.A.; Halpern, B. Exploring the Perceptions of Obesity, Health Habits, Stigma, and Eating Behaviors in Brazil. *Diabetol. Metab. Syndr.* **2025**, *17*, 119. [[CrossRef](#)] [[PubMed](#)]
- Khaledi-Paveh, B.; Abdi, A.; Heydarpour, S.; Dehghan, F.; Haghparast, R.; Ghasemi, H. The Perceived Experience of Adhering to Vegan Diet: A Descriptive Phenomenological Study. *BMC Public Health* **2024**, *24*, 753. [[CrossRef](#)] [[PubMed](#)]
- Salimi, S.; Kuşcu, G.S. Factors Influencing Cardiovascular Patients' Knowledge of CVD Risk Factors. *J. Vasc. Nurs.* **2023**, *41*, 121–124. [[CrossRef](#)]
- Sgroi, F.; Sciortino, C.; Baviera-Puig, A.; Modica, F. Analyzing Consumer Trends in Functional Foods: A Cluster Analysis Approach. *J. Agric. Food Res.* **2024**, *15*, 101041. [[CrossRef](#)]
- Fasakin, I.; von Massow, M. Consumer's Preferences and Willingness to Pay for Immune Enhanced Dairy Products in Canada. *Appetite* **2024**, *196*, 107156. [[CrossRef](#)]
- Majid, I.; Khan, S.; Aladel, A.; Dar, A.H.; Adnan, M.; Khan, M.I.; Mahgoub Awadelkareem, A.; Ashraf, S.A. Recent Insights into Green Extraction Techniques as Efficient Methods for the Extraction of Bioactive Components and Essential Oils from Foods. *CYTA J. Food* **2023**, *21*, 101–114. [[CrossRef](#)]
- Won, S.; Kwon, K.H. Green Technology for Extraction of Bioactive Compounds from Edible Plants. *J. Oleo Sci.* **2024**, *73*, 1249–1265. [[CrossRef](#)]
- Tonini, S.; Tlais, A.Z.A.; Filannino, P.; Di Cagno, R.; Gobetti, M. Apple Blossom Agricultural Residues as a Sustainable Source of Bioactive Peptides through Microbial Fermentation Bioprocessing. *Antioxidants* **2024**, *13*, 837. [[CrossRef](#)]
- Sharma, S.; Singh, R.; Rana, S. Bioactive Peptides: A Review. *Int. J. Bioautom.* **2011**, *15*, 223–250.
- Lordan, S.; Ross, R.P.; Stanton, C. Marine Bioactives as Functional Food Ingredients: Potential to Reduce the Incidence of Chronic Diseases. *Mar. Drugs* **2011**, *9*, 1056–1100. [[CrossRef](#)] [[PubMed](#)]
- Peighambaroust, S.H.; Karami, Z.; Pateiro, M.; Lorenzo, J.M. A Review on Health-promoting, Biological, and Functional Aspects of Bioactive Peptides in Food Applications. *Biomolecules* **2021**, *11*, 631. [[CrossRef](#)] [[PubMed](#)]
- Topolska, K.; Florkiewicz, A.; Filipiak-Florkiewicz, A. Functional Food—Consumer Motivations and Expectations. *Int. J. Environ. Res. Public Health* **2021**, *18*, 5327. [[CrossRef](#)]
- Świąder, K.; Marczevska, M. Trends of Using Sensory Evaluation in New Product Development in the Food Industry in Countries That Belong to the Eit Regional Innovation Scheme. *Foods* **2021**, *10*, 446. [[CrossRef](#)]
- Talib, W.H.; Abed, I.; Raad, D.; Alomari, R.K.; Jamal, A.; Jabbar, R.; Alhasan, E.O.A.; Alshaeri, H.K.; Alasmari, M.M.; Law, D. Targeting Cancer Hallmarks Using Selected Food Bioactive Compounds: Potentials for Preventive and Therapeutic Strategies. *Foods* **2024**, *13*, 2687. [[CrossRef](#)]
