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Microgreen: The Superfood

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Abstract:

Microgreens are young, fragile greens used to add color, texture, and flavor to salads and main courses. Due to their small-scale and indoor growth capabilities, controlled environment agriculture has embraced them extensively. This indoor farming method is particularly significant for meeting the growing food needs of urban populations. The food industry, which aims to satisfy consumers growing need and expectations for healthy foods, is mostly driven by innovation in the design of new and functional foods. Microgreens have gained endorse as functional foods in recent years because of their high nutritional density and presence of bioactive or secondary metabolites. Microgreens are made up of well-developed cotyledonalary leaves, immature true leaves, and a central stalk.

Keywords: Microgreens, Functional foods, Indoor farming, Cotyledonalary leaves,

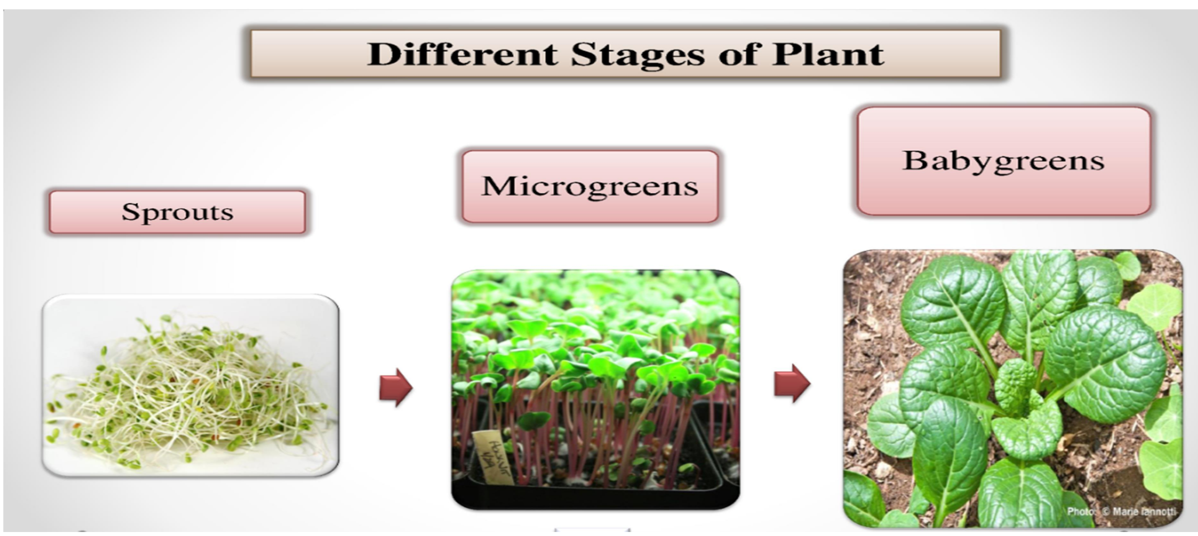
Introduction:

There is an enormous and growing need for a more sustainable, easily available and nutrient-dense food supply due to the increase in the world's urban population. Both the public and private sectors are interested in urban farming, particularly in controlled environment agriculture (Benke *et al.,* 2017). Microscale vegetables have grown in popularity in the twenty-first century because of their high nutritional content and bioactive enrichment (Ayoub, 2003). Microgreens have gained significant scientific and industrial attention, notably due to their ready-to-eat nature and strong nutraceutical potential (Jambor *et al.,* 2022). Crops are cultivated in an enclosed room where the climate, lighting, and irrigation can be managed, optimized, and even automated using data analytics and machine learning techniques. Furthermore, indoor farming has the potential to be more ecologically friendly and accessible for city inhabitants. Even with the entire hype, controlled environment agriculture is still relatively new and only applies to a small number of agricultural products. Because they are so simple to grow in soil or hydroponically, microgreens are one of the most popular crops in controlled environment agriculture. Microgreens are vegetable greens that are collected shortly after the formation of cotyledonalary leaves with one set of genuine leaflets. Microgreens have become a popular addition to diets in the age of global health consciousness because of their capacity to maintain and supplement nutrients. Microgreens, frequently referred to as "superfoods," are thought to be extremely nutrient-dense and can be harvested in one to three weeks (Jambor *et al.,* 2022). Microgreens' unique flavors, eye-catching colors, and delicate textures make them ideal for use as salad or edible garnishes for soups, sandwiches, and a range of main courses. Using a different species of microgreens can enhance a dish's flavor and appearance (Wood, 2019). Due to their higher nutritional content and more strong flavor and taste, microgreens can be thought of as superior alternatives to sprouts (Puccinelli *et al.,* 2019). Furthermore, compared to their mature counterparts, microgreens might have higher concentrations of vitamins, minerals, and phytochemicals (Yadav *et al.,* 2019). Thus, adding microgreens to meals may enhance their nutritional value and help people achieve better health results. However, because microgreens are so fragile and typically have a short shelf life, they have also brought numerous issues to the farmers and the supply chain.

