IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Microgreens As Functional Food: Potential For Preventing Chronic Diseases

[1]Hinal H. Ghevariya1,[2]Nayan K. Jain

[1]Senior Research fellow (SRF), [2]Retired professor & head

[1] Department of Life Science, Food Science and Nutrition, Gujarat University, Ahmedabad, Gujarat, India-380 009.

Abstract: Microgreens, often referred to as "vegetable confetti," are the young, edible seedlings of vegetables and herbs harvested at the cotyledonary leaf stage. Renowned for their vibrant colors, robust flavors, and rich nutritional content, microgreens are increasingly recognized for their potential role in preventing chronic diseases such as cardiovascular diseases, cancer, diabetes, and neurodegenerative disorders. This review critically examines the nutritional composition of microgreens, highlighting their dense concentrations of vitamins, minerals, and bioactive compounds like glucosinolates, polyphenols, and carotenoids. Notably, microgreens often surpass their mature counterparts in nutrient and phytochemical content, making them valuable in addressing dietary deficiencies and promoting health. This review critically examines the role of microgreens as functional foods in chronic disease prevention. By exploring their nutrient-rich profiles, bioactive compounds, and evidence-based health benefits, we highlight their potential to mitigate global challenges like cardiovascular diseases, cancer, diabetes, and neurodegenerative disorders along with obesity and osteoporosis Additionally, this analysis emphasizes the significance of microgreens in fostering healthier dietary habits and advancing research in nutritional biochemistry and disease prevention. In conclusion, this paper highlights the importance of microgreens as a functional food and encourages their inclusion in diets to help prevent chronic diseases. Furthermore, it emphasizes the need for additional research into their bioavailability and long-term health effects, stressing their potential to improve public health and clinical nutrition.

Keywords **-** Microgreens, Bioactive Compounds, functional food, antioxidant activity, Phytochemicals

I. INTRODUCTION

Generally referred to as "vegetable confetti," microgreens are young, edible vegetable and herb seedlings that are picked at the cotyledonary leaf stage or right before the first true leaves appear. These small plants are prized for their strong flavors, vivid colors, and rich nutritional profile. Their health-promoting qualities are attributed to their abundance of vitamins, minerals, and bioactive substances like glucosinolates, polyphenols, and carotenoids (1–3). The potential of microgreens to deliver higher levels of essential nutrients and phytochemicals, frequently exceeding those present in their mature counterparts, accounts for their nutritional significance (2).

Sedentary lifestyles and poor eating habits contribute to the substantial global health burden of chronic diseases, which include diabetes, cancer, and cardiovascular diseases. Globally, these illnesses account for a significant amount of morbidity and mortality. Diet plays a crucial role in the prevention and management of these diseases, with increasing emphasis on the consumption of functional foods rich in bioactive compounds (2,4). Microgreens are gaining attention for their strong antioxidant and anti-inflammatory properties, making them promising options for the dietary prevention of chronic diseases (5,6). Thus, The function of microgreens as functional foods in the prevention of chronic diseases is critically examined in this review. By exploring their nutrient-rich profiles, bioactive compounds, and evidence-based health benefits, we highlight their potential to mitigate global challenges like cardiovascular diseases, cancer, diabetes, and neurodegenerative

disorders. Additionally, this analysis emphasizes the significance of microgreens in fostering healthier dietary habits and advancing research in nutritional biochemistry and disease prevention.

1.1 Nutritional Composition of Microgreens

It is well known that microgreens are concentrated sources of essential nutrients. According to studies, they are especially high in vitamins like beta-carotene, vitamin C, and vitamin E (7). Research showed that microgreens have much greater levels of tocopherols (vitamin E) and ascorbic acid (vitamin C) than their mature counterparts. Significant amounts of minerals like potassium, calcium, magnesium, and iron are also present, though the amounts vary based on the species and growing environment (8). Furthermore, by adding to their antioxidant activity and anti-inflammatory qualities, phytochemicals such as flavonoids, phenolic acids, and glucosinolates increase their efficacy as functional foods.(9).

1.2 Variation in Nutrient Content Across Species

Microgreen species differ greatly in their nutrient composition. Broccoli and mustard microgreens, for example, are remarkable for having a high glucosinolate content, that has been connected to cancer-preventive characteristics (10). Carrot microgreens have greater levels of lutein and beta-carotene than other species, demonstrating that the variability also extends to carotenoid content (7). These interspecies variations highlight the necessity of carefully choosing microgreens according to particular dietary objectives.

