

Translational agricultural medicine: A conceptual framework linking plant science, nutrition, and preventive medicine

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Abstract

Agricultural sciences and medicine are converging toward a shared mechanistic framework that links plant biology to human health. This editorial proposes Translational Agricultural Medicine (TAM) as a conceptual and hypothesis-generating framework. Translational Agricultural Medicine positions plant molecular responses, particularly stress-induced redox regulation and phytochemical biosynthesis, as biologically relevant factors that may inform preventive nutrition and translational health research. Evidence from plant stress biology, including redox networks, parallels key biochemical processes underlying metabolic disorders and cancer in humans. Plant-derived bioactives, such as glucosinolates and phenolics, as well as legume proteins, further illustrate how agricultural variables influence the nutritional and biochemical properties of diets relevant to health outcomes. Climate-driven changes in crop physiology reinforce the need to align breeding and agroecological management with public health priorities. Collectively, this perspective reframes plants not as passive dietary components but as upstream contributors to the nutritional modulation of human metabolism, positioning climate-resilient crops and targeted dietary strategies as important components of future preventive health approaches.

Key words: nutrition, phytochemicals, plant proteins, preventive medicine, translational medical research

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Highlights

- Translational Agricultural Medicine (TAM) links plant stress biology and phytochemical production to human metabolic health and disease prevention.
- Plant redox regulation and bioactive compounds provide mechanistic insights relevant to nutrition, cancer research, and metabolic disorders.
- Climate-resilient crop breeding and agroecological management may enhance dietary quality and support future preventive health strategies.

Introduction

Modern clinical medicine continues to treat diet as a downstream lifestyle factor, while its upstream biological origins in agricultural systems remain largely unaddressed.¹ This disconnect limits the effectiveness of preventive strategies, which rarely account for how plant genotype, environmental stress, and agroecological practices shape the biochemical composition of food.² Agriculture should be considered an upstream determinant of diet quality and long-term health outcomes.^{3–5} In this context, Translational Agricultural Medicine (TAM) is introduced as a framework that integrates plant sciences, agronomy, and clinical nutrition within a mechanistic translational continuum linking agriculture, nutrition, and preventive health research. By positioning plant molecular responses, particularly redox regulation and phytochemical biosynthesis, as biologically and nutritionally relevant variables, this approach reframes crops not as passive dietary inputs but as active contributors to nutritional and metabolic health processes.

Translational Agricultural Medicine, while aligned with the interdisciplinary ethos of One Health, Systems Nutrition, and Food Systems Science, differs from these frameworks in 3 key respects. First, it places plant sciences and crop-level molecular processes at the core of translational pathways linking agriculture to nutrition and preventive medicine. Unlike existing approaches, it explicitly accounts for interactions among plant genotype, environmental conditions, stress responses, and post-harvest processing as determinants of nutritionally and translationally relevant outcomes. Second, TAM establishes a mechanistic translational continuum linking agriculture, nutrition, and preventive health research, in which agronomic variables, environmental stress physiology, and phytochemical profiles function as biologically informative predictors rather than contextual modifiers. This shifts agriculture from a background determinant to an integral component of preventive nutrition and translational health research. Third, TAM introduces a bidirectional translational model: agriculture informs medicine, while clinical priorities actively shape agricultural practices. This reverse translation is enabled by targeting shared biochemical pathways, including redox regulation and metabolic

control, with implications for conditions such as obesity, inflammation, diabetes, insulin resistance, purine-related disorders, and cancer. In contrast, prevailing frameworks remain largely unidirectional and do not systematically integrate clinical needs into crop development, breeding strategies, or agroecological design. Translational Agricultural Medicine is proposed here as a conceptual and hypothesis-generating framework rather than an established clinical discipline. Its purpose is to stimulate integration among plant sciences, agronomy, nutrition, and preventive medicine by identifying mechanistic and translational links that may guide future interdisciplinary research. Translational Agricultural Medicine does not seek to replace existing frameworks such as One Health, Planetary Health, or Food Systems Science, but rather to complement them by placing plant molecular physiology and crop stress biology at the center of translational nutrition research. Unlike broader public health-oriented frameworks, TAM specifically emphasizes plant physiology and stress biology as translational variables relevant to nutrition research.

