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Microgreens: A New Dimension in Human Nutrition

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Abstract

Growing demand for nutritious foods, sustainable production systems and urban agriculture has increased global interest in microgreens. These young edible seedlings are harvested shortly after germination and are valued for their rich nutritional profile, attractive appearance and diverse flavours. Several crops, including broccoli, radish, mustard, amaranth, beetroot, pea and chickpea, can be cultivated as microgreens. They are rich in vitamins, minerals, carotenoids, phenolic compounds and antioxidants that contribute to human health and well being. Their short production cycle, low resource requirement and suitability for indoor cultivation make them promising components of urban food systems. Microgreens also offer opportunities for local food production, value addition and entrepreneurship. However, limited consumer awareness, short shelf life and food safety concerns restrict their wider adoption. This article discusses the nutritional importance, crop diversity, cultivation practices, urban farming potential and emerging entrepreneurial opportunities associated with microgreens in sustainable food systems.

1. Introduction

Modern agriculture is facing multiple challenges including population growth, climate change, shrinking cultivable land and increasing demand for nutritional food on other hand. Consumers these days are seeking food that not only satisfy hunger but also enhances health and wellness and this shift has stimulated interest in functional foods and nutrient rich vegetables. Among the emerging food products, microgreens are gaining momentum these days because of their nutritional value, ease of production, and suitability for urban agriculture.

Microgreens are young edible seedlings harvested at early stage of growth when cotyledons are fully expanded and first true leaves begin to emerge. They occupy an intermediate stage between sprout and baby greens and are harvested within 7 to 21 days after

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Microgreens, nutrition security, sustainable agriculture, urban farming, value addition, vertical farming

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germination (Kyriacou et al., 2016). Although initially used as garnishes in high end restaurants, microgreens are now recognised as valuable components of healthy diets and sustainable food culture. Nowadays, their popularity has increased because they combine visual appeal, flavour diversity, and nutritional richness in a compact form. Also their ability to grow in limited spaces makes them suitable for households, educational institutions, rooftop gardens etc.

2. Understanding Microgreens

The edible portion of microgreen consists of stem, cotyledons and sometimes the first true leaves. Their colour varies depending on species ranging from light green to deep red and purple. Their flavour may vary from mild and sweet to pungent and spicy. Microgreens have gained much popularity because of their rapid growth cycle and ability to be produced throughout the year under controlled conditions. They are increasingly used in salads, sandwiches, soups, wraps, smoothies and gourmet dishes.

3. Diversity of Microgreen Crops

One of the most remarkable features of microgreens is the diversity of species that can be cultivated. Numerous vegetable, herb and legume crops are suitable for microgreen production.

Among these, brassica microgreens are the most widely cultivated due to their attractive flavour and high concentration of bioactive compounds. Beetroot and amaranthus are valued for their vibrant pigmentation, while pea and chickpea microgreens are appreciated for their tender texture and pleasant taste.

Table 1: Major crop families and examples used for microgreen production

Family	Examples
Brassicaceae	Broccoli, Radish, Mustard, Kale, Cabbage
Apiaceae	Coriander, Celery, Fennel
Amaranthaceae	Beetroot, Amaranthus, Swiss chard
Fabaceae	Pea, Chickpea, Lentil, Fenugreek
Asteraceae	Lettuce, Chicory

4. Nutritional Importance of Microgreens

One of the main factors contributing to microgreens' growing appeal is their high nutritional value. Numerous

studies have shown that microgreens are rich in vitamins, minerals, and phytochemicals that promote health (Xiao et al., 2012). Vitamins A, C, E, and K are abundant in microgreens. Vitamin A is necessary for growth and vision, while vitamin C is a potent antioxidant that boosts immunity. Vitamin E protects cells against oxidative damage while vitamin K contributes to bone health and blood coagulation. Minerals that are present in significant amounts include calcium, potassium, magnesium, phosphorus, iron, and zinc. These nutrients are necessary for enzyme activity, metabolic processes, and the maintenance of physiological activities. Beyond vitamins and minerals, microgreens contain numerous bioactive compounds including carotenoids, flavonoids and phenolic compounds. These substances possess antioxidant properties that help reduce oxidative stress in human body (Choe et al., 2018). Brassica microgreens are particularly rich in glucosinates, a group of sulphur containing compounds associated with various health promoting effects. Similarly, pigmented microgreens such as red cabbage, beetroot and amaranthus contain anthocyanins that contribute both colour and antioxidant capacity. Some microgreens may contain higher concentrations of nutrients compared with their mature vegetable counterparts (Xiao et al., 2012). Although nutrient content varies according to species and growing conditions, microgreens can significantly enhance dietary quality.

5. Production and Cultivation Practices

The cultivation of microgreens is relatively simple and requires minimal infrastructure. This characteristic has encouraged both home scale and commercial production. Successful cultivation begins with the selection of high quality seeds that possess good germination capacity and are free from contaminants. Growing media commonly used for microgreen production include cocopeat, peat moss, vermiculite, perlite and compost based substrates. Seeds are generally sown densely and irrigated carefully to maintain adequate moisture during germination. Most species germinate within a few days under favourable environmental conditions. Light is a critical factor influencing growth, colour development and nutritional quality. Natural sunlight may be used, but controlled environment systems frequently employ LED lighting to optimize production. Temperature and humidity management are equally important. Excessive moisture can favour fungal growth and reduce product quality. Proper ventilation and sanitation practices help maintain

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healthy crops and improve food safety. Microgreens are generally harvested when they reach a height of 5 to 10 cm and the first true leaves begin to emerge. Harvesting is performed using clean scissors or sharp knives to minimize contamination.

