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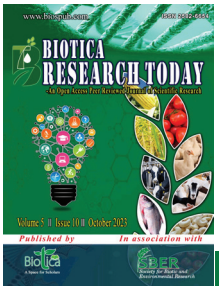

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Microgreens: The Treasure Trove of Nutrients

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Abstract

Microgreens, often referred to as "vegetable confetti," have emerged as a nutritional treasure trove in the modern quest. These tiny, vibrant greens, harvested just 7 to 21 days after sowing, offer a powerhouse of nutrients, often surpassing their mature counterparts. Originally developed in San Francisco in the late 1980s, microgreens widely recognized for their exceptional nutritional value and sensory qualities, making them a superfood of choice. This article explores the production of microgreens from plants, including herbs, vegetables and grains. Microgreens are rich in vitamins, minerals, phenolics and flavonoids, with potential health benefits, such as reducing the risk of Alzheimer's disease, diabetes, heart disease and certain cancers due to their antioxidant-rich nature. Practical application of microgreens extends to Indian army, which uses them in challenging high-altitude environments for essential nutrition. In a world overwhelmed with dietary choices, microgreens offer a simple, accessible and profoundly nutritious solution.

Keywords: DIHAR, Leafy vegetables, Microgreens, Phytochemicals

Introduction

Health is the top most concern among the people of the modern world. So everyone are busy searching for a healthy food in the middle of so many that are available and it's like finding a needle in a stack of hay. We often hear about healthy diet and the information is too much that one can't decide to go for a particular food and will often end up in confusion. So does any such simple healthy food really exists? Yes..!! There is such a simple, easy and healthy foods exist and are called as 'microgreens'. Microgreens are also called as 'vegetable confetti' and in latest times, their high nutritional value and diverse sensory qualities have led to an increase in the popularity of these ingredients in food. These are functional foods and provide almost all nutrients required by the body and are often regarded as the one of the super foods. Microgreens cultivation has capacity to have a substantial impact in urban agriculture, offering a diverse array of colors, textures, and flavors, which may introduce a unique and exciting element to culinary creations. In the late 1980s, the concept of microgreens was developed in San Francisco, California and first become popular in the best eateries and upscale supermarkets.

Microgreens are those plants which are usually green with very small height (2-3 inches) and are harvested generally after 7 to 21 days after sowing. Microgreens are available for purchase while retaining their stem, cotyledons (seed leaves) and first true leaves. Although harvested and consumed while still in their early stages of growth, sprouts, microgreens, and baby greens exhibit distinct characteristics. Microgreens are little larger and more developed in comparison to sprouts reaching to a height of approximately two inches. These represent the subsequent stage in the progression of plant growth, as seeds are sown into a growing medium, go through germination, develop roots and a few leaves and are subsequently consumed as food. Microgreens were very good source of phytonutrient, which can be as high as 40 times in comparison to full grown vegetables green part (Xiao *et al*., 2016). Apart from their nutritional benefits, they can enhance the taste, consistency and visual appeal of salads, soups, or sandwiches. Individuals may incorporate Microgreens into smoothies or utilize it like decorative element.

How Microgreens are Produced?

• Make a firm flat surface by pressing the seedling flat filled

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with growing medium.

• Plant your seeds densely, ensuring they are distributed evenly.

• To ensure good soil-to-seed contact, press the surface of your planting area.

• For reducing evaporation, apply a thin layer of growing medium or use newspaper to cover the soil.

• Once seeds have germinated and grown to four leaf stage they can be harvested.

• Use scissors for better and easy harvesting.

Several leafy vegetables, herbs, other vegetables and some grains can be used as microgreens. Herbs like basil, coriander, amaranth, mustard and fenugreek; vegetables such as broccoli, lettuce, cabbage, celery, peas, radish, beets, basil and grains like barley, oats, wheat, linseed, buckwheat, *etc*. can serve as a potential microgreen. Selection of plants for growing can be dependent on nutrient requirement and ease of growing. It would be great if multiple species are grown together as they serve a very balanced nutritional element.

Microgreens are nutritionally beneficial and are good source of different phytochemicals like vitamins, minerals, total phenolics, total flavonoids, *etc*. According to Xiao *et al*. (2016), microgreens are rich in phytochemicals having ascorbic acid content (20.4-147.0 mg per 100 g fresh weight), while violaxanthin (0.9-7.7 mg per 100 g FW), β-carotene (0.6-12.1 mg per 100 g FW) and lutein/ zeaxanthin (1.3-10.1 mg per 100 g FW), Phylloquinone (0.6-4.1 µg g^{-1} FW); meanwhile, α-tocopherol (4.9-87.4 mg per 100 g FW) and γ-tocopherol (3.0-39.4 mg per 100 g FW). Ghoora *et al.* (2020) estimated nutrient composition of some commercial microgreens which is given in table 1.

It can be easily understood from the above table that microgreens are certainly treasure of nutrients and can serve as a complete food. Pinto *et al*. (2015) demonstrated that lettuce microgreens have notably greater mineral content (such as calcium, magnesium, iron, manganese, zinc, selenium and molybdenum) and lower levels of nitrate compared to mature lettuce in its full growth stage. Similarly, Weber (2016) conducted a nutritional assessment of microgreens in cabbage and lettuce, revealing that, on average, throughout the ten elements (phosphorous, potassium, calcium, magnesium, sulphur, manganese, copper, zinc, sodium and iron), lettuce microgreens grown on vermicompost, lettuce microgreens grown hydroponically, cabbage microgreens grown on compost and cabbage microgreens grown hydroponically were significantly higher in nutrients compared to their fully grown vegetables. Specifically, they were approximately 2.8, 2.7, 8.1 and 2.9 times richer in essential nutrients respectively. Notably, cabbage microgreens exhibited elevated iron levels, with cabbage microgreens grown on compost containing 54.6 times higher constituent of Fe as full grown cabbage and cabbage microgreens grown hydroponically having 5.4 times the Fe content of full grown cabbage. Additionally, in case of Zn, it was 5 to 7.5 times the content of Zn compared to mature cabbage.

