

Micro greens: A New Initiative and Harmonizing Approach for Promoting Livelihood and Nutritional Security-India

Sreenivasa R J^{1*}
Durga Sai Sri T²
Shivudu G³
Veenita kumari⁴

^{1,2,3}Food Chemistry Division, National Institute of Nutrition-ICMR,
Hyderabad, India

⁴National Institute of Agricultural Extension Management, MoAFW,
Hyderabad, India

Abstract

Micronutrient Malnutrition (MNM) is one of the major public health and socioeconomic problem at global level. It is severely affecting to third world countries particularly weaker sections in the population, together with pregnant and lactating mothers, children and adolescent girls. Globally greater parts of the community are consuming persistently less nutritional foods when compare to recommended levels. The nutritional gap is too high in emergent nations. The most important dietary harms in under developed countries include protein-energy malnutrition (PEM), iodine deficiency (ID), vitamin A deficiency (VAD) and iron deficiency anemia (IDA). Though the green leafy vegetables (GLV) are in concert an important role to prevent the diet related nutritional disorders, the extensive literature explored that there is a huge gap of knowledge in the proper consumption of GLV and its benefits to human. From past decade, Micro Greens (MGs) have gained attractiveness because of changes in way of living and healthiness of consumers. The nutritional values of MGs are four times superior to the matured greens. Owing to their favorable concentration of antioxidants and micronutrients includes vitamins, minerals and low nitrate content, MGs have great potential to be a positive and simple way to reduce the mineral malnutrition problems to meet the requirements for elementary dietary intake. Comprehensive investigation is required to distinguish superior nutrient status in MGs. Further efforts should make to widen the knowledge in this unmapped area of research.

Keywords: MNM, Vulnerable groups, Micro Greens, Green leafy vegetables.

Introduction

A healthy diet and a healthy lifestyle are cornerstones of good health and reduced risk especially for non-communicable disease. Good nutrition, daily exercise and adequate sleep are the fundamentals for long-term health lifestyle [1]. Greater parts of the inhabitants in developing world are still not meeting their daily recommended nutrients in society. The reasons attributed towards poor income resource, much attention is not given towards the importance of micro nutrients, lack of awareness about health concern and many more. Micronutrient malnutrition (MNM) is widespread in emergent countries, and predominantly high in the regions of Asian and African continents. The highly affected subjects are vulnerable sectors includes pregnant women, lactating mothers, adolescent girls and children below five years of age [2] and [3]. The three important predominating common micro nutrient diseases at global level are iron deficiency, vitamin A deficiency and iodine deficiency.

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***Corresponding author:** Sreenivasa R J, Food Chemistry Division, National Institute of Nutrition-ICMR, Hyderabad, India. Tel: +9140-27197393; Email: [sreenu.nin\(at\)gmail.com](mailto:sreenu.nin(at)gmail.com)

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Table 1: Differences between Micro Greens and Sprouts [12]

Micro greens	Sprouts
Micro Greens are defined as leafy vegetables and herbs shoots used to enhance salads or as edible garnishes to embellish a wide variety of other dishes	Sprout seeds are usually nuts, grains or beans and are consumed after germination or partially germination
Micro Greens are harvested just above the roots, the stem, cotyledons and first true leaves are eaten	Sprouts are eaten with their roots intact. Hence these seeds are washed properly to remove foreign substances and soil particles
Micro Greens are grown over soil surface or other growing medium such as peat moss, vermiculite and perlite etc	Sprouts are grown entirely in water in an enclosed container such as a glass jar. The seeds are soaked in water in various time-temperature schedules depending on the type and size of seeds
Micro Greens take more time to grow than sprouts	Sprouts take less time to grow than micro greens
These Micro Greens require sunlight for their efficient growth	Sprouts are grown in high moisture, humidity levels, optimum temperature and dark or low light conditions
Micro Greens present relatively less risk of food borne illness than sprouts	Sprouts have a high risk of food borne illnesses because their growth conditions are ideal for the growth of bacteria.

