Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6251

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (2):** 182-186 (2018)

International Journal of Pure & Applied Bioscience

Review Article

OPEN ACCESS

Microgreens: A Nutrient Rich Crop that can Diversify Food System

Pooja Bhatt[1*] and Sonika Sharma[2]

[1*]Ph.D. Scholar, [2]Assistant Professor,

Department of Food and Nutrition, College of Home Science, Punjab Agricultural University, Ludhiana, Punjab, India

*Corresponding Author E-mail: poojabhattpau@gmail.com

Received: 14.02.2018 | Revised: 22.03.2018 | Accepted: 25.03.2018

ABSTRACT

As the world's population increasing at a rapid speed, food system must be revised to supply adequate nutrition while minimizing environmental impact. Current malnourishment statistics are high and affected large number of population. Thus, microgreens are new special category crop which are gaining popularity these days. They are tenuous cotyledonary leafy greens of many vegetables, spices and herbs that are found in variety of colours, textures and flavours, which are harvested at infancy stage. They belong to class of functional foods. They are dense source of many nutrients such as minerals, vitamins and antioxidants which are potential to prevent many diseases and deficiencies when consumed in small quantity. The nutritional values of microgreens are more quantitatively than mature ones. Microgreens can be easily cultivated and it takes minimum resource demands i.e. water, soil and pot or tray. Commonly grown microgreens are mustard, spinach, beetroot, lettuce, cilantro, cabbage, radish and broccoli. Microgreens production provide better access to adequate nutrition along with diversify food system. This review provides insight potential for microgreens to diversify food system.

Key words: *Microgreens, Functional food, Cilantro, Cotyledonary, Food system*

INTRODUCTION

Nowadays, functional foods and substantial interest for consumption of fruit and vegetable are in rising, compelled by growing interest of consumers for diets that support health and longevity. To feed the world's rapidly growing population environmental sustainability of crop production has come into focus as problem-solving efforts work[3]. There is focus on production of fewer staple crops and thus the nutritional value of average diet reduced[12,9] and there is a loss of nutrients when it comes from farm to plate. Therefore, simply upscaling current agricultural practices to increase crop yields is not an applicable solution for feeding the World's population. It is a priority to establish dietary guidelines that satisfy human nutritional requirements with a diversity of foods that can be produced with minimized environmental impact [26,25]. Thus for accomplishing such advancements, there is a need to revising the food systems.

Cite this article: Bhatt, P. and Sharma, S., Microgreens: A Nutrient Rich Crop that can Diversify Food System, *Int. J. Pure App. Biosci.* **6(2):** 182-186 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6251

An estimated, two billion lives are affected in developed and developing countries by a chronic deficiency of essential minerals and vitamins (micronutrients), collectively known as hidden hunger[30]. Current efforts to alleviate micronutrient deficiency are an emphasis on genetically engineering crops[8] and biofortification methods[24] of crops to overcome hidden hunger. However, microgreens are a new emerging crop that is a dense source of nutrients without biofortification and genetically engineering. Microgreens are a young seedling of edible vegetables, spices, herbs and grains including wild species. Microgreens are edible greens having two or more developed cotyledonary leaves[32]. Depending on the species, microgreens are harvested at 7-14 days after germination with short crop cycle and usually with the average height of 2.5-7.6 centimetres. Microgreens are harvested at ground level including stem and cotyledons[19]. Even in tiny size, microgreens can give a wide variety of intense flavour and it is known for its flavour that is spicy, nutty, sweet and sour etc. and colours. So microgreens can be used as a new ingredient in various dishes i.e. in salads, soups, dhal, chapatti and sandwiches etc. which help the dishes to enhance its texture, colour, flavour and also it gives diversity to food system [17]. All microgreens demonstrated good to excellent consumer acceptance and overall acceptability of microgreens was strongly correlated to flavour acceptability[34]. Microgreens should not be confused with sprouts, although both greens are consumed in an infantile stage. Sprouts are produced in wet and dark conditions whereas microgreens are produced in light condition and in soil media, so microgreens contain more nutrient and less microbial contamination then sprouts[29]. Microgreens possess higher levels of vitamins, minerals, and other health-giving phytonutrients than the mature leaves[32]. In this review, we will discuss production as well as the nutritional and biochemical composition of microgreens and their potential to diversify food system.

