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Microgreens: A potential food for 21st century

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Abstract

Microgreens are tiny, edible greens that have gained a lot of popularity in the past few years. Grown from the seeds of vegetables and herbs, not only do they add intense flavor, vivid colors and a crisp texture to dishes, but they also are extremely nutritious. Although they are only a few inches tall, studies show that they pack forty times the nutritional value of their mature counterparts. Microgreens have gained increasing popularity as food ingredients in recent years because of their high nutritional value and diverse sensorial characteristics. Microgreens share many characteristics with sprouts, and while they have not been associated with any food borne illness outbreaks, they have recently been the subject of seven recalls. Thus, the potential to carry food borne pathogens is there, and steps can and should be taken during production to reduce the likelihood of such incidents. One major limitation to the growth of the microgreen industry is the rapid quality deterioration that occurs soon after harvest, which keeps prices high and restricts commerce to local sales. Once harvested, microgreens easily dehydrate, wilt, decay and rapidly lose certain nutrients. Research has explored preharvest and postharvest interventions, such as calcium treatments, modified atmosphere packaging, temperature control, and light, to maintain quality, augment nutritional value, and extend shelf life. However, more work is needed to optimize both production and storage conditions to improve the safety, quality, and shelf life of microgreens, thereby expanding potential markets.

Keywords: Microgreens, nutritional value, Proharvest interventions, herbs

Introduction

Micro greens are newly sprouted, immature plants without roots that are harvested after the development of the cotyledon leaves, or seed leaves, usually between 10 and 14 days from seeding. They are smaller than baby greens and they are harvested later than sprouts. (Paradiso *et al.*, 2018) ^[14].

They have an aromatic flavor and concentrated nutrient content and come in a variety of colors and textures. Micro greens are considered baby plants, falling somewhere between a sprout and baby green. That said, they shouldn't be confused with sprouts, which do not have leaves. Sprouts also have a much shorter growing cycle of 2-7 days, whereas microgreens are usually harvested 7-21 days after germination, once the plant's first true leaves have emerged. Microgreens are more similar to baby greens in that only their stems and leaves are considered edible. However, unlike baby greens, they are much smaller in size and can be sold before being harvested. This means that the plants can be bought whole and cut at home, keeping them alive until they are consumed. Microgreens are very convenient to grow, as they can be grown in a variety of locations, including outdoors and in greenhouses.

Micro greens are ideally suited for indoor production and are part of the global movement towards controlled environmental agriculture (CEA), (Riggio, Jones, & Gibson, 2019a) ^[17]. This movement is driven by population growth, shrinking arable land, and the need for ensuring food security (Goodman & Minner, 2019; Stoleru, Ioniță, & Zamfirache, 2016; Wood, 2019) ^[7, 19, 22]. The short time to harvest for micro greens and high market values makes them important CEA crops (Wood, 2019) ^[22]. Micro greens are gaining increasing interest as potential functional foods, due to their relevant contents of micronutrients and bioactive compounds. Even though small in size, microgreens can provide surprisingly intense flavors, different colors, and crisp texture and can be served as a new salad ingredient or an edible garnish (Xiao *et al.*, 2012) ^[23]. Scientific names, family, commercial name and plant colors of the 25 commercially grown microgreens assayed in this study are listed in Table-1.

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Table 1: List of the various crops grown as micro green