The conceptual gap between agricultural sciences and medicine, both clinical and preventive, is rapidly narrowing, moving toward functional convergence.^{6,7} Plant foods should therefore not be regarded as passive nutritional matrices,^{8–10} but as integrated biological outputs^{11–13} shaped by plant genetics,¹⁴ stress physiology, agroecological conditions,^{15–17} and post-harvest handling and processing.^{18,19} Consequently, many diet-associated risk²⁰ and protective factors are embedded within agricultural practices well before they become apparent in clinical contexts. Evidence from plant biochemistry,²¹ stress biology, and nutrition research^{22,23} shows that mechanisms underlying plant stress resilience²⁴ parallel pathways central to human metabolic health and disease prevention.²⁵ Compounds such as glucosinolates from cruciferous vegetables, polyphenols,²⁶ and legume proteins, alongside redox defense systems characterized in barley, exemplify how agricultural biochemistry yields translationally relevant insights. These mechanisms extend beyond crop performance, informing dietary strategies and nutrition-informed preventive approaches,^{27,28} including the modulation of redox balance,²⁹ metabolic regulation,³⁰ and purine metabolism in complex disease settings, thereby positioning plant sciences

as a foundational contributor to prevention, nutrition science, and translational health research.^{31–35}

In parallel, the development of TAM aligns with broader contemporary efforts to bridge mechanistic research and evidence-based healthcare practice. Modern translational medicine increasingly emphasizes the integration of biological plausibility, contextual relevance, and clinically meaningful evidence rather than relying solely on isolated reductionist observations. In this perspective, TAM is intended not as a clinically validated discipline, but as a conceptual framework designed to stimulate interdisciplinary integration among plant sciences, agronomy, nutrition, and preventive medicine. Similar to evidence-based healthcare models that seek to connect research generation, evidence synthesis, and practical implementation, TAM aims to strengthen the translational continuum linking agricultural biology with nutritional and preventive health research.³⁶ The aim of this editorial is to introduce TAM as a conceptual and translational research framework integrating plant science, agronomy, nutrition, and preventive medicine, and to outline key mechanistic and translational pathways that may guide future interdisciplinary research.

Conceptual scope and literature selection

This article is a conceptual, perspective-style editorial rather than a systematic review or meta-analysis. The examples discussed were selected to illustrate representative mechanistic, nutritional, and translational aspects relevant to the proposed TAM framework. The literature selection was therefore narrative and hypothesis-driven, with an emphasis on studies linking plant stress biology, food composition, nutrition, and preventive health.

Mechanistic and nutritional foundations of TAM

Mechanistic evidence from plant stress biology

How do plants sense, integrate, and resolve oxidative and nitrosative pressures? In barley simultaneously challenged by nematodes and cadmium, an atypically coordinated antioxidant response has been documented: superoxide dismutase (SOD) activity increased, the Foyer-Halliwell–Asada pathway efficiently scavenged H₂O₂, S-nitrosoglutathione accumulated via inhibition of S-nitrosoglutathione reductase, and polyamine biosynthesis was preferentially activated, collectively limiting lipid and protein oxidation while preserving membrane integrity.³⁷ When barley was co-infested with nematodes and mites, photosystem electron transport was retuned, redox buffers were

redistributed, and cellular ultrastructure adapted, providing an instructive model of metabolic resilience.³⁸ Under combined salinity and mite stress, distinct stress-specific reactive oxygen species (ROS) signatures and differential activation of catalases, peroxidases, and SODs were observed, underscoring how combinatorial stress elicits non-additive redox logic.³⁹ In parallel, exposure to barium induced nitrooxidative responses in barley leaves, characterized by concentration- and time-dependent shifts in the nitric oxide (NO)/H₂O₂ balance and in antioxidant gene expression and activity, further demonstrating that plants deploy flexible, tiered defense strategies to maintain homeostasis.⁴⁰ Notably, these plant redox adaptations share mechanistic parallels with pathways involved in human redox biology, in which oxidative and nitrosative stress play central roles in carcinogenesis, cardiometabolic disease, neurodegeneration, and chronic inflammation.^{41–50} However, mechanistic similarities alone should not be interpreted as direct evidence of clinical efficacy or causality.

