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Microgreens: A Super Food for Nutritional Security in the 21st Century-A Review

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ABSTRACT

Diurnal increase in a population growth has led to the imbalance in horticultural food supply chain including vegetables resulting in several issues such as malnutrition and hidden hunger. Many families in our nation still suffer from malnutrition due to unaffordability or lack of easy access to the nutritious foods. Under such dejected situation microgreens can be used as a key source of nutritional compound. Microgreens are simply a juvenile form of edible vegetables, aromatics, condiments and other wild edible species with enriched nutritional composition beneficial for human beings in fulfilling their balance diet and also treating numerous health issues viz., cardiovascular disease, neurodegenerative disease such as alzheimer's, parkinson's and huntington's disease, diabetes, cancers. They are a good source of vitamins, minerals, fibers and antioxidant along with low levels of nitrite content which makes them a super food for addressing overall food security, nutrition, health, income generation and ecosystem services for the human wellbeing in forthcoming days.

Keywords Microgreens, Malnutrition, Antioxidant, Nutritional security.

INTRODUCTION

"Microgreens" although is not entirely hot off the fire despite that, it is relatively underrated among the people. It had initially garnered popularity about the mid-90s in California, USA yet the term "microgreens" was documented only around 1998. Since then there are few upscale market and restaurants where the microgreens took root. Microgreens are a juvenile (4 to 14 days old) form of edible vegetables, aromatics, condiments and other wild edible species. Their height usually varies from 5 to 10 cm therefore typically consisting of the central stem, two cotyledonary leaves and a pair of true leaves. Within the overall microgreens are young, tender greens that stand between sprouts and baby greens. Among the three sprouts are the youngest and undifferentiated versions for which the whole i.e. the seedling, the radical and what remains of the seeds act as an edible portion. While baby greens are the oldest version (usually 7-10 cm tall) with edible parts similar to microgreens i.e. aerial part of seedling consisting of

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central stem cut just above the soil line.

How to use microgreens

Microgreens are considered as a versatile food not only it adds extra color, intense flavor, delicate textures but they taste great too, packed with high nutritional value (Samuoliene *et al*. 2016). Commonly microgreens are used in salads or to garnish main dishes henceforth for these reasons microgreens are also sometimes referred to as "vegetable confetti". Microgreens are best when eaten as raw, the freshness and crispy texture remains well preserved and at the same time there is no loss or degradation of thermolabile micronutrients. Like any other food upon cooking it tend to lose some of the nutrients. Often it is used to prepare salads and appetizers or to garnish dishes like soups, curries, stir fries, pasta and pizzas. As compared to sprouts microgreens provides more intense flavour, textures and colors making them an ideal flavoring component.

Incorporating microgreens in diet

Its 21st century, unhealthy lifestyle and poor dietary choices are astronomical leading to the mineral malnutrition among the large part of the population. Iron deficiency is one of the most prevalent nutrient deficiencies in the world especially among children, young women and vegetarians. Another essential nutrient that is deficient in an about third of the world population is iodine. Also, in western diets deficiency of magnesium is a common matter. Vitamin A (especially in developing countries), vitamin B_9 and vitamin B_{12} are incredibly common deficiency among the people around the globe.

Also many families suffer malnutrition due to unaffordability or lack of easy access to the nutritious foods. Therefore, to repress this problem identification of new, easily accessible and cost effective sources of nutritional compound has become important. In quest of that, microgreens have again attracted considerable attraction in recent past not just for their diverse sensorial characteristics but also for their dense source of nutrition gaining the appellative of 'super food' or "functional foods". As a bonus, micro greens are easily accessible, available all year long and above all heat sensitive phytonutrients are well delivered as they are consumed in raw form.

Microgreens are a great source of vitamins, minerals, fibers and antioxidant along with low levels of nitrate and nitrite content which have large implication for human health. Several reports have been published regarding the nutritional profiling of various micro greens. Xiao *et al*. (2019) reported that micro greens from *Brassica* family (red cabbage, green daikon radish) are a good sources of the macroelements, K and Ca along with the microelements, Fe and Zn. Additionally, they were found to be moderate to excellent sources of ascorbic acid, phylloquinone, carotenoids, tocopherols, glucosinolates and polyphenols. Pinto *et al*. (2015) also reported that micro greens from lettuce (2-weeks old) had greater content of minerals such as Ca, Mg, Fe, Mn, Zn, Se and Mo than mature lettuce (10-week old). Also, lower level of NO_3 content in it makes it safe for consumption. Similarly, in Lester *et al*. (2010) proclaimed that the young leaves of baby spinach (*Spinacia oleracea* L.) have higher content of vitamins C, B_9, K_1 and the carotenoids (beta-carotene lutein, zeaxanthin and violaxanthin) than in the mature leaves. Barillari *et al*. (2005), Nakamura *et al*. (2001) supported the fact that the level of phytonutrient differs according to the different physiological stages of the plant and often curtails from the seedling stage to the fully developed stage.

