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## FUNCTIONAL FOOD OF 21<sup>ST</sup> CENTURY – MICROGREEN

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### ABSTRACT

World is suffering from malnutrition. Mainly children and women affected by anaemia, kwashiorkor, obesity, vitamin deficiency, marasmus etc. One of the reason of this problem is over population; need more agricultural land to feed them healthy food. Due to industrialization need alternative of this. Microgreen is an edible seedling of vegetable, herbs, legumes having cotyledon leaf that ready to harvest in 14 to 21 days. Short life, colourful delicate structure, strong flavour and bundle of nutrition make them popular. Microgreens contain 4 to 40 times more nutrition than mature green. It is a great source of variety of minerals and vitamin that detoxify the body help in weight management. Their bioactive compounds help to fight against disease, boost immunity, fight against cancer like life threatening diseases. Microgreens are revolutionary food that can be grown organically by a person themselves which contain bunch of nutrition help to improve health.

**Key words: Microgreen, Health benefits, Antioxidant, Nutrition**

### INTRODUCTION

Nowadays people concern is increased towards the health. Specifically, after time of COVID-19 pandemic human society is become \*more conscious about immunity and good food practising. Conventional farming

use pesticides, herbicides which cause bioaccumulation in human body leads to neurodevelopmental disorder, cardiovascular disease, carcinoma, diabetes, respiratory disease etc [1]. In era of adulterated world, we

need to find alternative of inorganically farming food [2]. Increased population come up with the crisis of natural resources like, petroleum products, food, space to live, water etc. Planetary food crisis is one of the real-world problems. The earth's population expected to reach nine billion by the year 2050; to accomplish the nutritional needs agricultural yields will need to enhance double the capacity [3]. By using modern farming techniques like hydroponics, agroforestry, crop rotation, polyculture and vertical farming in minimal area cultivate multiple crops in large quantity [4] [5]. A great solution is an agricultural product "Microgreen" market term used for a juvenile and nascent stage in the life of fully grown plant. The term microgreen is not new, a refreshing flavour and texture make them popular as culinary agent in restaurants [6]. In recent era use of microgreen is increased because of its nutritional value support healthy life style and fresh flavour- texture do beautification. However, short shelf life & rapid product deterioration is major problem, but with proper postharvest handling & improved packaging process can solve this problem [7].

### **OBJECTIVES**

The main objectives of this study are as follows:

- 1) To understand the term "Microgreens"
- 2) To study nutritional characteristics and health benefits of variety of microgreen

### **WHAT IS MICROGREEN?**

Consider as a new class of salad crop that consumed and harvested in immature stage which is frequently called as 'vegetable confetti' [8]. Microgreen is edible seedling harvested when cotyledon leaves fully expanded & just before true leaf is emerged [6]. It achieves 2-3-inch length within 7 to 21 days after germination depending on species [9]. These tiny forms of green have varied colours starting from bright green, shades of green, red to purple, pink and yellow. Pleasing palette of microgreen having intense flavour like spicy bitter to sweet nutty, strong or mild, earthy or tangy, peppery or crunchy [8]. Due to vivid intense colour and flavour used in salads to enhance the taste of sandwich, soup, juice, pizza, omelette, taco, smoothie etc.,. Microgreen is harvested in immature stage as a result they have different texture & length in cotyledon leaf, root, and stem than mature one. It can grow large quantity in small area. These seedlings can grow whole year in controlled condition.

### **EXAMPLE OF MICROGREEN**

More than 60 seedlings of vegetable, cereal, legume, medicinal plant, herbs used as microgreens. Check edibility of species before

consumed as microgreen. At immature stage of solanaceae family eggplant, tomato, pepper, potato etc. contains antinutrients poisonous alkaloid content such as solanine which cause adverse effect to nervous and digestive system, therefore considered as

inedible [9]. Mixture of arugula, basil, beet, coriander and kale known as rainbow mix [10]. Here a table shows example of microgreen with their scientific name and family [9] [11].

