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Microgreens as Functional Foods: Nutritional Attributes, Health Implications and Sustainable Production Prospects

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Abstract: *Microgreens are juvenile edible greens harvested within 7–21 days of germination. Due to their dense micronutrient profile and rich phytochemical content, they have gained attention as nutrient-rich functional foods. This narrative review synthesizes up-to-date scientific evidence on their nutritional composition, bioactive profiles, associated health benefits, and sustainability potential. Recent studies indicate that microgreens contain elevated levels of vitamins (C, E, K, β-carotene), essential minerals (iron, zinc, potassium, magnesium, calcium), and secondary metabolites including phenolics, flavonoids, glucosinolates, and sulforaphane, which contribute to significant antioxidant capacity and biological activities (Seth et al., 2025; Balik et al., 2025; Lone et al., 2024). Their short production cycle and adaptability to controlled environments further support their integration into sustainable food systems. These collective findings underscore the promising role of microgreens in enhancing nutritional security and mitigating lifestyle-related disorders.*

Keywords: Microgreens; Functional foods; Phytochemicals; Nutraceuticals; Urban agriculture; Chronic disease prevention

INTRODUCTION

Non-communicable diseases such as obesity, cardiovascular diseases, type 2 diabetes, and certain cancers are globally rising and closely linked to micronutrient deficiencies and poor diet quality. In this context, functional foods—foods with health-enhancing properties beyond basic nutrition—have become a focus of research and dietary intervention strategies. Microgreens, the early seedlings of vegetables and herbs harvested soon after germination, have emerged as promising candidates due to their high concentrations of micronutrients and bioactive compounds (Lone et al., 2024; Seth et al., 2025).

Unlike sprouts, which are harvested before true leaf emergence, microgreens are grown in soil or growth media and harvested above the root level after full cotyledon expansion, typically between 7 and 21 days of growth. Numerous studies have demonstrated their superior nutrient density compared with mature vegetables, including vitamins, minerals, and antioxidants, suggesting potential roles in the prevention of nutrient deficiencies and chronic diseases (Balik et al., 2025; Choe et al., 2018).

This review aims to summarize current evidence on the nutritional characteristics, bioactive profiles, health-related biological activities, and sustainability prospects of microgreens.

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II. RESULT

Nutritional Composition

Vitamin Content:

Recent analyses confirm that microgreens are rich in essential vitamins, including vitamin C (ascorbic acid), vitamin E (tocopherols), vitamin K, and provitamin A carotenoids (Seth et al., 2025; Balik et al., 2025). For example, several microgreen varieties exhibited high ascorbic acid content and significant carotenoid levels, suggesting stronger antioxidant potential relative to mature greens.

Mineral Profile:

Microgreens also provide substantial amounts of essential minerals. Assessments across multiple species revealed considerable concentrations of potassium, magnesium, calcium, iron, zinc, and phosphorus (Balik et al., 2025). These micronutrients are key for immune function, bone health, and metabolic regulation.

Phytochemical and Antioxidant Profile

Detailed biochemical analyses indicate that microgreens contain diverse secondary metabolites, including phenolic compounds, flavonoids, anthocyanins, and glucosinolates (Seth et al., 2025; Chunthawodtiporn et al., 2023). These phytochemicals contribute to strong antioxidant capacities demonstrated in in vitro assays (Balik et al., 2025; Seth et al., 2025).

III. HEALTH-PROMOTING EFFECTS

1. Antioxidant and Anti-Inflammatory Potential

High phenolic content enhances the free radical scavenging capacity of microgreens, which may mitigate oxidative stress and related cellular damage (Seth et al., 2025).

2. Role in Chronic Disease Prevention

Emerging evidence suggests potential cardioprotective, antidiabetic, and chemopreventive properties. Antioxidant and glucosinolate pathways have been associated with improved lipid metabolism and modulation of malignancy-related biochemical processes (Lone et al., 2024; Choe et al., 2018).

Sustainability and Production Advantages

Microgreens offer clear agronomic advantages:

Short cultivation cycle (7–21 days)

Low water and land requirements

Compatibility with vertical and controlled-environment agriculture

Reduced reliance on synthetic fertilizers

These attributes support their adoption in urban and sustainable farming scenarios (Seth et al., 2025; Food Bioscience, 2024).

IV. DISCUSSION

The reviewed literature establishes microgreens as nutrient-dense, phytochemical-rich functional foods with the potential to support chronic disease prevention and improve micronutrient intake. Their elevated micronutrient profiles and abundant bioactive compounds highlight a functional role that transcends traditional vegetable consumption patterns.

Moreover, their short production cycles and resource efficiency align with sustainable and urban agriculture paradigms, addressing food security concerns in rapid urbanization contexts. However, most health claims are based on biochemical and preclinical evidence, necessitating well-designed human intervention trials.

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V. CONCLUSION

Microgreens offer promising nutritional and functional benefits relevant to public health and sustainable food systems. Their rich profiles of vitamins, minerals, and bioactive compounds support dietary diversification and chronic disease mitigation efforts. Continued research should prioritize clinical validation, optimized production practices, and postharvest management strategies to fully integrate microgreens into mainstream nutritional frameworks.

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