Microgreens, sprouts and vegetable:

Microgreens are young vegetables that are harvested five to twenty-one days after germination, often measuring one to three inches in height. It is made up of two young true leaves, a stalk, and one or more cotyledonary leaves. However, not all immature leafy vegetables are classified as microgreens. These are smaller than baby greens and are often harvested later than sprouts. The main difference between microgreens, sprouts, veggies, and baby greens is when they are harvested. Baby greens are usually harvested between 20 and 40 days, whereas microgreens are harvested as soon as their genuine leaflets mature. Sprouts are harvested earlier in the season than microgreens.

Sprouts are harvested earlier in the season than microgreens. Sprouts are consumed along with their seeds, roots, stems, and immature cotyledonary leaves. Microgreens, in contrast, are eaten without their roots. Since microgreens take longer to harvest than sprouts or baby greens, they might have more delicate textures and unique flavors. Vegetables, on the other hand, are harvested at the end of either the vegetative or reproductive phase, or both. Compared to fully grown plants, microgreens typically contain higher levels of minerals and micronutrients. This suggests that microgreens, even in tiny doses, might provide nutritional benefits comparable to those of bigger, fully-grown plants.



Health Benefits:

Anti-oxidant potential:

The dietary transporters of naturally occurring antioxidant compounds, such as vitamins and polyphenols, are microgreens. Actually, compared to seeds and sprouts, microgreens of Vigna radiata and Cicer arietinium show higher levels of antioxidant activity (Ebert, 2022). Likewise, it has been discovered that cruciferous and umbelliferous microgreens have exceptionally significant antioxidant capacities. In Alzheimer's disease, naturally occurring polyphenolic compounds with antioxidant properties may lessen oxidative stress in the brain. Watercress showed the highest antioxidant activity, while mustard and rocket salad showed significantly lower activities. Accordingly, antioxidant-rich microgreens with high polyphenol contents could provide defense from Alzheimer's disease as well as other age-related conditions like cancer and cardiovascular disease (Marchioni *et al.,* 2021).

Cardiovascular disease:

Consuming microgreens may reduce the risk of cardiovascular disease, which is a major global health concern brought on by sedentary lives and poor diets. Red cabbage microgreens have been found to change cholesterol and lipid levels. Huang et al. (2016) found that supplementing mice with red cabbage microgreens lowers their levels of triglycerides, hepatic cholesterol ester, low-density lipoprotein, and liver inflammatory cytokines. Red cabbage microgreens had glucosinolate and polyphenol concentrations of 17.15 and 71.01 µmol g-1, respectively. Polyphenols and glucosinolates, when combined with dietary fibers, have been demonstrated to lower cholesterol levels (Złotek *et al.,* 2019).

Anti-diabetic and anti-obesity activity:

Enzymatic inhibition and increased glucose absorption can both help diabetic people control their blood glucose levels. At a concentration of 2 mg mL-1, fenugreek microgreen, which is rich in polyphenols and other antioxidant compounds, has been shown to have an antidiabetic impact by inhibiting -amylase (70%) and increasing glucose uptake in L6 cells (25%) (Sharma *et al.,* 2022).