Nutritional and food-composition evidence

Contemporary redox systems biology increasingly conceptualizes nutrition as a regulator of interconnected redox networks, offering a mechanistic framework that may explain why reductionist interventions based on isolated bioactive compounds frequently yield inconsistent outcomes.^{51–54} In contrast, dietary patterns that act on multiple network nodes may help modify disease-related risk pathways.⁸ In this context, plants function not only as nutritional sources but also as repositories of biochemical templates and bioactive molecules that can be translated into diet-based prevention strategies.^{55,56} Two examples are particularly illustrative.

First, the glucosinolate-myrosinase system in cruciferous vegetables generates isothiocyanates and indoles, including sulforaphane, phenethyl isothiocyanate, and indole-3-carbinol, following tissue disruption; these compounds activate nuclear factor erythroid 2-related factor 2 (Nrf2)-dependent detoxification pathways, modulate apoptosis, and influence epigenetic programming, thereby supporting mechanisms associated with chemopreventive potential.¹¹ Because glucosinolate profiles are shaped by plant genotype, soil conditions, weather, agricultural practices, and culinary processing, potential chemopreventive exposure is determined as much by agronomy as by food preparation.¹¹ Second, sorghum, often primarily associated with drought tolerance, emerges as a functional grain, as its polyphenols (including phenolic acids and 3-deoxyanthocyanidins), dietary fiber, and peptides align with antioxidant, anti-inflammatory, glycemic-regulatory, satiety-enhancing, and microbiota-modulating effects that support cardiometabolic prevention.^{15,17} Together, these cases illustrate how agricultural variables may influence the nutritional and translational relevance of foods.

Climate change further magnifies these relationships. Studies on legumes demonstrate that elevated CO₂ and heat stress can reduce protein content and key micronutrients (Fe, Zn), reshape phenolic and isoflavone profiles, and alter pest and mycotoxin risk patterns, thereby constituting an upstream public health challenge given the global reliance on legumes as accessible sources of protein and health-promoting phytochemicals. Consequently, climate adaptation emerges as an important component of preventive health planning: breeding strategies targeting thermotolerance and pest resistance, ecologically integrated pest management, and soil fertility optimization function as potential contributors to preventive health strategies by safeguarding nutrient density and food safety.¹⁸

Translational interfaces between plant biochemistry and clinical nutrition

The newly established clinical nutrition axis provides a substantive translational bridge, grounded in research on purine metabolism and uric acid (UA) homeostasis in patients with cancer and ileostomies.⁵⁷ In this population, anatomical alterations, hydration challenges, electrolyte imbalances, and treatment-related toxicities substantially complicate dietary management. Evidence from this analysis indicates that plant-based proteins and bioactive phytochemicals may help reduce purine burden while simultaneously providing potential anti-inflammatory, antioxidant, and uricosuric effects. Legumes, soy products, nuts, whole grains, vegetables, and fruits generally have low to moderate purine content, and when selected judiciously, these foods can lower serum UA levels despite their inherent purine content. This effect is mediated by factors such as dietary fiber, vitamin C, and polyphenols, which modulate xanthine oxidase activity and renal urate handling.⁵⁷ In individuals with ileostomies, who are particularly vulnerable to dehydration and micronutrient deficiencies, well-designed plant-based dietary patterns may support wound healing, maintain fluid and electrolyte balance, and promote overall metabolic control. This clinical scenario, therefore, illustrates how agricultural biochemistry can be translated into personalized nutrition strategies.⁵⁷ In parallel, recent systems-level analyses of adiposity and diet-driven endometrial carcinogenesis further provide translational proof of concept that diet-modifiable biochemical networks rooted in plant-derived foods can be systematically mapped, stratified, and targeted, thereby exemplifying the translational potential of TAM.⁵⁸ Although this example concerns a specific clinical population, it illustrates the broader translational rationale underlying the TAM framework and should not be interpreted as broad clinical validation of the concept.