According to global nutrition report 2018 [4], children below five years of age face more nutritional associated problems which 150.8 million are stunted, 50.5 million are wasted and 38.3 million are overweight respectively. The report highlighted that women are more vulnerable to malnourishment problems than men. Globally one third of women of reproductive age have anemia and suffer from obesity than men, while million women are underweight. It is awful to know that India has one third of world's stunted children with 46.6 million kids, followed by Nigeria (13.9 million) and Pakistan (10.7 million) and also accounts for 25.5 million wasted children.

As per Global Hunger Index 2018 (GHI) report, India, the second most populous country in the world and also the 7th largest country in terms of area ranked 103rd in out of the 119 countries [5]. Despite 72 years of independence the health risks related to food and nutrition have still become a serious threat in India though being the second largest producer of food grains at global level. World Health Organization 2016 (WHO) [6] report reveals that consumption of junk foods and fast foods are also major grounds to promote non communicable diet related diseases such as obesity, underweight, cardiovascular diseases, cancer and diabetes etc. Indian diet is found to be very low in the consumption of Green Leafy Vegetables (GLV) and fruits that indicates many suffer from essential micronutrient diseases like anemia and vitamin A deficiency. UNICEF 2012 [7] report highlighted that about 40% of preschool children are underweight in India due to lack of food security.

Many studies revealed that people in greater part of the world are consuming less than the recommended levels to meet the requirement of nutrient components. It was observed surprisingly that highly urbanized countries include Australia, Canada, Europe, UK and USA, researchers have accomplished that there is large gap between actual and recommended consumption of green leafy vegetables and fruits despite decades of concern and publicity. This gap is more in rising nations together with India [1]. The principal nutritional problems comprise Protein-Energy Malnutrition (PEM), Iodine Deficiency (ID), Vitamin A Deficiency (VAD) and Iron Deficiency Anemia (IDA) [8]. Published literature reveals that improved intake of GLV and vegetables are connected with decreased threat of cancers, Cardiovascular Diseases (CVD), cataract, macular degeneration and other

age-related diseases. Recent published data proven to facilitate that consumption of GLV keeps mental abilities sharp, reduce neurological disorders and other nutritional related diseases [9]. In ordered to meet the demands of increasing population, it is an emerging need to find an alternative [10], and focus researchers' attention and efforts towards finding innovative means that can help alleviate the problem and ensure food security.

Micro greens (MGs)

Malnutrition problems are major distress that needs to be eliminated in the society. Nutrition researchers are focusing to tackle the necessity of diet with clean, nutrient-enrich and elevated levels of indispensable nutrients includes minerals, vitamins and Phyto compounds for healthy growth of the body. In this context the vegetables industry has come up with innovative and alternative new generate Micro Greens (MGs). The MGs can be measured a novelty of the concept of vegetables and vegetables industry in general having the potential to renovate the whole idea of vegetables [11]. The present review aim is to extrapolate the importance of nutritional facts and health benefits of MGs and their utility in daily life. MGs are miniature edible green vegetables harvested from 7 to 21 days after sprouting as shoots. MGs are used as flavoring agents and visual components with different textures and colors to garnish the recipes in reputed restaurants and household levels also. MG's size ranges from 3 to 8cm and are larger than sprouts and smaller than baby greens (Table 1).

The MGs have two main basic parts a central stem with two developed cotyledon leaves. They are not only known

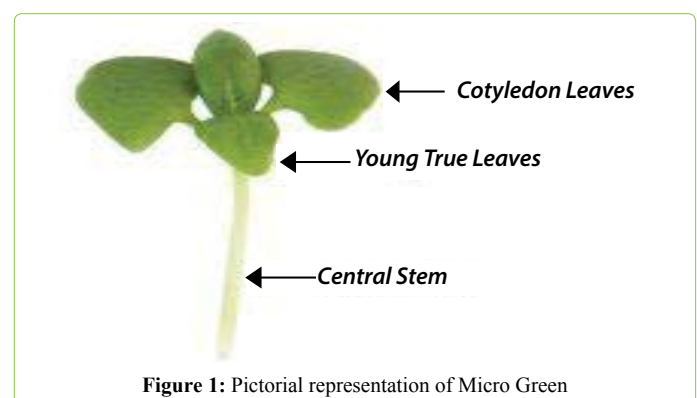
**Figure 1:** Pictorial representation of Micro Green