Anti-cancerous activity:

Previous studies have suggested that a diet high in fruits and vegetables may help to prevent cancer. Thus, microgreens that are high in bioactive compounds could provide cancer prevention. For instance, compared to the florets and mature leaves of broccoli, the microgreens contain four times as much anti-cancerous aliphatic glucosinolates. Antioxidant components found in Brassicaceae microgreens dramatically reduced tumor cell proliferation by 20–41.9% (Trypan-blue) and 10–12.8% (MTT assay). Additionally, it was discovered that microgreens with lower levels of antioxidant activity and ascorbic acid were less effective against cancer cell types. Microgreens have the potential to prevent cancer by controlling inflammation and xenobiotic metabolism.

Anti-inflammatory activity:

Higher levels of polyphenols and glucosinolates in microgreens, are supposed to modulate the immune system and prevent the aforementioned diseases (L´opez-Chill´on *et al.,* 2019).

Conclusion:

One well-known feature of microgreens is their high nutritional density. Typically, microgreens are cultivated inside, where lighting and climate control demand a large amount of energy and water. For long-term viability and environmental impact, it will be essential to address the sustainability aspects of microgreen production, such as minimizing water usage and maximizing energy efficiency. Because of their high respiration rates and sensitive nature, microgreens have a limited shelf life. Enhancing post-harvest handling practices, including as packaging, storage, and shipping, can assist consumers maintain their quality and increase their shelf life. These days, microgreens like broccoli, radish, pea shoots, and sunflower are the most often produced types (Marchioni *et al.,* 2021). In addition to giving consumers additional choices and tastes, investigating new crops and introducing a greater range of microgreens will increase growers' market potential. The advantages of microgreens are largely unknown to many people. Demand and market expansion will be aided by raising consumer knowledge and teaching them about the nutritional benefits, culinary applications, and sustainability features of microgreens.

Technology and automation can be very helpful in maximizing the output of microgreens. Microgreens' small size and quick growth cycle make them ideal for urban agriculture and vertical farming. By using these strategies, microgreens may be brought closer to urban customers, transportation costs can be decreased, and area usage can be maximized. . All things considered, resolving these issues and concentrating on potential future paths would support the long-term expansion and broad acceptance of microgreens as a tasty and nutrient-dense dietary choice.

Plant	Days to germination
Amaranth	3-4
Arugula	5-7
Basil	3-7
Beet	5-7
Broccoli	3-7
Swiss Chard	5-7
Chive	7-10
Cilantro	7-14
Dill & Fennel	7-21
Kale	5-7
Lemon Balm	5-7

Plant	Days to germination
Mint	14-21
Mustard	5-10
Oregano	14-21
Parsley	10-21
Pea	7-14
Radish	3-7
Sage	10-21
Sunflower	3-7
Tatsoi	7-10
Thyme	14-28
Watercress	3-7

Some Requirements for Growing Microgreens

Micro-greens	Seed (g)/Tray (30 x 30 cm)	Soaking Time (h)	Depth of media Mix (cm)	Temperature (ºC)	Maturity (Days)
Amaranth	2.5	NA	2	>22	16-25
Purple Basil	2.5	NA	1	>24	16-25
Beet root	12.5	24	2	16-25	16-25
Buckwheat	12.5	8-12	2	20-25	5-6
Cress	8	NA	1	16-25	5-14
Dill	5	NA	1	15-23	16-25
Kale	5	4-8	2	16-28	16-25
Linseed	36	NA	2	16-25	6-8
Mustard	2.5	8	2	16-25	15-20
Pea shoots	100-150	8-12	2	15-25	10-14
Radish	5	6-12	3	16-28	12
Cabbage	5	4-8	2	16-25	3-6
Arugula	3	NA	2	16-25	16-25
Sunflower	50	8-12	2	20-25	8-12

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