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Microgreen Nutrition, Bioactive Components, Cultivation: A Review

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Abstract: *"Microgreens" modern popular food gained attention with its nutritional qualities. In recent period because of their various characteristics and health-promoting nutritional value gained specific popularity in diet food. Microgreens are also known as functional food and superfood because it considers a healthy and nutritive diet. They are eatable greens that include vegetables and herbs, which have been used as salads, toppings, and sprinklers in the restaurant industry since 1996. They are an emerging group of vegetables that is at the very initial stage of greens that have two cotyledon leaves with a small stem structure. This whole concept is very moderate to attain people's interest as new cooking with diet recopies. These help to enhance the flavors and on veggies as an eatable topping to garnish many food items. The consumption of microgreens has been improved because of their nutritional value and higher bioactive components like vitamins, minerals, and antioxidants than mature greens. They have a higher concentration of phytonutrients too. Minerals perform a very effective role in the system of pre-harvest and post-harvest. The study is an overview of mineral treatments and nutrient value in microgreens.*

Key Words: *Microgreens, Bioactive Components, Light, Calcium.*

1. INTRODUCTION:

The word "micro" represents the whole meaning of these greens. Microgreens are the very initial stage of baby greens. They are advanced edible supplements with nutrition found with two cotyledonary leafy greens. They have different types of flavors, colors, and textures (Xiao *et al.*, 2012; Pinto *et al.*, 2015). Microgreens have more bioactive components than their seeds and mature plant which is why it is known as a "superfood" (Patras *et al.*, 2021). This specific type of plant is collected and consumed in its initial stage (Xiao *et al.*, 2014a).

Microgreens are the type of distinction crop that presents the soft juvenile greens from seeds of vegetables, grains, herbs as well as wild types (Riggio *et al*., 2019). Microgreens can define by their various tastes, colors, and textures. Soft, tender, and soft vegetables are found in different species and families (Paradiso *et al*., 2018). They are an imported category of edible greens that have gained renown as a unique cooking trend throughout several decades, including start-ups in exclusive markets and restaurants. Microgreens are a salad crop that can be harvested 10 to 20 days after seedling emergence. (Lee *et al*., 2004; Xiao *et al*., 2014b). Since developed countries move toward healthy nutritious food, microgreens take place in the diet because of their easy eating in salad as a topping, garnishing, or seasoning (Riggio *et al*., 2019). Microgreens are a type of leafy green crop harvested only a few days after the first real leaves appear. These are picked from the root and enjoyed fresh as a salad in about ten days (Kou *et al*., 2013). Harvested after the first real leaf appeared and sold with the stem to consumers. They're one of the many types of new greens on the market, and they're usually distinguished by their size and maturity (Pinto *et al*., 2015). Microgreens have a higher concentration of useful components than seeds or plants, such as antioxidants, phenolics, vitamins, and minerals (Janovska *et al*., 2010). They have health-enhancing or disease-preventing properties that promote nutritional value. Thus, they are considered as "functional food" which is a highly rich source of bioactive components. They are recognized as a good carrier of bio components (Xiao *et al*., 2015; Mie *et al*., 2017). Microgreens, on the other hand, are less commercialized due to their rapid disintegration and short shelf life, which ranges from 3 to 5 days at room temperature, making them a highly perishable commodity (Chandra *et al.*, 2012). Microgreens began to emerge at farmers' markets and grocery shops as the strong demand for them grew. After collecting, packing and stockpiling are the best ways to ensure long-term usage and extend the period (Mir *et al*., 2017).