Table 2: Types of few Micro Green [24] [25]

Family	Micro Green	Growth medium	Harvest time in days	Flavor	Nutrients rich
Amaranthaceae	Amaranth	Soil or hydroponic	8-12	Mild, sweet flavor	Protein, Fiber Minerals like Mg, P, Fe.
	Beets	soil	11-21	sweet	Antioxidants and Vitamins.
Brassicaceae	Arugula	Soil or hydroponic	6-8	Strong peppery flavor	Protein & B complex vitamins (B ₁ , B ₂ , B ₅ , B ₆), minerals (Fe, Ca, Mg, P, Mn, K).
	Broccoli	Soil or hydroponic	8-12	Strong broccoli flavor	Minerals, Vitamins, Enzymes
	Brussel Sprouts	Soil or hydroponic	7-14	Broccoli flavor	Rich in Fiber, Protein, Vitamins and Minerals.
	Cabbage	Soil or hydroponic	6-14	Strong broccoli flavor	Rich in vitamins E and C
	Cauliflower	Soil or Hydroponic	8-14	A strong Broccoli flavor	Vitamins (C, K & E) and β -carotenes
	Mustard	Soil or Hydroponics	8-12	Bold mustard flavor with spice	Vitamins (C, K & E) and β -carotene
	Radish	Soil and Hydroponics	6-12	Spicy & slightly floral	Vitamins (A, E, K and B complex and C) and Minerals (Fe, P, Ca)
	Pak Choi	Soil and Hydroponics	8-12	Slightly sweet and Robust flavor.	Vitamins and Minerals.
	Red Cabbage	Soil or hydroponic	6-14	A strong Broccoli flavor	Vitamins C, E, K & β -carotenes & Fe.
White Radish	Soil and Hydroponics	6-12	Spicy & slightly floral	Vitamins A, E, K, B complex, C & Minerals like Fe, P, Ca.	
Fabaceae	Fenugreek	Soil and Hydroponics	20-30	Bitter flavor	Minerals rich.
Lamiaceae	Basil	Soil or hydroponic	8-12	Intense basil flavor	Vitamin C and β -carotene.
	Chia	Soil or hydroponic	8-12	Earthy flavor	Proteins, Healthy fat and fiber
Poaceae	Rye	Soil and Hydroponics	5-9	Slightly bitter flavor	Protein, Fiber, Vitamins & minerals
Polygonaceae	Buck Wheat	Soil or hydroponic	7-14	Tangy and tarty flavor	Amino acids, Minerals & Antioxidant.

for their attractive colors or for their aroma but also for their nutritious aspects (Table 2).

Nutritional composition of Micro Greens

Studies are very rare to explore about the MGs nutritional composition. Available literature has confirmed that MG's have high level of minerals, Phyto nutrients, vitamins, antioxidants and carotenoids. MGs are high in protein, dietary fiber and other essential minerals like potassium (K), calcium (Ca), phosphorus (P), zinc (Zn), iron (Fe), and copper (Cu) and low in fat and carbohydrates. MGs have wide range of polyphenols and rich in enzymes which support to digestion. Xiao et al, [13] [14] assessed commercially grown 25 micro greens (including garnet, cilantro, red cabbage etc.) for different nutritional components and observed higher levels of essential minerals, ascorbic acid and B complex vitamins in cabbage, phylloquinone and violaxanthin in garnet, amaranths when compared to matured greens. The other study published by Pinto et al 2015 [15] reveals that the trace elements levels in lettuce are five times higher in MGs than matured leaves. Nutrition data of MGs shown that, free of the toxic heavy metals and low nitrate content unlike mature greens and is advisable to include them in human diet especially for kids. Research carried out by Alarcon-Flores *et al* 2014 [16] and Martinez-Tomas *et al* 2012 [17] highlighted that vegetables are known to show positive benefits to fight against oxidative stress associated diseases. Vegetable consumption is linked with decrease in development of non-communicable diseases like cancer and cardiovascular disorders [18,19]. But as vegetables are source of nitrates due to extension fertilizers nitrates may accumulate in plants and cause health related diseases [20-22]. Nitrate is nontoxic but when ingested it can be metabolized to nitric oxide and N-nitroso compounds, that are toxic and may lead to methaemoglobinaemia in infants and kids [20-23]. Micro Greens are grown naturally without the usage of fertilizers or pesticides and devoid of nitrate

content when compared to matured greens which are prone to develop after using fertilizers and pesticides. MGs can be developed commercially in addition to smaller scale by persons for home use, either as sole crop or mixed crop.

