Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2021; 10(1): 2226-2228
Received: 19-11-2020
Accepted: 22-12-2020

Kusumitha VN
Department of Vegetable Science, Horticultural College and Research Institute, Tamil Nadu, Agricultural University, Coimbatore, Tamil Nadu, India

V Rajasree
Associate Professor (Horticulture), Department of Vegetable Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

R Swarnapriya
Professor and Head (Horticulture), Department of Vegetable Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

D Uma
Professor and Head (Plant Biochemistry), Department of Plant Biochemistry, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

P Meenakshi
Assistant Professor (Plant Biochemistry), Department of Plant Biochemistry, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Corresponding Author:
V Rajasree
Associate Professor (Horticulture), Department of Vegetable Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Nutrient availability of selected leafy vegetables at micro green stage grown in vertical gardening

Kusumitha VN, V Rajasree, R Swarnapriya, D Uma and P Meenakshi

DOI: https://doi.org/10.22271/phyto.2021.v10.i1ae.13686

Abstract
Nutritional composition of some selected leafy vegetables grown in vertical gardening namely *Anethum graveolens* (Dill), *Trigonella foenum-graecum* (Fenugreek), Amaranth spp (Green Amaranth), *Amaranth cruentus* (Red Amaranth) and *Spinacia oleracea* (Spinach) at their micro green stage were analyzed. The Vitamin C content of the samples ranged from 14.66 to 80mg/100g, Vitamin A was in the range of 0.63-0.66µg/g and Total Carotenoid content varied from 13.67-24.93mg/100g whereas Beta carotene was present in between 2.25-11.94mg/100g. Mineral element analysis showed that the micro greens had moderate level of Calcium (48.60mg/100g-81.50mg/100g), appreciable amount of Iron content in the range of 1.19-4.10mg/100g and little amount of Phosphorous (0.018-0.060%). Carbohydrate content was present in the range of 1.06 and 2.63 g/100g, Protein presence among selected micro green showed variation between 1.26-3.1g/100g. Crude fibre content varied between 14.2-27.88% whereas total phenols was showing difference in values between 58.32- 84.74mg/100g. These results revealed that micro greens contain moderate amount of nutritional composition and can be included in daily diet to meet individuals RDA needed by the body.

Keywords: Micro green, leafy vegetables, vitamins, minerals, protein, carbohydrate

Introduction
Micro greens are the leafy greens which are harvested just after the appearance of 2-3 true leaves, having a length of 2-4 cm and are harvested including stem and leaf. But micro greens are entirely different from the sprouts. Average time duration for harvesting micro greens ranges between 10-14 days.

For urban dwellers sprouts and micro greens are very easy to grow and they can maintain the plants as a hobby during their free time in available vertical space at their home by using method of vertical gardening where land is a limiting factor. Due to their short life cycle micro greens can be grown easily without soil and also any other pesticides and fertilizers. Various vegetable seeds can be used to grow edible young micro greens. Micro greens are majorly used in fine dining restaurants for their visual and flavour component. Micro greens will be colourful; hence they can be used in garnishing of their dishes by chefs and also to enhance unique favours, vivid colours and tender textures. Therefore, micro greens can be added as a new ingredient in various dishes like salad, soups, and sandwiches, to enhance flavour, textures and colour.

History of micro greens dates back to 1980's in San Francisco. It is written that micro greens were growing since mid-90's in Southern California. Only few varieties like arugula, basil, beets, cilantro and kale were available in early days. These micro greens can also be mixed together in a combination to make dishes.

Even though, micro greens are trending to be nutritionally beneficial vegetable to the best our knowledge, scientific data are very less as findings in this area are still in lime light. The objective of present study is to assess the vitamin, minerals, carbohydrates and protein content of selected leafy vegetables namely, Dill, Fenugreek, Red Amaranth, Green Amaranth and Spinach at micro green stage.

Materials and Methods
The current research work was performed at Department of Vegetable Science, Horticulture College and Research Institute, TNAU, Coimbatore during December month of academic year 2019-2020

Planting materials
The following leafy vegetable seeds were collected from the local farmers and plants after growing were used for the experiments: Dill, Fenugreek, Red Amaranth, Green Amaranth

and Spinach. Seeds were then placed 1.5 to 2 cm deep in pots containing coco peat, vermicompost and soil in the ratio of 9:2:1. Containers were placed vertically by hanging to the side walls by following method of vertical farming. The seedling were watered carefully daily by using spray bottle. Plants samples were harvested in four replicates at 14 days after planting for nutritional analysis.