Limitations and future directions

Several limitations should be acknowledged. Translational Agricultural Medicine currently represents a conceptual and translational framework rather than a clinically validated discipline. Many of the proposed links remain supported primarily by mechanistic, nutritional, and observational evidence, while direct interventional clinical validation remains limited. Future interdisciplinary studies integrating agronomy, crop science, systems nutrition, biomarker profiling, epidemiology, and clinical trials will be required to further validate and operationalize the TAM framework.

Conclusions

The convergence of plant sciences and medical practice indicates that the foundations of translational medicine extend into agricultural biology. Integrating agronomic knowledge with clinical and nutritional research enables the intentional design of health-promoting crops, foods, and dietary strategies, thereby strengthening the agriculture-to-health continuum as a translational research pathway. Progress in this direction requires aligning agricultural variables with human biomarkers, moving beyond reductionist nutrition toward network-based dietary approaches, and recognizing climate adaptation as an integral component of preventive medicine. Strengthening transdisciplinary integration will further enable predictive nutrition approaches that integrate upstream agricultural variables with downstream nutritional and clinical research. Together, these advances support the view that agriculture is an important and potentially modifiable determinant of food quality, nutrition, and preventive health. Future progress will require interdisciplinary validation integrating agronomy, crop science, systems nutrition, biomarker profiling, epidemiological studies, and clinical research. At its current stage, TAM should primarily be viewed as a translational and hypothesis-generating framework intended to stimulate interdisciplinary research rather than direct clinical implementation.

Use of AI and AI-assisted technologies

During the preparation of this work, the author used Grammarly (v1.2.215.1793; Superhuman Platform Inc., San Francisco, USA) to verify language accuracy and obtain style and tone recommendations. After using this tool, the author reviewed and edited the content as necessary and takes full responsibility for the content of this publication.