2. VARIETIES OF MICROGREENS:

Since the stock and utilization are greatly affected by the happening of culinary trends and chosen species by cultivators' discussions with chefs and consumers adapt to their particular choice. Microgreens were distributed as a new type of cut greens and reached out to the client. Species of these families are Brassicaceae, Asteraceae, Chenopodiaceae, Lamiaceae, Apiaceae, Amaryllidaceae, Amaranthaceae, and Cucurbitaceae are the most exploited (Xiao et al., 2012). Microgreens can be derived from different kinds of seeds. The well-known species are harvested using from these families (View and Club, 2019). Brassicaceae Family: Broccoli (*Brassica oleracea var. italica*), Cauliflower (*Brassica oleracea var. botrytis*), Watercress (*Nasturtium officinale*), Cabbage (*Brassica oleracea var. capitata*), Arugula (*Eruca vesicaria ssp. sativa*), Radish (*Raphanus sativus L*), Mustard (*Brassica nigra L.*)

Asteraceae Family: Endive (*Cichorium endivia*), Lettuce (*Lactuca sativa*), Radicchio (*Cichorium intybus var. foiliosum*), Chicory (*Cichorium intybus*)

Apiaceae Family: Carrot (*Daucus carota*), Dill (*Anethum graveolens*), Celery (*Apium graveolens*), Fennel (*Foeniculum vulgare*)

Amaryllidaceae Family: Onion (*Allium cepa*), leek (*Allium porrum*), Garlic (*Allium sativum*)

Amaranthaceae Family: Quinoa Swiss chard (*Beta vulgaris*), Amaranth (*Amaranthus L.*), Spinach (*Spinacia oleracea*)

Cucurbitaceae Family: Cucumber (*Cucumis sativus*), Squash (*Cucurbita*), Melon (*Cucumis melo*) Cereals like wheat, rice, oats, barley, and legumes such as chickpea, beans, and lentils are also sometimes grown as microgreens. These may flavor different from simple to spicy, bitter, or tangy regarding the type of species. Flavors are supposed to be strong enough (View & Club, 2019).

3. BIOACTIVE COMPONENTS OF MICROGREENS:

The current high demand for these items is fast expanding as a result of the user's recent focus on healthy meals. Microgreens have a higher concentration of active chemicals than mature plants or seeds do. They are highly regarded for their nutrition, which include vitamins, trace minerals, amino acids, antioxidants, and other nutrients (Finley et al., 2001; Han et al., 2006). Since 2016, a number of research have shown that the developed leaves of non-head-forming vegetables have a greater amount of some bioactive components than their leaves. When compared to mature kale, kale microgreens had reduced carotenoid levels; broccoli and cauliflower microgreens had greater quantities than their florets (Xiao et al., 2019). A mature leaf of pea and lupin microgreens had a higher carotenoids concentration (Klopsch et al., 2018). Food that has a rich source of nutrients like vitamins, minerals, and antioxidants is known as a functional food. Certain changes in lifestyle and awareness about health attract consumers toward functional food. When compared to mature leafy greens or seeds, microgreen ingestion is favorable to one's health since it includes phenolics, vitamins, and minerals. (Chandra et al., 2012; Xiao et al., 2012; Kou et al., 2013).

After 16 days of development, the carotenoid content of wheat and barley microgreens rose. On the last day of harvesting, the maximum quantities were obtained (Niroula et al., 2019). Microgreens of kale and mustard were found to have less ascorbic acid than their mature equivalents (de la Fuente et al., 2019). Microgreens cultivated in a hydroponic system showed lower quantities of phenols, carotenoids, chlorophyll, and anthocyanin than baby greens and mature leaves of same species, according to some studies (Bulgari et al., 2017). In addition, Brassicaceae microgreens were shown to provide moderate to excellent sources of ascorbic acid, glucosinolates, tocopherols, phylloquinone, carotenoids, and polyphenols (Xiao et al., 2019). Cauliflower, rapini, red radish, China rose radish, and ruby radish microgreens were chosen for their high concentrations of total ascorbic acid, phylloquinone, total tocopherols, and total glucosinolates. The DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) radical scavenging capability of ruby radish microgreens was likewise the highest (de la Fuente et al., 2019).