Production of Microgreens

Microgreens can be produced from a large number of vegetable, herb, and agronomic crops. The producer should evaluate various crop varieties to determine their value as microgreens[29]. Microgreens are cultivated in a variety of environments specifically indoor, outdoor and controlled environment i.e. greenhouse and developing frameworks (growing systems) that is soil and soilless, depending on the scale of production. Containerized production, adaptable both to micro-scale urban and large-scale commercial operations, allow for commercialization of the product while growing on the media, to be harvested directly by the end user. This methodology bypasses harvesting and many postharvest handling issues and may guarantee freshness and high quality[7]. Table:1 showing the commonly cultivated microgreens that are Spinach[2,18], Table beet[20,21], Mustard[13], Buckwheat[10], Arugula, bull's blood beet, celery, cilantro, amaranth, golden pea, basil, spinach, mizuna, peppercress, popcorn shoots, red mustard, red beet, red cabbage, red orach, sorrel, red sorrel, wasabi[32], Cabbage[4], Broccoli[15], Radish[33], Lettuce[22].

Table 1: showing commonly cultivated crops

Potential Microgreens Crops	
Amaranth	Fennel
Arugula	Spinach
Table beet	Mustard
Buckwheat	Celery
Radish	Cilantro
Red cabbage	Broccoli
Lettuce	Carrot

Harvesting of microgreens at the right stage is one of the most important production strategies. The time period from cultivation to harvesting varies greatly from crop to crop[22,1]. Some grower cultivate mixed crops of microgreens[23], thus grower should select the crops that are having similar growth rate so that whole crop can be harvested at once. Microgreens can be produced in the garden, pot, tray as well as container, depending upon requirements. Microgreens are harvested just above the soil line[7].Harvested microgreens are highly perishable and immediately washed, cooled as soon as possible using good handling practices for food safety. Microgreens are generally packed in polyethylene packages and cooled to recommended temperatures before supplying to the market or consumers[15,33].

Bioactive Compounds

Utilization and consumption of microgreens have increased due to increased customer's interest toward health and their awareness for health foods. High levels of functional compound have been found in microgreens due to which demand for it increased. Microgreens have been found to contain human bioactive compounds i.e. ascorbic acid, tocopherol, phylloquinone, phenolics, minerals and antioxidants more than mature one[14].A comparison study of mineral and nitrate content of microgreens and mature leaves of lettuce found that most of the minerals are high in the microgreens (Iron Calcium, Magnesium, Zinc, Selenium and manganese) with low content of nitrate than mature one. So microgreens can be safely used as new ingredient as it is dense source of nutrients without exposure to harmful nitrate[22].Fenugreek microgreens and the mature fenugreek leaves were compared for sensory quality, phytochemical content and antioxidant activity when stored for 14 days at 10°C. The higher levels of ascorbic acid, total polyphenols and total chlorophyll obtained in fenugreek microgreens, which confirmed that phytochemical content tend to decrease with increasing maturity of the plant. Microgreens possess better retention of phytochemical compounds on storage. Fenugreek microgreens could be used both in the cooked and fresh form with good acceptability as indicated by the organoleptic evaluation[6].Consumption of microgreens could be a health strategy to meet the mineral requirements as microgreens contain both micro minerals and macro minerals in good amount as compared to the mature one. The mineral composition was analysed for 30 varieties of microgreens revealed that microgreens are good source of iron & zinc i.e. 0.47-0.84mg/100g FW and 0.22-0.51mg/100g FW respectively (micro minerals) and calcium & potassium i.e. 28-66mg/100g FW &176-387mg/100 FW respectively (macro minerals)[31]. Microgreens are grown from variety of crops such as radish, lettuce, mustard, cabbage, broccoli, amaranth etc. High concentration of ascorbic acid found in red cabbage[32]. 50 times more sulfurophane found in Broccoli microgreens by weight than mature broccoli[34]. A total of 164 polyphenols including 30 anthocyanins, 105 flavonol glycosides and 29 hydroxycinnamic acid, and hydroxybenzoic acid were identified. The results showed that the Brassica species microgreens tended to have more complex polyphenol profiles and contain more varieties of polyphenols compared to mature plant counterparts[27].The protective effect against the oxidative stress shown by Brassicaceae (broccoli, Brussels sprouts, cabbage, kale, and cauliflower) is given by glucosinolates which are sulphur-containing glucosides. It was found that broccoli microgreens contain elevated levels of glucosinolates as compared to mature one[28].Proper dietary intake for space travellers with minimal resupply from the Earth, as food and food packaging currently represent a significant burden on space mission consumables. Usually traveller were suffered from weight loss, oxidative stress, increased muscle proteolysis, impairment of eye health and changes in the central nervous system[11,5]. Microgreens are diminutive greens which provide abundance of vitamins, minerals, antioxidants, polyphenols with wide range of colour ,flavour and crispness to the

food[32]. Microgreens can act as an abundance of functional food as a component of space life support systems[16].