SL. No.	Scientific Name	Family	Commercial Name	Plant Colour
1.	<i>Eruca sativa</i> Mill.	Brassicaceae	Arugula	Green
2.	<i>Beta vulgaris</i> L.	Chenopodiaceae	bull's blood beet	Reddish-green
3.	<i>Apium graveolens</i> L.	Apiaceae	Celery	Green
4.	<i>Raphanus sativus</i> L.	Brassicaceae	China rose radish	Purplish-green
5.	<i>Coriandrum sativum</i> L.	Apiaceae	Cilantro	Green
6.	<i>Amaranthus hypochondriacus</i> L.	Amaranthaceae	Garnet amaranth	Red
7.	<i>Pisum sativum</i> L.	Fabaceae	Golden pea tendrils	Yellow
8.	<i>Ocimum basilicum</i> L.	Lamiaceae	Green basil	Green
9.	<i>Raphanus sativus</i> L. var. longipinnatus	Brassicaceae	Green daikon radish	Green
10.	<i>Spinacia oleracea</i> L.	Chenopodiaceae	Magenta spinach	Red
11.	<i>Brassica rapa</i> L. ssp. nipposinica	Brassicaceae	Mizuna	Green
12.	<i>Octimum basilicum</i> L.	Lamiaceae	Opal basil	Greenish-purple
13.	<i>Raphanus sativus</i> L.	Brassicaceae	Opal radish	Greenish-purple
14.	<i>Pisum sativum</i> L.	Fabaceae	Pea tendrils	Green
15.	<i>Lepidium bonariense</i> L.	Brassicaceae	Peppergrass	Green
16.	<i>Zea mays</i> L.	Poaceae	Popcorn shoots	Yellow
17.	<i>Brassica oleracea</i> L. var.	Brassicaceae	Nutrient purple	Purple

Source: Xiao *et al.*, 2012 ^[23]

Micro green has three basic parts

- A central stem
- Cotyledon leaf or leaves
- First pair of true leaves

Resources needed

- Containers-Pint size or half-pint size.
- Soil-preferably potting soil and seedling soil, but just one will do.
- Seeds-preferably organically grown.
- Water, sunlight, warmth and air the usual suspects. (Chatterjee & Joshi, 2020) ^[5].

Steps to grow micro greens

- Step 1: Pre-Soak seeds:** Most seeds that require soil as a growing medium require a presoak (like beets, sunflower, peas, buckwheat and cilantro) need to be pre-soaked before being spread over soil. To soak, submerge the seeds in jar filled with cold water. Make sure there is plenty of water as some seeds (like peas) absorb surprising amounts of water. Keep in a cool place (even your refrigerator on hot days). When pre-soaked for an appropriate time, rinse thoroughly with cold water. Optionally one can transfer the seeds (except beet, which should be planted directly) to a colander and rinse every 12 hours for another day before planting.
- Step 2: Prepare the trays:** For micro greens one will want about an inch and a half to two inches of soil in the tray. Put 4 cups of pH balanced water in the tray, then transfer the soil to the tray, spread the soil evenly and gently tamp it flat, (the back of a spatula is perfect for this). A flat even bed of soil that is firm, but not compacted is needed. Dampen the top soil by sprinkling a little water gently and evenly over the soil. The soil should be quite damp but not soggy. Re-tamp gently if necessary.
- Step 3: Spread the seeds:** Spread the soaked seed evenly across the tray. Larger seeds like buckwheat, sunflower and pea will end up being quite thickly spread.
- Step 4: Water & Cover:** Gently tamp the seeds flat into the soil. The goal here isn't to crush the seeds into the soil, but to simply make sure that the seeds are making firm contact with the soil. Use the spray bottle to thoroughly mist the seeds directly on the soil. Now take

one of the other trays and use your spray mister to spray the inside of it 4 or 5 times with an even distribution of mist. Use that misted tray as a black-out and humidity dome on the recently seeded tray. The newly sown seeds need humidity and dark to thrive. Set the tray in a place where it won't get too hot, or too cold

- Step 5: Mist every 12 hours:** Uncover the seed tray every 12 hours or so and mist them again with the spray bottle. 15 to 20 evenly distributed sprays should do. Do not add additional water other than the misting. Re-cover the tray.
- Step 6: Uncover the tray:** The crop should be ready to uncover after 4 or 5 days (7 days for beet & cilantro). One can judge this by watching for when the baby leaves (cotyledons) of the crop first emerge and then waiting one more day. It is important to keep the crop in the dark for the first 4 to 5 days to force the crop to grow in the struggle for light. This will help to grow a strong crop. Once the tray is uncovering, make sure the crop gets plenty of light.
- Step 8: Check daily:** The crop should have the right balance of water from now till harvest. Check the soil. It should be moist but not soggy. If necessary, replenish water by sprinkling or pouring water over the soil, avoiding the leaves as much as possible.
- Step 9: Time to harvest:** Most microgreens will be ready to harvest in 10 days. Some crops can be harvested as early as 7 days. Most crops will not last past 14 or 15 days before they must be harvested. Keep in mind that there are exceptions to these harvest times.
- Step 10: Harvest:** Move the trays to a cool, shady place. If the greens are harvested when it is too hot, they will wilt very quickly after harvesting. If harvested when cool (late evening, early morning), they will tend to stay fresh and crisp. (Xiao *et al.*, 2012) ^[23].