Microgreens, in comparison to mature leaves, have a substantially greater amount of vitamins, minerals, and other health-promoting phytonutrients, according to studies (Lester and Hallman et al., 2010). They have reported that baby spinach (Spinacia oleracea L.) has more phytonutrients than mature leaves, a higher level of nutrients: vitamins C, B9, K1, and carotenoids in baby leaves. In compared to mature leaves, young lettuce (Lactuca sativa) seedling germination after 7 days possesses the highest total phenolic content and antioxidant capacity (Oh et al., 2010). Ascorbic acid, phylloquinone, carotenoids, and tocopherols were measured in 25 commercially available microgreens. Variation microgreens supplied a wide range of vitamins and carotenoids, according to the findings. The greatest concentrations of ascorbic acids, carotenoids, phylloquinone, and tocopherols were found in cilantro, red cabbage, garnet amaranth, and green daikon radish among the microgreens studied (Xiao et al., 2012)

Brassicaceae, Fabaceae, Pedaliaceae, Polygonaceae, Convolvulaceae, and Malvaceae are among the fourteen microgreens studied from six distinct families. All of the microgreens were low in calories and fat, with lentil microgreens having the most chlorophyll and carotenoids, and buckwheat microgreens having the greatest total phenol content. The only microgreens with anthocyanin concentration were purple radish and red cabbage (Kowitcharoen et al., 2021). Comparison of the nutritional profile of minerals with nitrate content in microgreens and mature lettuce.

Microgreens have a higher mineral content than matured lettuces, including calcium, magnesium, iron, zinc, selenium, manganese, and molybdenum, as well as a reduced nitrate concentration (Pinto et al., 2015). Brassicaceae microgreens had the highest phenolic antioxidant properties. These microgreens had also a higher amount of α-tocopherol and carotenoids than mature vegetables (David *et al*., 2018).
Six various species of microgreens including China rose radish (Raphanus sativus L.), pepper cress (Lepidium bonariense L.), red amaranth (Amaranthus tricolor L.), bull's blood beet (Beta vulgaris L.), opal basil (Ocimum basilicum L.), Dijon mustard (Brassica juncea L. Czern), were appraised for their sensory attributes and chemical composition. According to phytochemical nutritional concentration, China rose radish had the highest amount of total ascorbic acid, phylloquinone, carotenoids, tocopherols, and total phenol (Xiao *et al*., 2015).

4. EFFECT OF LIGHT ON MICROGREENS:

Instead of natural sunshine, farmers frequently utilize indoor grow lights. "Grow lights" are frequently used to complement natural light in greenhouse planters. Although studies are uncovering the benefits of light-emitting diode (LED) lights, gas-discharge lamps (GDLs) such as high-pressure sodium (HPS) lamps remain the most often utilized (Agarwal and Gupta, 2016). Plant growth, morphology, flavor, color, and nutrition are all influenced by light quality (Kyriacou et al., 2016). For increasing photosynthesis and modifying plant metabolism, red, blue, and mixed red and blue light are more powerful than white light and some other wavelengths (Alrifai et al., 2019). Green lighting (510 nm) supplementation improved the antioxidant capabilities of lentil and wheat-sprouted seeds (Samuoliene et al., 2011). Beet microgreens had a higher mineral element concentration (Brazaityte et al., 2018). In red pak choi, tatsoi, and basil microgreens, the use of blue (447 nm) LED illumination in conjunction with red (638 and 665 nm) as well as far red (731 nm) lighting influenced phytonutrient levels differentially. The light was balanced with 638 nm red light, giving all treatments the very same total photosynthetic photon flux density (PPFD) (Vastakaite et al., 2015).
Plant biochemistry and nutritional properties may be affected differently by the same quality of light at different irradiance levels (Samuoliene et al., 2013). The influence of irradiance on the development and nutritional properties of brassica microgreens such as mustard, red pak choi, and kohlrabi. For diverse species, the maximum leaf area was found at varied light intensities (Jones-Baumgardt et al., 2019). Increasing the intensity of blue light Tatsoi nitrate content decreased 3 days before harvest at 23 days, but ascorbic acid content in plant leaves decreased (Simanavicius and Virsile, 2018). Increased photosynthetic capacity is enabled by improved photosystems, electron transport, ATP synthase complexes, and Calvin-Benson cycle enzymes under high light conditions (Walters et al., 2005). The advanced concentration of photosynthetic "machinery" reduces photodamage sensitivity. Low-light conditions, on the other hand, produce a rise in the relative number of light-harvesting complexes and the stacking of thylakoid membranes to create grana in plant leaves, both of which improve light usage (Walters et al., 2005).