1.3 Impact of Cultivation Practices on Nutritional Value

Cultivation practices play a pivotal role in determining the nutritional quality of microgreens. Their nutrient profile can be greatly impacted by variables like watering frequency, substrate composition, and light intensity. Studies have demonstrated, for instance, that microgreens cultivated under regulated light-emitting diode (LED) lighting have higher concentrations of carotenoids and anthocyanins than those grown in the presence of natural sunlight (11). Similarly it has been observed that hydroponic systems enhanced with nutrient solutions enhance the uptake of minerals and the production of phytochemicals (12). Additionally, organic farming practices, which eliminate synthetic pesticides and fertilizers, tend to increase antioxidant levels, most likely as a result of plant stress responses (13). Nevertheless, nutrient concentrations can be diluted by overwatering or nutrient imbalance, highlighting the necessity of ideal growing conditions.

1.4 Functional Food Potential and Chronic Disease Prevention

Microgreens are being promoted as functional foods that may help prevent chronic diseases because of their high nutrient density as well as bioactive compound content. Microgreens contain antioxidants that scavenge free radicals, reducing oxidative stress and the the likelihood of diseases like type 2 diabetes and cardiovascular disorders (1). Glucosinolates found in Brassica microgreens have demonstrated potential for chemopreventive effects and in regulating the metabolism of carcinogens (10). Furthermore, the anti-inflammatory properties of phenolic compounds may help with conditions like arthritis and inflammatory bowel disease. Given these promising attributes, this review will subsequently discuss the potential therapeutic role of microgreens in the management and prevention of cardiovascular diseases, cancer, diabetes, neurodegenerative disorders, as well as other conditions such as obesity and osteoporosis.

II. THE POTENTIAL THERAPEUTIC ROLE OF MICROGREENS IN THE PREVENTION AND MANAGEMENT OF CHRONIC DISEASES

Cardiovascular Diseases

Because of their abundant anti-inflammatory and antioxidant qualities, microgreens have drawn interest for their possible contribution to the prevention of cardiovascular diseases. These young plants are rich in vital nutrients that are important for heart health, including potassium, vitamin K, and folate. Vitamin K is essential for blood clotting and preserving vascular health, while folate is known to help lower homocysteine levels, which are indicators for cardiovascular diseases (1,14). Since potassium is necessary for sustaining normal blood pressure, eating microgreens can help protect your heart by lowering your risk of hypertension and regulating blood pressure (15,16). Furthermore, consuming microgreens has been linked to improved heart health and lower cholesterol, according to studies. Microgreen's high concentration of bioactive substances, including polyphenols and carotenoids, enhances their antioxidant potential and lowers inflammation and oxidative stress, two factors associated with cardiovascular disorders (17,18). These properties make microgreens a promising functional food for supporting cardiovascular health.

Cancer

Microgreens are also known for their ability to prevent cancer, owing to their high phytochemical content. These compounds, which include carotenoids, phenolic compounds, and glucosinolates, have been shown to have anticancer properties (3,14). The antioxidant activity of microgreens helps to neutralize free radicals, thus decreasing oxidative damage to cells and DNA, which is an identified mechanism in cancer prevention (5,18). Microgreens have been shown in specific studies to have antiproliferative effects on various cancer cell lines, including colon cancer cells. The bioactive compounds in microgreens may promote apoptosis (programmed cell death) and restrict the proliferation of cancer cells, making them a beneficial addition to cancer preventive diet (5,19). The consumption of microgreens, with their rich phytochemical profile, can thus be a strategic dietary approach to reduce the risk of cancer development.

Diabetes

Microgreens have shown promising potential in blood sugar control, making them a valuable addition to diets aimed at managing diabetes. Rich in nutrients, these young plants are having crucial role in controlling blood sugar levels. For example, microgreens are known to have high levels of chromium and magnesium, two elements that are critical for improving glucose metabolism and insulin sensitivity (17,20,21). According to research, diets high in fiber and bioactive substances, like those in microgreens, can enhance insulin sensitivity and have a positive impact on the glycemic index. Increased fiber consumption is linked to notable decreases in fasting plasma glucose, HbA1c, and insulin resistance—all important indicators of diabetes management, based on a systematic review and meta-analysis.(22). Likewise, Research has shown that eating microgreens, like broccoli, can lower insulin resistance and enhance glucose homeostasis, which lowers the likelihood of diabetes (18,23).