CONCLUSION

This study provides critical insights into the potential for various kinds of microgreens to provide a dense source of bioactive compound that can be grown with a small ecological footprint by individuals. Microgreens production could also diversify the average diet, as various crops contain wide range of nutrients which can be easily produce and consume by individual without much efforts. This review paper revealed that production of microgreens is a great addition to food system.

REFERENCES

1. Allende, A., Luo, Y., McEvoy, J.L., Artes, F. and Wang, C.Y., Microbial and quality changes in minimally processed baby spinach leaves stored under super atmospheric oxygen and modified atmospheric conditions. *Postharvest Bio Tech.* **33:** 51–59 (2004).
2. Bergquist, S.A.M., Gertsson, U.E. and Olsson, M.E., Influence of growth stage and postharvest storage on ascorbic acid and carotenoid content and visual quality of baby spinach (*Spinacia oleracea L.*). *J Sci Food Agri.***86:** 346–55 (2006).
3. Burlingame, B., Grand challenges in nutrition and environmental sustainability. *Front Nutr*. **1:** 3 (2014).
4. Chandra, D., Kim, J.G. and Kim, Y.P., Changes in microbial population and quality of microgreens treated with different sanitizers and packaging films. *Hortic Env Biotech* **53:** 32–40 (2012).
5. Cohu, C.M., Lombardi, E., Adams, W.W., and Demming-Adams, B., Increased nutritional quality of plants for long-duration spaceflight missions through choice of plant variety and manipulation of growth conditions. *Acta Astonaut.* **94:** 799–806 (2014).
6. Ghoora, M.D. and Srividya, N., Storage effects on phytochemicals, antioxidant activity and sensory quality of fenugreek (*Trigonella foenum-graecum L.)* microgreens and mature leaves. *Int. J. Food. Nut Sci.* **6**: 59-68 (2017).
7. Gioia, F.D. and Santamaria, P., Microgreens, agrobiodiversity and food security.(eds) Microgreens. Eco-logicaeditore, Bari.pp 7–24 (2015)
8. Grusack, M.A., Enhancing mineral concentration in plant food products. *J Am Coll Nutr* **21(3):** 178S–83S (2002).
9. Hunter, D., Ozkan, I., Moura De Oliveira Beltrame, D., Lokuge, W., Samarasinghe, G., Wasike, V.W., Enabled or disabled: is the environment right for using biodiversity to improve nutrition? *Front Nutr* **3:** 14 (2016).
10. Janovska, D., Stockova, L. and Stehno, Z., Evaluation of buckwheat sprouts as microgreens. Acta Agri Slov. **95**:157–62 (2010).
11. Kennedy, A.R., Guan, J., and Ware, J.H., Countermeasures against space radiation induced oxidative stress in mice. Radiat. *Environ. Biophys.* **46:** 201–203 (2007).
12. Khoury, C.K., Bjorkman, A.D., Dempewolf, H., Ramirez-Villegas, J., Guarino, L., Jarvis, A., Increasing homogeneity in global food supplies and the implications for food security. *Proc Natl Acad Sci* **111(11):** 4001–6 (2014).
13. Kopsell, D.A., Pantanizopoulos, N.I., Sams, C.E. and Kopsell, D.E., Shoot tissue pigment levels increase in 'Florida Broadleaf' mustard (*Brassica juncea L.)* microgreens following high light treatment. *Scientia Hortic.* **140:** 96–99 (2012).
14. Kou, L., Luo, Y., Yang, T., Xiao, Z., Turner, E.R., Lester, G.E., Wang, Q. and Camp, M.J., Postharvest biology, quality and shelf life of buckwheat microgreens. LWT-Food *Sci Technol Int.* **51:** 73–88 (2013).
15. Kou, L., Yang, T., Luo, Y., Liu, X. and Huang, L., Pre-harvest calcium application increases biomass and delays senescence of broccoli microgreens. *Postharvest Bio Tech.* **87:** 70–08 (2014).
16. Kyriacou, M.C., De Pascale, S., Kyratzis, A. and Rouphael, Y., Microgreens as a Component of Space Life Support

Systems: A Cornucopia of Functional Food. *Front. Plant Sci.* **8:** 1587 (2017).