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References

- Lakerveld J, Mackenbach J. The upstream determinants of adult obesity. *Obes Facts*. 2017;10(3):216–222. doi:10.1159/000471489
- Anim AO, Lutterodt HE, Ofori CW, et al. The impact of agricultural practices on food composition: A systematic review. *J Food Compos Anal*. 2025;148:108388. doi:10.1016/j.jfca.2025.108388
- Kanter R, Walls HL, Tak M, Roberts F, Waage J. A conceptual framework for understanding the impacts of agriculture and food system policies on nutrition and health. *Food Sec*. 2015;7(4):767–777. doi:10.1007/s12571-015-0473-6
- Fanzo J, Rudie C, Sigman I, et al. Sustainable food systems and nutrition in the 21st century: A report from the 22nd Annual Harvard Nutrition Obesity Symposium. *Am J Clin Nutr*. 2022;115(1):18–33. doi:10.1093/ajcn/nqab315
- Madzorera I, Jaacks L, Paarlberg R, et al. Food systems as drivers of optimal nutrition and health: Complexities and opportunities for research and implementation. *Curr Dev Nutr*. 2021;5(Suppl 3):nzab062. doi:10.1093/cdn/nzab062
- Rose D, Gosliner W, Otten JJ, et al. Translating science to improve health: A report from the “Agriculture and Diet: Value Added for Nutrition, Translation, and Adaptation in a Global Ecology” (ADVANTAGE) Project Working Group 5. *Adv Nutr*. 2026;17(3):100586. doi:10.1016/j.advnut.2025.100586
- Mattoo AK. Translational research in agricultural biology: Enhancing crop resistivity against environmental stress alongside nutritional quality. *Front Chem*. 2014;2:30. doi:10.3389/fchem.2014.00030
- Dennis KK, Go YM, Jones DP. Redox systems biology of nutrition and oxidative stress. *J Nutr*. 2019;149(4):553–565. doi:10.1093/jn/nxy306
- Dinu M, Martini D, Lotti S, Del Bo’ C, Scalfi L, Tagliabue A. Toward a comprehensive definition of diet quality: Perspectives from the Italian Society of Human Nutrition (SINU). *Nutr Metab Cardiovasc Dis*. 2026;36(5):104636. doi:10.1016/j.numecd.2026.104636
- Zhang Y, Zhou T, Luo Z, et al. Comparative study of B vitamins in multiple tissues of oilseed crops and leafy vegetables reveal sesame as a valuable resource in vitamin B3, B6 and B12. *Antioxidants (Basel)*. 2026;15(2):224. doi:10.3390/antiox15020224
- Labudda M, Rybarczyk-Płońska A, Sobieszek KA, et al. The chemopreventive and anticancer potential of glucosinolates and their hydrolysis products from cruciferous vegetables. *Nutrients*. 2026;18(5):751. doi:10.3390/nu18050751
- Huang X, Kang P, Chen H, Li J, Liu J. Global research trends in dietary polyphenols for preventing non-communicable chronic diseases: A bibliometric study. *Food Sci Nutr*. 2026;14(3):e71539. doi:10.1002/fsn3.71539
- Bhatia A, Mehta J, Hashmi AR, et al. From ancient spice to advanced science: Therapeutic, nutraceutical and nanotechnological insights into the fruits of *Piper longum* Linn. for modern drug development. *Drug Des Dev Ther*. 2026;20:556602. doi:10.2147/DDDT.S556602
- López-Román MI, De La Rosa L, Castaño-Herrero C, Marcos-Prado MT, Ramírez-Parra E. Influence of genetic diversity, drought stress and rhizobial symbiosis on the nutritional quality of common vetch (*Vicia sativa* L.) grain. *J Sci Food Agric*. 2026;106(7):3952–3970. doi:10.1002/jsfa.70410
- Frankowski J, Zielińska A, Labudda M, Kluz MI, Kačániová M, Kowalczewski PŁ. Health-promoting properties of sorghum bioactive compounds: A comprehensive bibliometric analysis. *Nutrients*. 2025;17(23):3732. doi:10.3390/nu17233732
- Nicholas KM, Tone A, Beal T, et al. Perspective: Nutrient bioavailability is the missing ingredient connecting food systems to nutrition security and environmental sustainability. *Am J Clin Nutr*. 2026;123(5):101253. doi:10.1016/j.ajcnut.2026.101253
- Przybylska-Balcerek A, Frankowski J, Stuper-Szablewska K. Analysis of kafirin content in sorghum sprouts cultivated in a temperate climate. *Appl Sci*. 2026;16(3):1485. doi:10.3390/app16031485
- Labudda M, Wurlitzer W, Niedziński T, et al. Climate-driven changes in the nutritional value and food safety of legume seeds. *Nutrients*. 2025;17(23):3703. doi:10.3390/nu17233703
- Ma GY, Yan CY, Liu H, et al. Study on dynamic expansion and β -carotene accumulation in storage root of orange-fleshed sweetpotato, and screening of germplasm resources with high rate of medium-sized storage roots. *Front Plant Sci*. 2026;17:1744016. doi:10.3389/fpls.2026.1744016