Microgreens have even found their way into the diet of the Indian army, particularly in high-altitude regions like Leh and Ladakh. In such areas, the Indian government typically incurs substantial expenses for airlifting fresh horticultural produce to cater nutritional needs of army personnel operating in

Table 1: Phytochemical and antioxidant capacity of the culinary microgreens

Parameters	Onion	Mustard	Carrot	Fennel	Sunflower	Roselle	French basil	Radish	Spinach	Fenugreek
Phytochemicals (mg per 100 g FW)										
Ascorbic acid	41.6	50.0	94.7	60.2	94.0	139.8	120.6	114.4	69.0	67.7
Lutein	13.8	18.3	23.9	10.8	20.2	17.2	15.2	10.7	8.7	12.6
Chlorophyll a	16.9	34.5	27.5	56.1	18.8	45.1	45.8	33.6	24.1	40.4
Chlorophyll b	12.6	18.3	15.8	34.3	14.5	25.9	34.2	17.3	11.2	21.7
Total chlorophyll	29.5	52.8	43.3	90.3	33.3	71.0	80.0	50.9	35.3	59.2
Total phenolics	21.4	49.3	35.6	63.5	39.4	73.6	28.6	61.8	14.6	23.5
Total flavonoids	1.7	1.1	4.5	5.5	5.9	6.5	2.9	2.1	2.4	3.8
Antioxidant Activity										
DPPH RSA IC50 (µg ml^{-1})	452.4	168.4	97.6	94.3	148.3	81.7	154.4	155.7	200.4	228.7
FRAP (µmol Fe^{2+} g^{-1})	7.0	9.3	17.8	38.7	29.2	36.3	20.1	22.7	10.4	10.0
TEAC ABTS (µmol TE g^{-1})	13.4	10.9	15.2	22.8	19.4	21.2	17.6	15.4	11.7	13.4
ILAP (%)	53.9	60.7	50.0	82.9	51.2	84.4	70.6	70.8	41.4	67.0

[Note: ABTS: 2,20-azinobis-(3-ethylbenzothiozoline-6-sulphonic acid); DPPH: 2,2-diphenyl-1-picrylhydrazyl; FRAP: Ferric reducing antioxidant power; ILAP: Inhibition of linoleic acid peroxidation; TEAC: Trolox equivalent antioxidant capacity]

harsh conditions. Singh *et al*. (2020) conducted microgreen cultivation at the Defence Institute of High Altitude Research (DIHAR) in Leh-Ladakh, which is under the aegis of the DRDO (Defence Research and Development Organization). Their findings indicated that, on average, each tray (measuring 30 × 22 × 6 cm and having 6 trays shelf^{-1}) yielded around 40 g of microgreens in a span of 8 to 12 days. This translates to the potential production of twelve hundred g of biomass (30 trays, each yielding 40 g tray^{-1}) from a single unit. One such unit is sufficient to provide fresh and nutritious greens for a group of 4 to 6 individuals. This method proves highly valuable in providing essential dietary components to army personnel in challenging high-altitude environments while reducing the logistical and financial burdens associated with transporting traditional fresh produce.

Health Benefits

Microgreens are abundant in nutrients, with slight variations in content depending on the variety. However, they generally contain significant amounts of essential minerals like K, Fe, Zn, Mn and Cu. Additionally, microgreens serve as a plentiful source of antioxidants. Their nutrient content is concentrated and is rich in polyphenols than their mature counterparts. Vitamins are nearly 40 times more than mature leaves. Microgreens typically contain equivalent or higher levels of these nutrients compared to fully grown greens. Consequently, they may have a similar potential to lower the risk of the following diseases:

Alzheimer's Disease

Polyphenol abundant microgreens have potential in reducing Alzheimer's disease as naturally produced polyphenolic compound having antioxidant property lessens the oxidative stress existing in brain of Alzheimer's disease.

Diabetes

Antioxidants have the potential to lowers the kind of stress that hinders the proper entry of sugar into cells. Laboratory studies indicate that fenugreek microgreens have shown the ability to boost cellular sugar uptake by a significant margin, ranging from 25% to 44%.

Heart Disease

Microgreens are rich source of phytosterols generally found in lipid bilayer of plant cell membranes and these are the class of antioxidants which are responsible for reducing risk of heart diseases.

Certain Cancers

Fruits and vegetables that are abundant in antioxidants, particularly those high in polyphenols, are known to potentially reduce the risk of different forms of cancer. Microgreens like other vegetables rich in vitamins, minerals and various phytochemicals and this helps in reducing cancer risk.

Conclusion

Microgreens are certainly the super food that can make us healthy and have all the potential to make it to everyone's plate as they are easy to grow and maintain. Because of their ease of growing, they are cost effective method of getting nutrients in place of buying costly vegetables. People could consider it as a kind of recreational activity. By all means they are worthy to get into one's diet.

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