Importance of Microgreens

- Easy to Grow:** Micro greens are incredibly easy to grow due since they are harvested at the first true leaf stage and can be grown effortlessly on a sunny windowsill.
- Quick to harvest:** Micro greens get ready to eat in just two weeks.
- Packed with flavours:** Though micro greens are tiny, the concentration of flavours makes them a favorite of chefs

and food lovers around the world.

4. **Loaded with nutrients:** Micro greens have a higher concentration of nutrients than mature vegetables and herbs. Some micro green varieties are having up to 40 times more nutrition than grown vegetables. (Zhou *et al.*, 2016) [24].

Health benefits of micro greens: Eating vegetables is linked to a lower risk of many diseases as they contain high amounts of vitamins, minerals and beneficial plant compounds which may reduce the risk of the following diseases:

- **Heart disease:** Microgreens are a rich source of polyphenols, a class of antioxidants linked to a lower risk of heart disease. Studies show that microgreens may lower triglyceride and “bad” LDL cholesterol levels. (Huang *et al.*, 2016; Tangney and Rasmussen, 2013) [11, 20].
- **Alzheimer’s disease:** Antioxidant-rich foods, including

those containing high amounts of polyphenols, may be linked to a lower risk of Alzheimer’s disease. (Guest and Grant, 2016) [8].

- **Diabetes:** Antioxidants may help reduce the type of stress that can prevent sugar from properly entering cells. In lab studies, fenugreek micro greens appeared to enhance cellular sugar uptake by 25-44%. (M.H., 1996; Wadhawan *et al.*, 2018) [13, 21].
- **Certain cancers:** Antioxidant-rich fruits and vegetables, especially those rich in polyphenols, may lower the risk of various types of cancer. Polyphenol-rich micro greens may be expected to have similar effects. (Zhou *et al.*, 2016) [24].
- **Chronic Disease:** Inflammation is a major indicator of disease in the body. Micro greens and vegetable intake in general is shown to reduce inflammation markers as well as lower the risk of several types of cancer.

What do micro greens tastes like

Micro greens	Flavor
Alfalfa	Mild, nutty, crunchy, pea-like taste
Amaranth	Beet-like, earthy taste
Arugula	Nutty, peppery, savory
Basil	Like Basil! Lemony, Intense, slightly sweet, zesty
Beet	Earthy, similar to beets but brighter/fresher, earthy
Broccoli	Mild, crunchy, dense, slightly bitter, like broccoli
Buckwheat	Crisp fresh green, lettuce-like taste, a subtle sweetness, sometimes slightly sour or tangy if grown longer
Bok Choy/Pak Choi	Mild, earthy, slightly sweet, juicy
Carrot	Similar to carrot
Cauliflower	Mild, peppery
Clover	Mild earthy, nutty, crunchy, juicy
Cilantro	Like Cilantro! Celery-like taste, strong, citrusy
Daikon Radish	Intense fresh spicy flavor
Cress	Peppery, tangy
Dun pea	Slight sweet, crunchy, robust flavor
Fava bean	Buttery, earthy, juicy, nutty, sweet
Flax	Nutty, mildly spicy
Kale	Mild, subtly sweet, broccoli-like taste, some varieties are bitter
Kohlrabi Purple	Mild, sweet, lightly spicy, broccoli-like flavor but milder
Lentils	Mild bitter, pea-like taste
Lettuce	Mild, rich flavor, some are slight sweet
Mung bean	Mild bean taste, slight buttery
Mustard	Sweet, mildly spicy
Parsley	Mild parsley taste, refreshing, succulent
Quinoa	Mild, slight bitter, earthy
Radish	Strong, Peppery
Pea Green	Delicate sweet pea flavor with large leaves, fibrous
Pea Speckled	Delicate pea flavor, large tender leaves, less fibrous than green pea
Perilla	Peppery
Sorrel	Lemony, tangy
Popcorn	Corn grown in the dark, sweet, tender malty flavor
Sunflower	Nutty or malty, mildly sweet, bitter if grown longer, sometimes used as a garnish on deserts
Wheatgrass	Mildly sweet, grassy
Tatsoi Mustard	Mild, slightly mustard-like, cabbage flavor