Table 1: List of microgreen with their scientific name

Name of family	Common name and scientific name of microgreen
Amaranthaceae	Amaranth - <i>Amaranthus viridis</i> , beet - <i>Beta vulgaris</i> , quinoa - <i>Chenopodium quinoa</i>
Amaryllidaceae	Chives - <i>Allium schoenoprasum</i> , garlic - <i>Allium sativum</i> , leeks - <i>Allium porrum</i> , onion - <i>Allium cepa</i>
Apiaceae	Cilantro - <i>Coriandrum sativum</i> , carrot - <i>Daucus carota</i> , dill - <i>Anethum graveolens</i> , fennel - <i>Foeniculum vulgare</i> , parsley - <i>Petroselinum crispum</i>
Asteraceae	Endive - <i>Cichorium endivia</i> , lettuce - <i>Lactuca sativa</i> , sunflower - <i>Helianthus annuus</i>
Brassicaceae	Arugula - <i>Eruca sativa</i> , broccoli - <i>Brassica oleracea</i> var. <i>italica</i> , collard - <i>Brassica oleracea</i> var. <i>viridis</i> , kale - <i>Brassica oleracea</i> var. <i>sabellica</i> , kohlrabi - <i>Brassica oleracea</i> var. <i>gongyloides</i> , mustard - <i>Brassica nigra</i> , pak choi - <i>Brassica rapa</i> subsp. <i>Chinensis</i> , radish - <i>Raphanus sativus</i>
Chenopodiaceae	Spinach - <i>Spinacia oleracea</i> , orach - <i>Atriplex hortensis</i> , wasabi - <i>Eutrema japonicum</i>
Cucurbitaceae	Cucumber - <i>Cucumis sativus</i> , melon - <i>Cucumis melo</i>
Fabaceae	Pea tendril - <i>Pisum sativum</i> var. <i>macrocarpon</i> , fenugreek - <i>Trigonella foenum graecum</i> , alfalfa - <i>Medicago sativa</i> , adzuki - <i>Vigna angularis</i>
Lamiaceae	Mint - <i>Mentha arvensis</i> , basil - <i>Ocimum basilicum</i> , rosemary - <i>Rosmarinus officinalis</i> , sage - <i>Salvia officinalis</i> , oregano - <i>Origanum vulgare</i>
Legumes	Bean - <i>Vigna radiata</i> , chickpea - <i>Cicer arietinum</i> , lentil - <i>Lens culinaris</i> ssp. <i>Culinaris</i>
Poaceae	Barley - <i>Hordeum vulgare</i> , corn - <i>Zea mays</i> , rice - <i>Oryza sativa</i> , oat - <i>Avena sativa</i> , wheatgrass - <i>Triticum aestivum</i>
Polygonaceae	Buckwheat - <i>Fagopyrum esculentum</i>

## DIFFERENCE BETWEEN SPROUTS, MICROGREEN AND BABY GREEN

Microgreens are intermediate stage between sprouts and baby green; harvesting time is the major difference. Sprouts are germinated seeds eaten with embryo need high humidity, low light and can be consumed within 24 to 48 hours. Microgreens juvenile version of adult plant which need high humidity, optimum temperature, light for photosynthesis need 7 to 21 days for harvesting. It can be cultivated by conventional farming and hydroponics. Baby

greens are generally harvested at 2 - 4 inch in 15 to 40 days [12].

## NUTRITIONAL PROFILE OF MICROGREEN

Protein and micronutrients deficient diet is major burden amongst underdeveloped and developing countries. Instead of that developed countries face other problems like high calorie diet deficient in vital vitamins and minerals which is ultimately result is overweight or obesity [13]. Among South Asian countries India is one of the fastest

growing countries. According to Global Hunger Index 2017, India ranks 100 out of 119 countries [14]. In 2019, 30% of women aged 15-49 years, 36.5% pregnant women and 40% of children aged 6 months to 5 years suffering from anaemia. India faces protein and six other micronutrients – iron, vitamin B12, folic acid, iodine, vitamin A and vitamin D deficiency [15]. Microgreen gained popularity as a new source of functional & bioactive components such as protein, amino acid, variety of carbs, vitamins such as thiamine, ascorbic acid, folic acid, biotin, pyridoxine, niacin, retinol and minerals such as selenium, calcium, magnesium, zinc, manganese, iron, sulphur [16]. It contains antioxidants; anthocyanin, catechin, phylloquinone, glutathione, flavonoid, ascorbic acid, beta carotene, alpha tocopherol and phenolic [17] [6] [7] [11]. It contains 4 to 40 time more quantity of bioactive compounds than ordinary crop that prevent malnutrition and helps to reduce the risk of heart disease, Alzheimer, diabetes, cancer [11] [18].

### 1) Nutritional profile

All micronutrients establish positive effect on human body. Vitamin K1 is necessary for blood coagulation in human. As showed in [6] green or bright red coloured microgreens such as garnet amaranth, red sorrel, green basil pea

tendrill, red cabbage had the high amount of phylloquinone compare to yellow coloured corn shoot. Ascorbic acid an antioxidant enhances iron absorption, wound healing, collagen synthesis and fight against cancer. As showed in [19] mature green of amaranth, bottle gourd, radish, pumpkin, palak had high vitamin C compare to microgreen [20]. As described in [6] fresh microgreen was a good source of TAA (total ascorbic acid) compare to vegetable plant for example red cabbage had 6 time more TAA than mature green; garnet amaranth, roselle, basil, radish and broccoli also had complete source of vitamin C which is comparable to citrus fruit. Chlorophyll can only synthesis in plant cell but it having different role in human health serves as great antioxidant, antitumor, wound healing, anti-inflammation [21]. Total chlorophyll concentration of microgreen in range of 29.5 mg/100 g to 90.3 mg/100 g and ratio of chl a/chl b was 1.3 to 2.15. The high concentration available in fennel, basil, swiss chard, rocket, chicory, lettuce, alfalfa [22]. The highest total phenolic content (TP) (73.6 mg GAE/100 g) recorded in roselle microgreen. Several intrinsic and extrinsic factors such as species, growth condition sample preparation and maturity at harvest affect phenolic content [20]. Carotenoid act as antioxidant, while other component of

carotenoid like  $\beta$  carotene has pro vitamin A function and lutein /zeaxanthin is constitute of macular pigment in the eye [23]. 3 – 5 mg/day lutein reduce the risk of age-related macular degeneration (AMD) and strengthening cataracts. Carrot had 2.7 time more lutein than spinach [22]. Red sorrel had high amount of  $\beta$ -carotene followed by carrot, sweet potato, cilantro, red cabbage, peppercress, wasabi, green basil, amaranth but seedling had 3 to 26 fold more amount of  $\beta$ -carotene than mature one. Rocket shows high value of calcium (18g/kg DW), nitrate (2679 mg/Kg FW) [24].