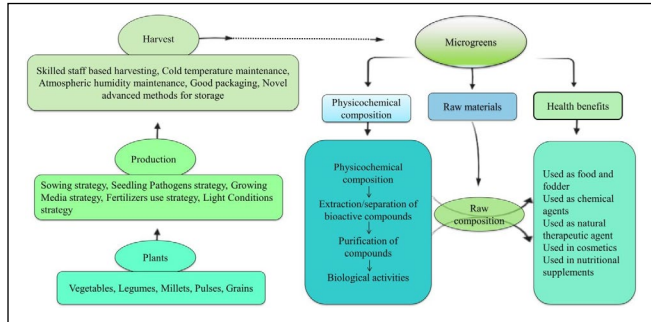


Figure 1. Overview of microgreen production, physicochemical composition and health benefits (Adapted from Bhaswant et al., 2023)

6. Microgreens in Urban Agriculture and Food Security

Urban agriculture has emerged as an important strategy for improving food security and enhancing access to fresh produce in cities. Within this framework, microgreens offer several advantages. Their short production cycle enables multiple harvests throughout the year. Unlike conventional field crops, microgreens require very little space and can be cultivated on balconies, rooftops, windowsills and indoor shelves. This makes them suitable for densely populated urban environments (Di Gioia et al., 2017). Water use efficiency is another significant advantage. Microgreens require considerably less water than many conventional crops due to their short growth duration and small biomass. The possibility of year round production under controlled conditions reduces dependence on seasonal weather patterns. This feature is especially important in the context of climate change and increasing environmental uncertainty. Microgreens can also strengthen local food systems by reducing transportation requirements and providing fresh produce near the point of consumption. Their cultivation can support community gardens, educational programmes and nutrition awareness initiatives. In developing countries, microgreens may contribute to dietary diversification and improved nutritional intake, particularly among urban populations with limited access to fresh vegetables.

7. Challenges and Future Prospects

Despite their advantages, microgreens face several challenges that must be addressed to achieve wider adoption. One major limitation is their short shelf life. Because they are harvested at a tender stage, they are highly perishable and require appropriate packaging and refrigeration to maintain quality (Renna and Kyriacou, 2017). Consumer awareness remains another challenge. Many individuals still confuse microgreens with sprouts or consider them products intended only for luxury restaurants. Increased awareness and educational programmes are necessary to expand consumer acceptance. Food safety is particularly important because microgreens are frequently consumed raw. The adoption of standardized production protocols and quality assurance systems is essential to minimize contamination risks. Future research should focus on improving production efficiency, extending shelf life and enhancing nutritional quality. Advances in controlled environment agriculture, hydroponics, vertical farming and precision agriculture are expected to accelerate the development of the microgreen industry. As demand for healthy foods and sustainable production systems continues to increase, microgreens are likely to play an increasingly important role in future food systems.

8. Business Opportunities in Indian Context

The microgreens sector remains as an excellent platform for entrepreneurs, as it requires low startup costs, offers rapid production cycles, and provides a high return on space used. Urban and controlled agricultural methods can be scaled effectively, especially in densely populated regions of India where space is limited (Malo et al., 2025), and there is a promising avenue for microgreens within the HORECA (Hotels, Restaurants & Cafes) sector, which enjoys consistent demand. Additionally, branching out into retail and online sales can enhance accessibility and broaden market reach. Another potential growth area is the addition of value through the use of ready to eat (RTE) salads, functional food products and health blends. Attractive branding, packaging and certification can improve product differentiation and builds consumer trust but the sector growth depends on the efficient supply chain, modern marketing and product innovation. This enables microgreens to transition from a niche market to a broader urban food market (Seth et al., 2025).

9. Marketing Strategies in the Indian Microgreens Market

Microgreens in India should be promoted on the basis of their value as they are a niche & premium market. Microgreens are sold for their nutritional benefits, freshness and sustainability features rather than their vegetable origins. Proper communication of health benefits, such as being high in antioxidants and micronutrients (Rawat et al., 2024), plays a crucial role in shaping consumer perceptions and encouraging product adoption. The major constraint in the Indian market is low consumer awareness and so consumer education is crucial particularly by showing how to use the products such as through recipes and how to integrate them into everyday meals. A key strategy has been building awareness, with digital media like Instagram & YouTube allowing for personal engagement with consumers by producers and creating trust through transparency and storytelling. Subscription delivery services, a kind of direct to consumer (D2C) model, also ensure consistent demand and consumer loyalty. The target marketing to fitness enthusiasts and health-conscious city dwellers can increase the efficiency of such efforts.

10. Conclusion

Microgreens have emerged as a promising solution for improving nutrition, promoting sustainable agriculture and creating new entrepreneurial opportunities. Their rich nutritional profile, short production cycle and adaptability to urban farming make them valuable for future food systems. In addition to scientific advancements, effective marketing, consumer awareness and innovative business models can accelerate their commercial adoption. With continued research, value addition and market development, microgreens have the potential to contribute significantly to nutrition security, sustainable livelihoods and resilient food systems.

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