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MICRO GREENS: PRODUCTION TECHNOLOGY, NUTRITIONAL VALUE AND COMMERCIAL POTENTIAL

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Abstract

Microgreens are young seedlings of vegetables, herbs, and grains harvested within 7–21 days of germination. They are rich in vitamins, minerals, carotenoids, phenolic compounds, antioxidants, and bioactive compounds such as glucosinolates (Sun *et al*., 2023; Liao *et al*., 2024). Varieties such as broccoli, red cabbage, kale, radish, amaranth, and beetroot can be grown in soil or soilless systems under controlled conditions. Vertical and hydroponic cultivation enables efficient use of space; one study reported a 6–10-fold increase in biomass within 10 days and about four-fold higher yield per m² than conventional cultivation (Tilahun *et al*., 2023). Optimized LED lighting can further improve growth, yield, and nutritional quality (Viršilė *et al*., 2023). Thus, microgreens have strong potential for sustainable food production and functional nutrition.

Keywords: Microgreens, nutritional value, LED lighting, urban farming, commercial potential

INTRODUCTION

The microgreens business is expanding rapidly, but it confronts a number of obstacles (Charlebois, 2019; Riggio *et al*., 2019). Microgreens are young, tender, edible seedlings of vegetables, herbs, or grains, typically harvested within 7–21 days after germination. Their rising popularity is also driven by a shift towards sustainable food systems and functional foods. Studies show that species like broccoli, red cabbage, and radish microgreens are rich in bioactive compounds such as glucosinolates, polyphenols, and carotenoids (Zhang *et al.,* 2023). Microgreens are a new class of

edible vegetables (Pinto *et al*., a very specific type which includes seedlings of edible vegetables, ranging in size from 8 to 10 cm. (Xiao *et al.*, 2012).

Microgreens: Cultivation, Nutritional Traits, Uses and Market Potential

Introduction

Microgreens are young, tender seedlings of vegetables, herbs, and grains that are harvested at an early stage of growth, usually within 7–21 days after germination. They are gaining popularity because of their high nutritional value, attractive appearance, distinctive flavors, and short production cycle. Microgreens can be cultivated in soil as well as soilless media such as coco peat, coconut coir, and perlite. Their ability to grow in limited spaces makes them suitable for home gardening, vertical farming, hydroponics, and commercial production.

Growing Process of Microgreens

Seed Selection and Variety Choice

Selecting good-quality seeds is the first step in successful microgreen production. Crops such as broccoli, cabbage, radish, mustard, beetroot, pea, amaranth, and spinach are commonly cultivated because of their rapid germination and nutritional value. Arugula, cilantro, and basil are also popular because of their distinctive flavors and health-promoting properties (Xiao *et al*., 2012).

Crop	Seed rate (g/1020 tray)
Broccoli	15–20
Cabbage	15–20
Beetroot	20–30
Radish	30–35
Mustard	10–15

Seed Soaking

Some larger seeds, particularly pea seeds, benefit from soaking before sowing. Seeds are generally soaked for approximately 4–12 hours depending on the crop. Soaking softens the seed coat, promotes water absorption, and can encourage faster and more uniform germination.

Selection of Growing Medium

Microgreens can be grown in soil or soilless substrates. Coco peat and coconut coir are commonly used because they are lightweight, retain adequate moisture, and provide good aeration for root

development (Kyriacou *et al*., 2019). A shallow tray with good drainage is generally filled with approximately 2–3 cm of moist growing medium.

Sowing of Seeds

After soaking, seeds are evenly broadcast over the moist growing medium and gently pressed to ensure good contact. A thin layer of coco peat may be used to cover the seeds. The trays are then maintained under suitable moisture and environmental conditions to initiate germination (Mir *et al*., 2023).

Germination and Environmental Conditions

During germination, environmental conditions should be carefully controlled. Most microgreens germinate well at approximately 18–22°C, with relatively high humidity. Covering the trays during the initial germination period can help maintain moisture and encourage uniform sprouting (Xiao *et al*., 2012). Once germination occurs, adequate ventilation is important to reduce excessive humidity and the risk of fungal growth.