Roselle microgreen exhibited maximum antioxidant activity such as DPPH RSA with  $IC_{50}$  value of 81.7  $\mu$ g/ml and ILAP (84.4%), total phenolic content (TP) (73.6 mg GAE/100 g) [22]. Only popcorn shoot and golden pea tendrils had very low amount of carotenoid, lutein, zeaxanthin, phylloquinone, ascorbic acid etc compare to other microgreens [6]. Microgreen contains high concentration of phylloquinone, rich source of K and Zn; whereas low amount of antioxidants and phenolics compare to mature greens [20].

## 2) Biological value and health effect

Table 2: Nutritional value and health effect of microgreen

Microgreen	Nutritional value	Health benefits
Amaranth	Gluten free, protein rich source, vitamin A, C, E and minerals	Improve appetite, weight loss, act as antioxidant and antitumor agent
Alfalfa	Complete source of vitamin k, calcium, iron, zinc	Natural detoxifying agent, lower risk of diabetes and heart disease
Beetroot	Vitamin A, B6, C, folate, minerals like – Cu, Fe, Mg, Mn, K, Zn nitrate, thiamine, riboflavin, beta carotenes	Reduce risk of anaemia, diabetes, PMS, migraine, epileptic seizures, alopecia hypertension, Alzheimer, aging
Broccoli	40 time more nutrition than mature one. High amount of sulfuraphane, Fe, Mg, P, Ca, vitamin C, A, E, K and protein	Fighting against inflammation, cancer, improved heart health, improved digestion.
Fenugreek	Dietary fiber, powerful phytonutrients, trigonelline, yamogenin, choline, neotigogen, diosgenin, tigogenin	Inhibit lipid accumulation, control diabetes, good for lactating mother neuroprotective, antimicrobial
Mustard	Dense of protein, fibre, folate, calcium, iron, vitamin C, glucosinolates	Fight against diabetes, boost hair growth, improve immunity
Radish	Good source of vitamin A, B3, B11, C, minerals Zn, Mg, P, Na, antioxidants, folate, dietary fiber, niacin, riboflavin,	Natural diuretic, antimicrobial activity, beneficial in urinary disorder, cancer, blood purify, help in constipation
Sunflower	High nutrition- low calories, Contains Ca, Fe, Cu, Mg, K, Zn, folate, lecithin, vitamin E, vitamin C, selenium	Help to break fatty acid, boost fertility, activate immune cells, deodorize body, ideal for weight loss, revitalize tissue.
Wheatgrass	Richest source of chlorophyll and live essential enzymes, 19 amino acid, more than 90 minerals, vitamin A, C & E	Detoxifying agent, prevent overeating, fight against fatigue, body odor, cancer, heart disease, inflammation, treat skin

## 3) Health beneficial effect

Microgreens having number of health benefits although very few studies available which

focus on in vivo advantage. Microgreens effective in diet-based disease prevention that is, diabetic obesity, heart associated disease. It

helps to improve digestion which beneficial for weight loss. Its fibrous texture helps to get rid of constipation. Great source of enzyme which help in to control blood sugar level [25]. Brassicaceae and poaceae family poses wide range of bioactive compounds such as phenolics, glucosinolate, anthocyanin, some minerals, vitamin C other than this total isothiocyanates and polyphenols are responsible for antioxidant activity and protect cells from free radicals, fight against cancer, support healthy aging [19]. In vitro study of tumoral colon cells treated with kale, broccoli, radish, mustard microgreens showed low cell viability compare to blank proves effectiveness to cure colon cancer. Mustard and radish showed high antiproliferative effect due to higher vitamin C, total

carotenoids and total isothiocyanates [19]. Brassicaceae family contain great amount of glucosinolates that is effective in cancer protection. According to [26] Extract of four species of Brassicaceae family arrest cell cycle in G2 phase in human colorectal adenocarcinoma cells by activating specific enzyme involved in cancer cell metabolism.  $\alpha$ -amylase and  $\alpha$ -glucosidase assays used for anti-diabetic activity and pancreatic lipase assay is used for anti-obesity. In beetroot and radish microgreen had inhibitory activity against  $\alpha$ -amylase. Mung, kale, radish, beetroot, pea and amaranth microgreen showed inhibition of pancreatic lipase [27]. Here showed some of the picture of microgreens in **Figure 1** [28] [29].



**Figure 1: Variety of microgreens a) arugulla microgreen, b) radish microgreen, c) amaranth microgreen, d) mustard microgreen, e) red basil microgreen**

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