Kyriacou *et al*. (2019) reported that purple basil were rich in ascorbic acid while green basil had a high beta-carotene content and total polyphenols. Further it has been found that basil microgreens are excellent sources of Mg and K. In amaranth (*Amaranthus tricolor*) Ebert *et al*. (2014) found that micro greens had higher content of a-carotene, b-carotene, violaxanthin, lutein and neoxanthin compared to sprouts. Weber (2017) reported that broccoli microgreens had high content of Cu, Mg, Mn and Zn irrespective of growing media. On a dry weight basis, microgreen kale reported with a higher level of most of the phytonutrients than mature kale.

In short, microgreens have about nine times higher nutrient levels than in mature greens which provide an additional benefits against cardiovascular

diseases, helps in regulating cholesterol metabolism (Singh *et al*. 2019) and they may reduce the risk of certain diseases.

Health benefits of microgreens

Cardiovascular disease: Microgreens are a rich source of antioxidants like; polyphenols, which is known to lower the risk of cardiovascular disease (Tangney and Rasmussen 2013). Huang et al. (2016) reported that microgreens may reduce low-density lipoproteins (LDL) cholesterol levels often considered as "bad cholesterol" and triglyceride levels which increases the risk of heart disease.

Neurodegenerative disease: Microgreens have time again proved to be a dense package of various classes of antioxidants such as polyphenols, alkaloids, flavonoids, terpens. which is allegedly linked to lower the risk of neurodegenerative disease like Alzheimer's disease, Parkinson's disease, Huntington's disease. (Essa *et al*. 2016).

Diabetes: The high bioaccessibility of polyphenols and glucosinolates after digestion of microgreens may effectively prevent the obesity and type 2 diabetes by controlling weight and blood glucose (Zhang *et al*. 2021).

Certain cancers: Microgreens of crucifer, chickpea, radish contains compounds called sulforaphane, is of lavonesand glucosinolates respectively, which has anti-cancer effects. Apart from that other microgreens like rutabaga and flax seed reportedly exhibits anti cancerous properties as well (Agarwal 2020, Sangronis *et al*. 2007).

Microgreens of red spinach and kale possess slightly higher antimicrobial activity than their mature counterparts against some pathogenic germs (Reddy *et al*. 2021).

Inflammation is a major indicator of disease in the body. Microgreens and vegetable intake in general is shown to reduce inflammation.

Where to find the microgreens?

Microgreens are found in the grocery stores nowadays but it can be easily grown by oneself either indoor, fully outdoor or in protected conditions. The major advantage of growing micro greens is that it requires a very small area therefore it is a part of the global movement towards controlled environmental agriculture (CEA) (Riggio *et al*. 2019). Overall the water and energy requirement is less for the microgreens production. They also have a short growth cycle with the possibility of growing without soil and external inputs (fertilizers and pesticides) in and around residential areas year-round.

At home consumers can easily grow micro greens on a window ledge, on a balcony or on a shelf in the kitchen. Normally, 2" to 3 ½" deep containers are sufficient for raising microgreens. It can be grown using either soil or soil less media like; peat moss, coconut fiber, shredded sphagnum, vermiculite, Perlite. or in their mixes. However, peat and peat based media are most commonly used for raising micro greens. Apart from this nowadays synthetic fibrous media which consist of rock wool or polyethylene terephthalate and natural fiber media made up of jute fibers are also commercially available for growing of micro greens (Kyriacou *et al*. 2016). However, many naturally occurring materials such as cotton, jute, sunhemp fibres, kenaf, etc. potentially be used as a low cost media after their fortification or enrichment with beneficial microorganism (Di Gioia *et al*. 2016, Nyenhuis and Drelich 2015, Pill *et al*. 2011).

A wide range of vegetables, herbs and agronomic crops and crop varieties can be used as microgreens yet it should not be grown from a regular seeds; one should opt for the seeds specifically sold for microgreen purpose. The seeds should be healthy and preferably organic which is not subjected to any treatments. Some seeds germinates readily while in some soaking is necessary for better germination. After sowing of seeds ample supply of water should be provided, normally neutral to slightly acidic water is suitable for growth of microgreens (Turner *et al*. 2020). During germination the containers may be covered, lightly covered or positioned in a reduced light condition. In an about 3 days, the plants may be unveiled to direct sunlight for 5 hr/day or for 8 hrs/day in indirect sunlight and watered until the emergence of the first set of true leaves. The germi-

nation may vary according to crops. Some are fast to grow such as; red cabbage, chinese cabbage, kale, mustard, radish. while some slow growing such as; amaranth, beet, carrot, dill, fennel, parsley. Microgreens will be ready to harvest when it reaches 1½ to 2 inches long which normally takes about 7 to 14 days depending upon crop species. Harvesting should be done when cotyledons are still turgid and before complete expanding of true leaves. Only the aerial part of seedlings is harvested and the roots are left behind (Wieth *et al*. 2019). The commonly grown and popular microgreens in India are given below. Not all of the crops are suitable for consumption as microgreens such as; potato, tomato, brinjal, pepper. Which contain high level of alkaloids at this stage and is toxic for humans (Di Gioia 2020).