Lighting

After germination, microgreens require sufficient light for photosynthesis and healthy development. Generally, 12–16 hours of light per day is suitable for many microgreen crops. Artificial LED lighting can be used in indoor and vertical farming systems and may improve biomass production and nutritional quality when properly optimized (Kyriacou *et al*., 2016).

Water and Nutrient Management

Proper water management is essential for healthy microgreen production. The growing medium should remain moist but should not become waterlogged. Most microgreens have a short growth cycle and require relatively little fertilizer when grown in a suitable substrate. In hydroponic systems, nutrient solutions can supply essential mineral elements directly to the plants (Pinto *et al*., 2021; Mir *et al*., 2023).

Harvesting

Microgreens are generally ready for harvest **7**–21 days after germination, depending on the crop and growing conditions. Harvesting is commonly carried out when the cotyledons are fully developed and the first true leaves begin to appear. The plants are cut close to the growing medium using a clean, sharp knife or scissors to avoid damaging the harvested product (Xiao *et al*., 2012). Careful handling after harvest is important for maintaining freshness and quality.

Types of Microgreens and Nutritional Traits

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Microgreens contain considerable amounts of vitamins, minerals, proteins, carotenoids, phenolic compounds, and other bioactive substances. Their nutritional composition varies according to species, cultivar, growing conditions, and harvest stage (Paradiso *et al*., 2023).

Crop	Protein (%)	Important nutrients	Nutritional importance
Broccoli	2.23–3.00	Vitamin C	Antioxidant activity and dietary health
Radish	1.81	Vitamin K	Supports bone health and normal blood clotting
Mustard	2.78	Vitamins A and C	Supports immune, eye, and skin health
Pea	4.03	Vitamin K	Important for bone health and blood clotting
Beetroot	2.09	Vitamins C and K	Supports immune and bone health
Amaranth	13–19	Minerals and bioactive compounds	Supports overall nutritional health
Spinach	Variable	Vitamins and minerals	Contributes to a balanced diet

Microgreens in Home and Commercial Production

Microgreens are increasingly cultivated in both homes and commercial farming systems because they require little space and have a short production period. At the household level, they can be grown indoors, on windowsills, balconies, or in small trays, providing a convenient source of fresh greens (Xiao *et al*., 2022; Poudel *et al*., 2021).

Commercially, microgreens are used in restaurants, salad mixes, fresh-food markets, and nutraceutical products because of their vibrant colors, distinctive flavors, and high concentration of nutrients and bioactive compounds (Kyriacou *et al*., 2021). Their short production cycle of approximately 7–21 days also makes them attractive for small-scale entrepreneurs and urban farms. Vertical and hydroponic systems can further increase production efficiency by making better use of limited growing space (Choe *et al*., 2022).

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Market Value of Microgreens

The market value of microgreens varies according to crop, quality, location, production system, packaging, and consumer demand. Indicative retail values reported for selected microgreens are shown below.

Microgreen	Approximate market value	Pack size
Broccoli	₹150–300	100 g
Radish	₹100–250	100 g
Mustard	₹100–200	100 g
Pea	₹100–200	100 g
Beetroot	₹150–300	100 g

(Gupta et al., 2023)

Conclusion

Microgreens represent a promising component of sustainable agriculture because of their high nutritional value, rapid growth, short production cycle, and suitability for urban, vertical, and hydroponic farming. Their rich content of vitamins, minerals, antioxidants, and other bioactive compounds makes them valuable functional foods. They can be produced on a small scale at home or commercially using controlled-environment systems. Advances in LED lighting, vertical farming, hydroponics, and controlled-environment agriculture can further improve their productivity and nutritional quality. With increasing consumer awareness and demand for fresh and nutritious foods, microgreens have considerable potential to contribute to food security, economic opportunities, sustainable agriculture, and health-oriented food systems.

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