17. Lee, J.S., Kim, J.G., Park, S., Effects of chlorine wash on the quality and microbial population of 'Tah Tasai' Chinese cabbage (*Brassica campestris var. narinosa*) microgreen. *Korean J. Hortic. Sci.* **27:** 625−630 (2009).
18. Lester, G.E. and Hallman, G.Y., γ-irradiation dose: effects of baby leaf spinach ascorbic acid, carotenoids, folate, a-tocopherol, and phylloquinone concentrations. *J Agri Food Chem.* **58:** 4901-06 (2010).
19. Murphy, C.J., Llort, K.F. and Pill, W.G., Factors affecting the growth of microgreen table beet. Int J Veg Sci. **16**:253–66 (2010).
20. Murphy, C.J.; Pill, W.G., Cultural practices to speed the growth of microgreen arugula (*roquette; Eruca vesicaria subsp. sativa*). *J. Hortic. Sci. Biotechnol.* **85:** 171−176 (2010).
21. Pill, W.G., Collins, C.M., Gregory, N. and Evans, T.A., Application method and rate of Trichoderma species as a biological control against *Pythiumaphanidermatum (Edson) Fitzp.* in the production of microgreen table beets (*Beta vulgaris* L.). *Scientia Hort* **129:** 914–18 (2011).
22. Pinto, E., Almeida, A. A., Aguiar, A. A., and Ferreira, I. M. P. L. V. O., Comparison between the mineral profile and nitrate content of microgreens and mature lettuces**.** *J Food Compos Anal.* **37:** 38-43 (2015).
23. Poorva, and Aggarwal, P., Microgreens in the food world. Indian Food Ind. **32:** 18–24 (2013).
24. Rawat, N., Neelam, K., Tiwari, V.K. and Dhaliwal, H.S., Biofortification of cereals to overcome hidden hunger. Plant Breed, **132:** 437–445 (2013).
25. Remans, R., Wood, S.A., Saha, N., Anderman, T.L., DeFries, R.S., Measuring nutritional diversity of national food supplies. *Global Food Secur*. **3:** 174–82 (2014).
26. Ridgway, E.M., Lawrence, M.A., Woods, J., Integrating environmental sustainability considerations into food and nutrition policies: insights from Australia's National Food Plan. *Front Nutr.* **2:** 29 (2015).
27. Sun, J., Xiao, Z., Lin, L. Z.,Lester, G.E.,Wang, Q. and Harnly, J.M., Profiling polyphenols in five Brassica species microgreens by UHPLC-PDA ESI/HRMS^n. *J Agri Food Chem.* **61:** 10960-70 (2013).
28. Sun, J., Kou, L., Geng, P., Huang, H., Yang, T., Luo, Y., and Chen, P., Metabolomic Assessment Reveals an Elevated Level of Glucosinolate Content in $CaCl_2$ Treated Broccoli Microgreens. *J Agri Food Chem.* **63:** 1863-68 (2015).
29. Treadwell, D., Hochmuth, R., Landrum, L., Laughlin, W., Microgreens: A New Specialty Crop. University of Florida IFAS Extension HS1164, 2010
30. WHO (2015) Global prevalence of vitamin A deficiency in populations at risk 1995–2005. WHO Global Database on Vitamin A Deficiency. Geneva: World Health Organization (2015).
31. Xiao, Z., Codling, E.E., Luo, Y., Nou, X., Lester, G.E. and Wang, Q., Microgreens of brassicaceae: mineral composition and content of 30 varieties. *J Food Compos Anal.* **49:** 87-93 (2016).
32. Xiao, Z., Lester, G.E., Luo, Y. and Wang, Q., Assessment of vitamin and carotenoid concentrations of emerging food products: edible microgreens. *J Agri Food Chem.* **60:** 7644–51 (2012).
33. Xiao, Z., Lester, G.E., Luo, Y., Xie, Z., Yu, L. and Wang, Q., Effect of light exposure on sensorial quality, concentration of bioactive compounds and antioxidant capacity of radish microgreens during low temperature storage. *Food Chem.* **151:** 472–79 (2014).
34. Xiao, Z., Lester, G.E., Park, E., Saftner, R.A., Luo, Y. and Wang, Q., Evaluation and correlation of sensory attributes and chemical compositions of emerging fresh produce: Microgreens. *Postharvest Bio Tech.* **110:** 140–48 (2015).