List of few microgreens which are gaining popularity in India

Amaranth- Leaves of amaranth are deep red in color with a hint of green and reddish pink stems. They are rich source of protein, fiber and minerals like magnesium, phosphorus and iron with mild sweet flavor (Sreenivasa *et al*. 2019).

Beetroot- Leaves and stem color of young tender beetroot are vibrant red/green which tastes sweet and earthy when consumed. They are a good source of antioxidant and rich in vitamins (Kumar *et al*. 2018).

Broccoli- Young tender leaves are bright green in colour with slightly pinkish stems. It tastes crunchy, dense and slightly bitter when consumed. Contain a good amount of chlorophyll, vitamins, minerals, enzymes and protein (Kumar *et al*. 2018).

Carrot- Young leaves and stem of carrot are bright yellowish green in colour with mild and sweet taste enriched with phytonutrient such as β-carotene, lutein and zeaxanthin (Kumar *et al*. 2018).

Cauliflower- Young tender leaves of cauliflower are light green in color with taste of broccoli flavor enriched with β-carotene and vitamins such as vitamin C, K and E (Sreenivasa *et al*. 2019).

Cress- Leaves of cress are bold green with yellowish white stems rich in Vitamins A, C and mineral like Sulfur (Kumar *et al*. 2018).

Fenugreek- Tender leaves of fenugreek are green in color rich in phytochemical content, minerals and antioxidant (Sreenivasa *et al*. 2019, Reddy *et al*. 2021).

Green mustard- Leaves are slightly yellowish green in color with spicy taste when consumed. They are rich in vitamins, minerals antioxidants and protein.

Kale- Leaves are bold green in color with light green/ pink stems. It tastes sweet when consumed and are rich source of antioxidants.

Palak- Young leaves of palak are green to reddish green in color containing a good amount of phenolics and betalians (Koley 2016).

Pak choi- Young tender pak choi is reddish green in colour rich in glucosinolates, phenolics and anthocyanins (Koley 2016).

Pea- Young tender leaves are light green in color which tastes sweet and crunchy when consumed in the form of microgreens. They are rich source of vitamins like A, C, K and minerals such as phosphorus, potassium, calcium, magnesium and iron (Kumar *et al*. 2018).

Radish- Leaves are green in color having white/ red stems. They taste spicy with floral flavour when consumed and reported to possesses several vitamins like A, E, K, B complex and C including minerals such as iron, phosphorous and calcium (Sreenivasa *et al*. 2019).

Red cabbage- Young tender leaves of red cabbage are green and purplish in color with light purple/ pink white stems that tastes earthy and peppery when consumed. Tender leaves and stems of red cabbage are enriched with vitamins like A, B, C, E, K along with various minerals (Kumar *et al*. 2018).

Certain problems related to microgreens

One major limitation of microgreens is the rapid quality deterioration that occurs soon after harvest. Due

to high respiration rate microgreens easily shrivel, decay and loose certain nutrients rapidly. At ambient temperature the shelf life of microgreens is up to 3 to 5 days (Mir *et al*. 2017).

The high density planting creates an idyllic environment for the progression of certain seedling diseases. Therefore, seed density must be maintained to provide good air circulation. Proper sanitation and good cultural practices are also necessary for growing healthy microgreens.

Generally microgreens are safer to eat but sometimes consuming in large amount will cause some mild issues for example consuming buckwheat microgreens in large quantity will cause redness, swelling or burning sensation on skin (Arbour 2004).

Sometimes improper fertilization leads to the microgreens with off flavor.

CONCLUSION

Microgreens synonymously known as "functional foods" or "super foods" are becoming more popular among people as their health benefits are drawing more recognition. Many studies have revealed that consuming microgreens promotes good health and prevent diseases as it contains higher concentrations of bioactive compounds such as minerals, vitamins, phenolics and antioxidants, than in fully developed greens or seeds. Consuming about 50 grams of micro greens per day can meet our recommended daily nutrient requirements and can replace intake of vitamin tablets. They are easy to grow at home, and are cost-effective to boost nutrient intake without having to purchase large quantities of vegetables. However, commercialization of microgreens is still limited due to their speedy degradation and a very short storage life. Therefore, methods for maintaining the quality and safety as well as post cultivation treatments for extending their life span needs to be further explored and identified to boost the fruitful production of the microgreens which ultimately strengthen the nutritional security of the nation in this 21st century.

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