Neurodegenerative Diseases

The high concentrations of bioactive substances in microgreens, including folate, vitamin K, and omega-3 fatty acids, are primarily responsible for antioxidant and anti-inflammatory properties, which may help prevent neurodegenerative diseases (3,24,25). Vitamin K is well-known for its role in brain health and defense against oxidative stress, whereas folate is essential for cognitive function and has been associated with a lowering risk of Alzheimer's disease (1,26). Some microgreens contain omega-3 fatty acids, which have been linked to a decreased risk of Parkinson's disease and are crucial for preserving neuronal integrity (25,27). The high antioxidant content of microgreens supports in the fight against oxidative stress, which is a major contributor to the development of neurodegenerative diseases (3,17).

III. POTENTIAL HEALTH BENEFITS OF MICROGREENS ON OTHER CHRONIC DISEASES

Obesity

Microgreens, particularly red cabbage, are abundant in bioactive compounds like anthocyanins. These compounds have been demonstrated to address inflammation linked to obesity by influencing metabolic and inflammatory markers, presenting a dietary approach to manage obesity and its related health concerns (28). The abundant polyphenols and antioxidants found in microgreens enhance their potential to combat obesity by blocking enzymes such as pancreatic lipase, which plays a key role in fat digestion (17). This indicates that including microgreens in the diet may serve as a natural method for weight management and lowering the risks associated with obesity.

Osteoporosis

Although there is limited research on the direct relationship between microgreens and osteoporosis, microgreens like broccoli and kale contain high amounts of vitamins and minerals, including calcium and vitamin K, which are crucial for maintaining bone health. These nutrients are recognized for their role in promoting bone density and strength, potentially lowering the risk of osteoporosis (14,18). The glucosinolates and other bioactive compounds found in microgreens might aid in supporting bone health by alleviating inflammation and oxidative stress, both of which play a role in bone degradation (1).

IV. NEED FOR FURTHER RESEARCH

Although microgreens show great promise in preventing chronic conditions discussed above, Further studies should focus on long-taerm clinical trials to assess the health benefits and long-term effects of microgreens, the impact of different cultivation practices on nutrient composition, and the bioavailability of their bioactive compounds. Additionally, research should explore species-specific health benefits, phytochemical synergies, and the role of microgreens in managing chronic diseases like diabetes, cardiovascular diseases, and cancer, with an emphasis on discovering the exact mechanisms of action.

V. CONCLUSION

Microgreens, packed with nutrients and bioactive compounds, are increasingly recognized as valuable functional foods. They are rich in essential vitamins, minerals, and plant compounds like glucosinolates and polyphenols, which may help prevent chronic diseases such as heart disease, cancer, diabetes, and neurodegenerative disorders. Different types of microgreens offer varying nutrient benefits, and how they are grown plays a crucial role in maximizing their health potential. With chronic diseases on the rise globally, adding microgreens to diets offers a natural and nutritious way to support overall health. Looking forward, more research is needed to fully understand how microgreens benefit health and to establish their role in clinical nutrition. By promoting better eating habits and deepening our understanding of nutritional science, microgreens could become a key player in improving public health and combating chronic diseases. Future studies should focus on investigating the bioavailability and long-term health effects of microgreens, along with their contribution to a balanced diet for preventing chronic diseases.

VI. Acknowledgement

Ghevariya Hinal Hiteshkumar is grateful to the SHODH-ScHeme Of Developing High quality research, Education Department, Gujarat State (Student Ref No : 201901380052) for providing financial support.