5. CALCIUM TREATMENT ON MICROGREENS:

Although calcium treatments influence both preharvest and postharvest phytonutrients in microgreens, the advantages of preharvest calcium treatments are far greater (Kou et al., 2014). Before harvest, he said, he used a 10mM calcium chloride treatment. Then the quality of broccoli microgreens kept at 5o C dropped all around and the shelf life was extended from 7-10 days to 14-21 days. During storage, the 10mM calcium chloride inhibited tissue electrolyte loss and microbiological development (Kou et al., 2014). The most abundant ingredient in broccoli microgreens was glucosinolates, which increased by 10mM calcium chloride preharvest treatment (Sun et al., 2015). After preharvest 10mM calcium chloride treatment, postharvest UV-B radiation boosted glucosinolates levels much more (Lu et al., 2018).

6. CULTIVATION AND HARVESTING OF MICROGREENS:

The time it takes for a crop to germinate to harvest varies substantially. One of the most important production techniques for success is to have a certain blend of microgreens at the correct level (Allende et al., 2004; Pinto et al., 2015). Seeding microgreens can be done in rows or in a spread fashion. Because the seed offers adequate nourishment for infant greens, most crops require very little fertilizer, and other crops require no fertilizer at all. Most growers sawed thickly to produce the most potential yield, but not too thickly because assembly promotes elongated stems and increases the danger of several illnesses (Xiao et al., 2015). Commercially, a selection of high-quality microgreens are cultivated, and they are sometimes grown on a small scale for daily household consumption. Cultivators also undertake a variety of microgreens cultivation (Poorva and Aggarwal, 2013). Planters usually choose crops that have a similar growing period to mixed crops so that the entire crop may be harvested at the same time. Some growers cultivate the crops separately and then combine them after harvest. Microgreens may be grown in a variety of ways, including garden beds, window sills, and pots, depending on the needs. These are cultivated in a typical, sterile, loose soil, and many different combinations of vermiculite, perlite, peat, and bark have been utilized to great effect (Kou et al., 2013). Therefore, using a variety of fertilisers, primarily organic ones, can significantly increase the output of microgreens (Murphy et al., 2010). When the very first two cotyledon and genuine leaves develop, as well as when the ideal height is reached, microgreens are harvested. They are ready when they reach the first genuine leaf stage, which is normally around 5cm high and varies according on the crop. The crop's period from sowing to harvest ranged from one to three weeks (Allende et al., 2004; Xiao et al., 2014b). Cultivated microgreens are extremely fresh and are cleaned and chilled as quickly as possible to ensure food safety. Before being sent to the market or clients, they are usually wrapped in polyethylene packaging and chilled to recommended temperatures (Kou et al., 2014; Xiao et al., 2014a). Furthermore, research has shown that exposure to light can have a negative impact on produce quality, thus optimal conditions are also required at trade outlets to maintain microgreen quality (Garrido et al., 2016). Microgreens are available in vegetable markets and provision stores in several packing materials, storage conditions and are usually presented below the light. The study of the quality and phytochemical concentration of different microgreens due to light exposure has been done extensively (Noichinda et al.,2007).

7. CONCLUSION:

The majority of microgreens research is carried out by a small group of researchers working together in very specific topics. There's still a lot of ground to cover. Numerous species of microgreens have indeed been investigated, and the ones that are most likely to be sold are not necessarily the ones that are most likely to be marketed. The impact of photoperiod on microgreen growth and nutrition has largely gone unreported. The impacts of low nighttime temperatures on microgreen plant development, nutrition, and food security have also yet to be determined. The discovery of helpful preventative and interventional therapies to maintain microgreens' quality and safety is a priority. Although postharvest light treatments can promote the development of bioactive compounds, this has yet to be investigated analytically to maximize nutritional content. nutrients throughout the whole spectrum of microgreens' potential Increased phytonutrient content can help to mitigate inherent safety and quality concerns. Many post-harvest treatments for other items have been developed that can help maintain the quality and shelf life of microgreens. To assure the safety and quality of this new addition to a healthy diet, it is very vital to do fundamental research.

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