Source: Alex Lafreniere (2021)

How to cook micro greens

Although microgreens are best eaten raw, some individuals prefer to mildly boil them. Microgreens' flavour profile and texture will change when cooked, so experiment with different cooking times until users discover one that works best for oneself. Microgreens can be lightly cooked by quickly sautéing them in a little oil over medium heat. Keep in mind that most microgreens don't tolerate heat well, so keep the cooking time to a minimum. In an empty heated

skillet, add the greens and toss regularly until they are barely cooked, about 30 seconds. If you want a salty flavour, add garlic or red pepper flakes; if you want something lighter, use lemon zest, balsamic vinegar, and olive oil. Sunflower microgreens are wonderful sautéed in olive oil with garlic for a few minutes, just long enough to wilt the leaves somewhat without losing their colour or form. Pea shoots can also be sautéed.

Tips to adding microgreens to daily meals

- It can be used as a topping for salads and soups.
- Used to garnish with any main dish.
- Placing microgreens on top of a flatbread or pizza after cooking.
- Adding microgreens into an omelette.
- Replacing lettuce with microgreens on a burger & sandwiches (Annigeri S, and Yamanur M, 2022) [3].

Nutrition facts

1. Microgreens provide more nutrition than mature leaves
2. Vitamin C is abundant in microgreens
3. Many microgreens are loaded with beta-carotene
4. Microgreens are a good source of vitamin E
5. Greens-Even if Small in Size-Contain Vitamin K

Challenges

The increased demand for "super foods" such as micro greens may present an opportunity for India's food business. More people are aware of microgreens as a result of the creation of separate categories for them. Microgreens have a high price market and a dependable client sector (culinary and gourmet restaurants). Their high price market is a result of high production costs and the problems of keeping them contamination-free throughout all stages, from medium preparation to correct packing. Because of modern technology, contamination is no longer a problem, but this comes at a cost. Microgreens, on the other hand, have a low yield, fast senescence, and a very short shelf-life, which limits their commercial production. The COVID pandemic is wreaking havoc on supply networks in a variety of businesses. Restaurants have closed or seen significant drops in demand, and many farmers have modified their operations in order to stay afloat. Because of its importance to public health, food safety, accessibility, and quality are frequently discussed in public policy and politics. The majority of microgreen production is now done in the United States, and the 2020 pandemic is projected to slow demand for organic crops due to lower discretionary expenditure.

Future Prospective

Microgreens are a growing part of the agriculture sector, with plenty of room for future research due to rising demand and consumption among health-conscious consumers. The standardization of microgreens production technology for various crop seeds will pique growers' attention. Postharvest processing and packaging technology advancements will help to keep quality for extended periods of time and improve shelf life.

Conclusion

Microgreens production to provide nourishment to the consumer's plate is an effective adaptation strategy in the face of changing climate and diminishing agrarian resources. Microgreens are a new type of specialty crop that has gotten a lot of attention in the recent decade because of their nutritional and organoleptic qualities, as well as the fact that they have a lot more bioactive components than adult greens. Furthermore, they enhance the taste and Flavour of the diet. Because it uses less inputs, it has a lower cost of production, higher net returns, and is 100 percent organic because no synthetic chemical sprays are used. They are easily grown by consumers, particularly in urban or peri-urban areas, and provide a year-round source of fresh, nutrient-dense produce

as well as educational and therapeutic tools for children on the farm.

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