REFRENCES

1. Bhaswant M, Shanmugam DK, Miyazawa T, Abe C, Miyazawa T. Microgreens—A Comprehensive Review of Bioactive Molecules and Health Benefits. Mol 2023, Vol 28, Page 867 [Internet]. 2023 Jan 15 [cited 2023 Jun 15];28(2):867. Available from: https://www.mdpi.com/1420-3049/28/2/867/htm
2. Jambor T, Zajickova T, Arvay J, Ivanisova E, Tirdilova I, Knizatova N, et al. Exceptional Properties of Lepidium sativum L. Extract and Its Impact on Cell Viability, Ros Production, Steroidogenesis, and Intracellular Communication in Mice Leydig Cells In Vitro. Molecules. 2022;27(16).
3. Marchioni I, Martinelli M, Ascrizzi R, Gabbrielli C, Flamini G, Pistelli L, et al. Small Functional Foods: Comparative Phytochemical and Nutritional Analyses of Five Microgreens of the Brassicaceae Family. Foods 2021, Vol 10, Page 427 [Internet]. 2021 Feb 15 [cited 2023 Jun 15];10(2):427. Available from: https://www.mdpi.com/2304-8158/10/2/427/htm
4. Rouphael Y, Colla G, De Pascale S. Sprouts, Microgreens and Edible Flowers as Novel Functional Foods. Agron 2021, Vol 11, Page 2568 [Internet]. 2021 Dec 17 [cited 2025 Jan 2];11(12):2568. Available from: https://www.mdpi.com/2073-4395/11/12/2568/htm
5. Fuente BD La, López-García G, Máñez V, Alegría A, Barberá R, Cilla A. Antiproliferative effect of bioaccessible fractions of four brassicaceae microgreens on human colon cancer cells linked to their phytochemical composition. Antioxidants [Internet]. 2020 Apr 1 [cited 2021 May 30];9(5):368. Available from: www.mdpi.com/journal/antioxidants
6. Le TN, Chiu C, Hsieh P. and Microgreens : An Updated Overview from a Nutraceutical Perspective. Plant Sci Today. 2020;
7. Xiao Z, Lester GE, Luo Y, Wang Q. Assessment of vitamin and carotenoid concentrations of emerging food products: edible microgreens. J Agric Food Chem [Internet]. 2012 Aug 8 [cited 2025 Jan 4];60(31):7644–51. Available from: https://pubmed.ncbi.nlm.nih.gov/22812633/
8. Choe U, Yu LL, Wang TTY. The Science behind Microgreens as an Exciting New Food for the 21st Century. J Agric Food Chem [Internet]. 2018 Nov 7 [cited 2021 May 30];66(44):11519–30. Available from: https://pubs.acs.org/doi/abs/10.1021/acs.jafc.8b03096
9. Kyriacou MC, El-Nakhel C, Pannico A, Graziani G, Soteriou GA, Giordano M, et al. Genotype-Specific Modulatory Effects of Select Spectral Bandwidths on the Nutritive and Phytochemical Composition of Microgreens. Front Plant Sci. 2019 Nov 19;10:489751.
10. Fuente BD La, López-García G, Máñez V, Alegría A, Barberá R, Cilla A. Antiproliferative effect of bioaccessible fractions of four brassicaceae microgreens on human colon cancer cells linked to their phytochemical composition. Antioxidants. 2020;9(5).
11. Samuoliene G, Brazaityte A, Jankauskiene J, Viršile A, Sirtautas R, Novičkovas A, et al. LED irradiance level affects growth and nutritional quality of Brassica microgreens. Cent Eur J Biol [Internet]. 2013 Dec 19 [cited 2025 Jan 4];8(12):1241–9. Available from: https://link.springer.com/article/10.2478/s11535-013-0246-1
12. Di Gioia F, Renna M, Santamaria P. Sprouts, Microgreens and "Baby Leaf" Vegetables. Food Eng Ser [Internet]. 2017 [cited 2025 Jan 4];403–32. Available from: https://pure.psu.edu/en/publications/sprouts-microgreens-and-baby-leaf-vegetables
13. Rouphael Y, Kyriacou MC, Petropoulos SA, De Pascale S, Colla G. Improving vegetable quality in