- Morales, D. Use of Strawberry Tree (*Arbutus Unedo*) as a Source of Functional Fractions with Biological Activities. *Foods* **2022**, *11*, 3838. [[CrossRef](#)]

18. Han, N.R.; Park, H.J.; Ko, S.G.; Moon, P.D. Naringenin, a Food Bioactive Compound, Reduces Oncostatin M Through Blockade of PI3K/Akt/NF-KB Signal Pathway in Neutrophil-like Differentiated HL-60 Cells. *Foods* **2025**, *14*, 102. [[CrossRef](#)]
19. Jiménez-Pulido, I.J.; Martín-Diana, A.B.; Tomé-Sánchez, I.; de Luis, D.; Martínez-Villaluenga, C.; Rico, D. Boosting Synergistic Antioxidant and Anti-Inflammatory Properties Blending Cereal-Based Nutraceuticals Produced Using Sprouting and Hydrolysis Tools. *Foods* **2024**, *13*, 1868. [[CrossRef](#)]
20. Cantero-Bahillo, E.; Navarro del Hierro, J.; de las Nieves Siles-Sánchez, M.; Jaime, L.; Santoyo, S.; Martin, D. Combination of Fenugreek and Quinoa Husk as Sources of Steroidal and Triterpenoid Saponins: Bioactivity of Their Co-Extracts and Hydrolysates. *Foods* **2024**, *13*, 562. [[CrossRef](#)]
21. Tejedor-Calvo, E.; Morales, D.; Morillo, L.; Vega, L.; Caro, M.; Smiderle, F.R.; Iacomini, M.; Marco, P.; Soler-Rivas, C. Pressurized Liquid (PLE) Truffle Extracts Have Inhibitory Activity on Key Enzymes Related to Type 2 Diabetes (α -Glucosidase and α -Amylase). *Foods* **2023**, *12*, 2724. [[CrossRef](#)] [[PubMed](#)]
22. Rastija, V.; Drenjančević, M.; Kujundžić, T.; Zmaić, L.; Karnaš, M. The Antidiabetic Effect of Grape Skin Extracts of Selected Indigenous Croatian White Grapevine Varieties. *Foods* **2024**, *13*, 4143. [[CrossRef](#)] [[PubMed](#)]
23. Gallegos-Alcalá, P.; Jiménez, M.; Cervantes-García, D.; Córdova-Dávalos, L.E.; Gonzalez-Curiel, I.; Salinas, E. Glycomacropeptide Protects against Inflammation and Oxidative Stress, and Promotes Wound Healing in an Atopic Dermatitis Model of Human Keratinocytes. *Foods* **2023**, *12*, 1932. [[CrossRef](#)] [[PubMed](#)]
24. Liu, Z.; Liu, J.; Tang, R.; Zhang, Z.; Tian, S. Procyanidin B1 and Coumaric Acid from Highland Barley Alleviated High-Fat-Diet-Induced Hyperlipidemia by Regulating PPAR α -Mediated Hepatic Lipid Metabolism and Gut Microbiota in Diabetic C57BL/6J Mice. *Foods* **2024**, *13*, 1843. [[CrossRef](#)]
25. Chu, H.; Liu, W.; Zhao, C.; Yin, T.; Shi, J.; Zhang, W. Glycated Casein by TGase-Type Exerts Protection Potential against DSS-Induced Colitis via Inhibiting TLR4/NF-KB Signaling Pathways in C57BL/6J Mice. *Foods* **2023**, *12*, 3431. [[CrossRef](#)]
26. Min, L.; Wang, G.; Tong, X.; Yang, H.; Sun, H.; Zhang, Z.; Xu, B.; Li, D.; Zhang, S.; Li, G. Feeding Aquilaria Sinensis Leaves Modulates Lipid Metabolism and Improves the Meat Quality of Goats. *Foods* **2023**, *12*, 560. [[CrossRef](#)]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.