Promotion of Micro Greens

Micro Greens are the enhanced source of essential nutrients which help to maintain good health. Urban population who interacts with different climate, food habitats including a lot of ready to eat foods as well as fast foods, lack of proper nutrition and physical activity is making them susceptible to diet related diseases. Under nutrition is resulting in anemia, low BMI and improper growth consequently over nutrition is making them suffer from non-communicable diseases. The well-known fact is that in the pastoral society and urban areas the public doesn't have time to give much attention with reference to healthy and nutritious food. But recent nutrition surveys have projected that they need to give priority for organic or micro greens foods which are having essential micronutrients to maintain healthy lifestyle. MGs can be easily grown in home gardens or backyards under optimum growing environment. They can also be grown in greenhouses or indoor in urban situations, if the temperature ranges about 18-25°C and light levels and day lengths are sufficient. Such small-scale home production could be encouraged in nutrient-deficient populations.

Types of media

Since MGs are fragile and sensitive to physical damage, they should be sheltered from rainfall and other environmental stresses. They can be grown-up in corridors, greenhouses, high tunnels, shade structures or indoors. MGs have a short growing cycle and are mostly produced hydroponically or semi-hydroponically. Under hydroponic systems, MGs can be produced using perlite or vermiculite. Sterilized growing media can be used to keep away from the threat of pest and disease development. Depending

on the necessities MGs are also formed in backyard and in containers. MGs may also be produced in flat nursery beds or plug trays with soil or compost mixed with vermin compost below predictable systems. They may be produced in plastic trays with bottom holes to allow drainage. According to Kou *et al.* [26] they can be grown in a standard, sterile, loose soil and many mixes have been used successfully with peat, vermiculite, perlite and bark. MGs can also be grown in soil media, coco peat and tissue culture media.

Benefits of Micro greens

Among the non-communicable diseases cardiovascular and diabetes is a major death cause in developing countries due to lack of nutritious and healthy food. As per population, animal and intervention studies, it was identified that consumption of wide range of vegetables is a means to reduce these diseases. Haiqiu Huang *et al* [27] conducted a study on rodents using red cabbage MGs and shown that MGs can modify weight gain, cholesterol metabolism and decrease CVD problems by reducing hypercholesterolemia.

Micro Greens in daily diet

MG's are vivid in color are used extensively as garnishing components. They can be used in salads, soups and sandwich and also used to garnish pastas noodles and raitas. MGs can also promote and add in making rotis, idlis and dosa in morning breakfast. Due to their attractive flavor, color and aroma people can add in bread omelet and khichidi, smoothies and various other food products including sandwich, dhoklas, pizzas etc. In Indian context they can be added to dhal and curries at the end to keep their nutrition intact.

Conclusion:

Micronutrient deficiency is widespread in emerging nations. These are silent epidemics of vitamins and mineral deficiencies as exacerbating factors in communicable and chronic diseases, significantly impacting morbidity, mortality and quality of life among population without gender difference. In the last few years micro greens have gained popularity because of changes in standard of living patterns and health awareness. Due to their high concentration of antioxidants, vitamins and minerals and low nitrate content, which are associated with well-being of good human health. The elevated levels of minerals in MGs could be used as health promoting approach to meet the provisions for elementary dietary intake. Comprehensive research is needed to characterize improved micronutrient status in MGs. Information on essential micronutrient mechanism and their bio accessibility for effective health benefits from MGs, GLV, Vegetables and Fruits is still sparse in Indian perspective. There is an emerging need to focus on this area and require furnishing emphasis towards food security, food safety, food sustainability and nutrition security in India.

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Conflicts of Interest

The authors declare no conflict of interest.

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