controlled environments. Sci Hortic (Amsterdam). 2018 Apr 14;234:275–89.
14. Jambor T, Knizatova N, Valkova V, Tirpak F, Greifova H, Kovacik A, et al. MICROGREENS AS A FUNCTIONAL COMPONENT OF THE HUMAN DIET: A REVIEW. J Microbiol Biotechnol food Sci [Internet]. 2022 Aug 1 [cited 2025 Jan 2];12(1):e5870–e5870. Available from: https://office2.jmbfs.org/index.php/JMBFS/article/view/5870
15. Newman RG, Moon Y, Sams CE, Tou JC, Waterland NL. Biofortification of Sodium Selenate Improves Dietary Mineral Contents and Antioxidant Capacity of Culinary Herb Microgreens. Front Plant Sci. 2021;12(August):1–9.
16. Ebert AW. Sprouts and Microgreens—Novel Food Sources for Healthy Diets. Plants. 2022;11(4).
17. Wojdyło A, Nowicka P, Tkacz K, Turkiewicz IP. Sprouts vs. Microgreens as Novel Functional Foods: Variation of Nutritional and Phytochemical Profiles and Their In vitro Bioactive Properties. Mol 2020, Vol 25, Page 4648 [Internet]. 2020 Oct 12 [cited 2025 Jan 2];25(20):4648. Available from: https://www.mdpi.com/1420-3049/25/20/4648/htm
18. Le TN, Chiu CH, Hsieh PC. Bioactive Compounds and Bioactivities of Brassica oleracea L. var. Italica Sprouts and Microgreens: An Updated Overview from a Nutraceutical Perspective. Plants 2020, Vol 9, Page 946 [Internet]. 2020 Jul 27 [cited 2025 Jan 2];9(8):946. Available from: https://www.mdpi.com/2223-7747/9/8/946/htm
19. Sharma K, Mahato N, Lee YR. Extraction, characterization and biological activity of citrus flavonoids. Rev Chem Eng [Internet]. 2019 Feb 1 [cited 2023 May 21];35(2):265–84. Available from: https://www.degruyter.com/document/doi/10.1515/revce-2017-0027/html
20. Bhaswant M, Shanmugam DK, Miyazawa T, Abe C, Miyazawa T. Microgreens—A Comprehensive Review of Bioactive Molecules and Health Benefits. Mol 2023, Vol 28, Page 867 [Internet]. 2023 Jan 15 [cited 2025 Jan 2];28(2):867. Available from: https://www.mdpi.com/1420-3049/28/2/867/htm
21. Gupta A, Sharma T, Singh SP, Bhardwaj A, Srivastava D, Kumar R. Prospects of microgreens as budding living functional food: Breeding and biofortification through OMICS and other approaches for nutritional security. Front Genet. 2023 Jan 25;14:1053810.
22. Reynolds AN, Akerman AP, Mann J. Dietary fibre and whole grains in diabetes management: Systematic review and meta-analyses. PLOS Med [Internet]. 2020 Mar 1 [cited 2025 Jan 2];17(3):e1003053. Available from: https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1003053
23. Ma S, Tian S, Sun J, Pang X, Hu Q, Li X, et al. Broccoli microgreens have hypoglycemic effect by improving blood lipid and inflammatory factors while modulating gut microbiota in mice with type 2 diabetes. J Food Biochem [Internet]. 2022 Jul 1 [cited 2025 Jan 2];46(7):e14145. Available from: https://onlinelibrary.wiley.com/doi/full/10.1111/jfbc.14145
24. Teng J, Liao P, Wang M. The role of emerging micro-scale vegetables in human diet and health benefits—an updated review based on microgreens. Food Funct [Internet]. 2021 Mar 15 [cited 2025 Jan 2];12(5):1914–32. Available from: https://pubs.rsc.org/en/content/articlehtml/2021/fo/d0fo03299a
25. Tallei TE, Kepel BJ, Wungouw HIS, Nurkolis F, Adam AA, Fatimawali. A comprehensive review on the antioxidant activities and health benefits of microgreens: current insights and future perspectives. Int J Food Sci Technol [Internet]. 2024 Jan 1 [cited 2025 Jan 2];59(1):58–71. Available from: https://onlinelibrary.wiley.com/doi/full/10.1111/ijfs.16805
26. Gupta A, Sharma T, Singh SP, Bhardwaj A, Srivastava D, Kumar R. Prospects of microgreens as budding living functional food: Breeding and biofortification through OMICS and other approaches for nutritional security. Front Genet [Internet]. 2023 Jan 25 [cited 2023 Jun 15];14:1053810. Available from: /pmc/articles/PMC9905132/
27. Sehrish A, Majeed I, Zongo E, Ayub H, Rasul H, Rahim MA, et al. A review on various extraction and detection methods of bio-functional components from microgreens: food applications and health properties. Int J Food Prop [Internet]. 2023 Dec 15 [cited 2025 Jan 2];26(2):3082–105. Available from: https://www.tandfonline.com/doi/abs/10.1080/10942912.2023.2272564
28. Lee YM, Yoon Y, Yoon H, Park HM, Song S, Yeum KJ. Dietary Anthocyanins against Obesity and Inflammation. Nutrients [Internet]. 2017 Oct 1 [cited 2025 Jan 5];9(10):1089. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC5691706/