- Tsai JH, Tsai TY, Li H, et al. Associations between plant-based dietary patterns and risks of cognitive impairment and dementia: A systematic review and dose-response meta-analysis. *J Prev Alzheimers Dis*. 2026;13(4):100521. doi:10.1016/j.tjpad.2026.100521
- Ashaolu TJ, Lee C, Tarhan O, Rashidinejad A, Jafari SM. Revisiting the nutritional and health-promoting properties of soy protein-based food formulations for infants and adults. *Comp Rev Food Sci Food Safe*. 2026;25(2):e70407. doi:10.1111/1541-4337.70407
- Balaji M, Vashishth R, Das U. Plant-based functional foods for healthy aging: Current trends, bioactive compounds, and future perspectives. *J Funct Foods*. 2026;138:107155. doi:10.1016/j.jff.2026.107155
- Pellegrini M, Vecchiatti A, Leonardo Briganti G, et al. Nutrients and food supplements for the prevention of musculoskeletal diseases: An umbrella review. *Nutr Res Rev*. 2026;39:e16. doi:10.1017/S0954422426100365
- Li Y, Li K, Lu J, et al. Modulating TPP riboswitch activity simultaneously enhances crop yield, nutritional quality and stress tolerance. *Nat Commun*. 2026;17(1):3328. doi:10.1038/s41467-026-69730-4
- Yu S, Pang Z, Fang H, Liu C. Ferroptosis in cardiovascular diseases: Molecular mechanisms and a novel therapeutic target. *Mol Biomed*. 2026;7(1):23. doi:10.1186/s43556-026-00420-9
- Jin J, Dai Y, Han Z, et al. Bioactivity and prebiotic potential of insoluble dietary fiber from discarded Chinese cabbage outer leaves and the metabolomic dynamics of bound polyphenols during alkaline extraction, in vitro gastrointestinal digestion and colonic fermentation. *Food Res Int*. 2026;228:118345. doi:10.1016/j.foodres.2026.118345
- Ray S, Shankaran P. Nutrition and the gut microbiome: A symbiotic dialogue influencing health and disease. *Front Nutr*. 2026;13:1761992. doi:10.3389/fnut.2026.1761992
- Khaliq M, Noor Z, Moazzam M, et al. Navigating the potential of algal peptides: Health effects, market applications, and scientific challenges. *Ann Med*. 2026;58(1):2637282. doi:10.1080/07853890.2026.2637282
- Vidya N, Saravanan K, Halka J, et al. Targeted expression of Glycine max isoflavone synthase enhances daidzein and genistein content in soybean. *Transgenic Res*. 2026;35(1):10. doi:10.1007/s11248-026-00485-w
- Van Kalker CA, Adam TC, Blaak EE. Gut microbiome-associated effects of plant-based diets on glucose homeostasis, body composition, and cognitive function: A scoping review. *Adv Nutr*. 2026;17(4):100610. doi:10.1016/j.advnut.2026.100610
- Ryu J, McClements DJ. Application of biomacromolecules in the creation of next-generation plant-based foods designed for improved health and sustainability. *Biomacromolecules*. 2026;27(4):2411–2429. doi:10.1021/acs.biomac.5c02661
- Egas-Montenegro E, Echeverría-Chilla J, García-Ulloa M, Aizaga-Benalcázar C, Ordoñez-Araque R. The influence of a plant-based diet on the composition and functions of the human gut microbiota: A review. *Front Nutr*. 2026;13:1774375. doi:10.3389/fnut.2026.1774375
- Wang XJ, Voortman T, Bos D, et al. Association between healthy plant-based diet-lifestyle (hPDI-Lifestyle) score and incidence of coronary heart disease, and effect modification by genetic predisposition: A prospective analysis in a population-based cohort. *Lancet Reg Health Eur*. 2026;64:101619. doi:10.1016/j.lanep.2026.101619
- Vompe AD, Hamidzade M, López MM, et al. Translational microbiomes in agriculture: Microbial communities as tools to effect host and system health for improved crop production. *Appl Environ Microbiol*. 2026;92(2):e01704-25. doi:10.1128/aem.01704-25
- Yu Q, Chen H, Qu Z, et al. Plant polysaccharides in neuroprotection: Mechanistic insights across central nervous system disorders. *Front Pharmacol*. 2026;16:1727705. doi:10.3389/fphar.2025.1727705
- Królikowska A, Prill R, Klugar M. Evidence-based healthcare: Bridging the gap between research and practice. *Adv Clin Exp Med*. 2025;34(2):139–147. doi:10.17219/acem/201184
- Labudda M, Muszyńska E, Gietler M, et al. Efficient antioxidant defence systems of spring barley in response to stress induced jointly by the cyst nematode parasitism and cadmium exposure. *Plant Soil*. 2020;456(1–2):189–206. doi:10.1007/s11104-020-04713-y
- Labudda M, Tokarz K, Tokarz B, et al. Reactive oxygen species metabolism and photosynthetic performance in leaves of *Hordeum vulgare* plants co-infested with *Heterodera filipjevi* and *Aceria tosichella*. *Plant Cell Rep*. 2020;39(12):1719–1741. doi:10.1007/s00299-020-02600-5

39. Graska J, Fidler J, Gietler M, et al. The effects of soil salinity and wheat curl mite infestation on the antioxidative response of barley. *Plant Soil*. 2025;516(1):855–875. doi:10.1007/s11104-025-07772-1
40. Fidler J, Gietler M, Graska J, et al. The nitro-oxidative response is induced in the leaves of barley plants exposed to barium. *Int J Mol Sci*. 2025;26(10):4661. doi:10.3390/ijms26104661
41. Reuter S, Gupta SC, Chaturvedi MM, Aggarwal BB. Oxidative stress, inflammation, and cancer: How are they linked? *Free Radic Biol Med*. 2010;49(11):1603–1616. doi:10.1016/j.freeradbiomed.2010.09.006
42. Mena S, Ortega A, Estrela JM. Oxidative stress in environmental-induced carcinogenesis. *Mutat Res Genet Toxicol Environ Mutagen*. 2009;674(1–2):36–44. doi:10.1016/j.mrgentox.2008.09.017
43. Federico A, Morgillo F, Tuccillo C, Ciardiello F, Loguercio C. Chronic inflammation and oxidative stress in human carcinogenesis. *Int J Cancer*. 2007;121(11):2381–2386. doi:10.1002/ijc.23192
44. Hayes JD, Dinkova-Kostova AT, Tew KD. Oxidative stress in cancer. *Cancer Cell*. 2020;38(2):167–197. doi:10.1016/j.ccell.2020.06.001
45. Hirst D G, Robson T. Nitrosative stress in cancer therapy. *Front Biosci*. 2007;12(8–12):3406. doi:10.2741/2322
46. Beevi SS, Rasheed MH, Geetha A. Evidence of oxidative and nitrosative stress in patients with cervical squamous cell carcinoma. *Clin Chim Acta*. 2007;375(1–2):119–123. doi:10.1016/j.cca.2006.06.028
47. Valaitienė J, Laučytė-Cibulskienė A. Oxidative stress and its biomarkers in cardiovascular diseases. *Artery Res*. 2024;30(1):18. doi:10.1007/s44200-024-00062-8
48. Pignatelli P, Menichelli D, Pastori D, Violi F. Oxidative stress and cardiovascular disease: New insights. *Kardiologia Pol*. 2018;76(4):713–722. doi:10.5603/KP.a2018.0071
49. Gandhi S, Abramov AY. Mechanism of oxidative stress in neurodegeneration. *Oxid Med Cell Longev*. 2012;2012:428010. doi:10.1155/2012/428010
50. Andersen JK. Oxidative stress in neurodegeneration: Cause or consequence? *Nat Med*. 2004;10(Suppl 7):S18–S25. doi:10.1038/nrn1434
51. Jones DP, Sies H. The redox code. *Antioxid Redox Signal*. 2015;23(9):734–746. doi:10.1089/ars.2015.6247
52. Halliwell B. The antioxidant paradox: Less paradoxical now? *Br J Clin Pharmacol*. 2013;75(3):637–644. doi:10.1111/j.1365-2125.2012.04272.x
53. Jacobs DR, Tapsell LC. Food synergy: The key to a healthy diet. *Proc Nutr Soc*. 2013;72(2):200–206. doi:10.1017/S0029665112003011
54. Jacobs DR, Gross MD, Tapsell LC. Food synergy: An operational concept for understanding nutrition. *Am J Clin Nutr*. 2009;89(5):1543S–1548S. doi:10.3945/ajcn.2009.26736B
55. Dunneram Y, Lee JY, Watling CZ, et al. Vegetarian diets and cancer risk: pooled analysis of 1.8 million women and men in nine prospective studies on three continents. *Br J Cancer*. 2026;134(8):1218–1229. doi:10.1038/s41416-025-03327-4
56. Cui E, Cui W. Bioactive food compounds and human health: From dietary sources to biological function. *Nutrients*. 2026;18(4):573. doi:10.3390/nu18040573
57. Sobieszek KA, Frankowski J, Labudda M. Dietary modulation of purine metabolism and uric acid homeostasis in cancer patients with an ileostomy. *Biochimie*. 2026;242:134–142. doi:10.1016/j.biochi.2026.01.002
58. Labudda M, Sobieszek KA, Frankowski J, Trafiałek J, Czapla M. Biochemical pathways linking adiposity, diet, and endometrial carcinogenesis. *Biochimie*. 2026;244:147–160. doi:10.1016/j.biochi.2026.03.008