Nutritional analysis

Estimation of minerals was done by following method of tri acid extraction of minerals. Phosphorous was done as per the procedure mentioned by Piper (1966) [12]. Calcium and Iron was estimated by following method suggested by Jackson (1973) [6]. Protein estimation was done by following methodologies developed by Lowry *et al*. (1951) [8]. Total Carbohydrate content was found out by referring works of Hedge *et al*. (1962) [5]. Total phenols, Total carotenoids, β carotene and vitamin C experiment was carried according to methodologies mentioned by Sadashivam and Manickam (1996) [14]. Crude fibre was estimated according to Sadashivam and Manickam (1996) [14].

Statistical analysis

Recorded data were stastically analysed by using Completely Randomized Design which contained five treatments and four replications. Values were represented as Mean only and data were analysed using AGRES software.

Result and Discussion

Mean value for mineral contents of studied leafy vegetables are presented in Table 1. Green Amaranth micro green contained highest calcium content (81.50mg/100g) while spinach micro green (48.60mg/100g) contained lowest amount. The micro greens analyzed in this study contained appreciable amounts of iron which varied from 1.19mg/100g to 4.10mg/100g, Green Amaranth micro green being highest in iron content followed by dill micro green and lowest iron content is present in fenugreek micro green and phosphorous which ranged from 0.018%-0.060% with green amaranth being the micro green with highest value among studied micro greens.

The results of the vitamin content of selected leafy vegetables are shown in Table 2.

Vitamin A content in selected leafy vegetables at micro green stage ranged from 0.63*µg*/g in *Spinacia oleracia* to 0.66µg/g in Anethum graveolens. Vitamin A is important for normal vision. Vitamin A also plays an important role in gene expression and growth and immune function by its maintenance of epithilial cell functions (Lukaski, 2004) [9]. Dill, Fenugreek and Red Amaranth micro green had 0.66µg/g of Vitamin A whereas Green amaranth and Spinach showed 0.63µg/g of Vitamin A content. The micro green stage of dill had (46mg/100g) the highest content of Vitamin C content whereas the least Vitamin C content was in fenugreek (14.66mg/100g) among the leafy vegetables investigated at micro green stage (Table 2). Vitamin C stands as an important and essential vitamin for human body as it has an important health benefits like anti carcinogenic, anti-aetherogenic and antioxidant. As mentioned by Frei and Traber (2001) [4] RDA for adults are 90 mg of Ascorbic acid/day for men and 75mg for women. Ebert *et al*. (2014) [3] studied that there was a substantial increase in vitamin C content from amaranth sprouts to micro greens (2.7-fold) and from amaranth micro greens to fully grown leafy amaranth (2.9-fold).

Total carotenoid and beta carotene were analyzed because beta carotene is the precursor of vitamin A (Ahamad *et al*., 2007) [2]. The beta carotene content varied from trace amount 2.25 mg/100g in Red Amaranth to 11.94mg/100g in fenugreek (Table 2). Total carotenoid content was in the range of 13.67mg/100g (Red Amaranth) and 24.93mg/100g (Fenugreek) (Table 2). In concurrence to Ahamad *et al*. (2007) [2] matured *Spinacia oleracea* contains 9.94 mg/100g of beta carotene whereas micro green stage of spinach contains 2.93 mg/100g of beta carotene.

Carbohydrates are produced by photosynthesis in plants are well known for its role as source of energy, As well as in animals carbohydrate is an important source for growth, movement and metabolism. They store energy in the form of starch. Carbohydrate content of all five micro greens were 1.06g/100g, 1.72g/100g, 1.89g/100g, 2.04g/100g, 2.63g/100g in Green Amaranth, Spinach, Dill, Red Amaranth and Fenugreek respectively as showing Table 3. Approximately 60% of daily intake should comprise carbohydrate (IFA, 2000). Adelanwa *et al*., (2015) [1] mentioned that 8 weeks cabbage showed the highest carbohydrate content compared with 12 weeks old cabbage plant. In this study, Carbohydrate content was highest in fenugreek micro green.

Protein forms the important part of our diet. Based on short-term nitrogen balance studies, RDA of protein for healthy adult is 0.8g protein/kg body weight per day as said by Wu and function (2016). The highest protein content is present in Dill micro green followed by Fenugreek, Red Amaranth, Spinach and Green Amaranth (Table 3). Ebert *et al*. (2014) [3] indicated that most of the leafy vegetables are good source of proteins and minerals. S. grandiflora, D. Volubilis and A. sessilis showed presence of higher amount of protein and carbohydrate content among the leafy vegetables they studied. Among 25 types of micro greens assessed by Xiao *et al*. (2012) [16] garnet amaranth micro greens showed a relatively high dry weight percentage of 9.3.

Phenolic compounds are diverse group of secondary metabolites and shows difference in distribution across and within plant species (Robards *et al*., 1999) [13]. In present study phenol content ranges between 58.32mg/100g (Spinach) and 84.74mg/100g (Red Amaranth) as mentioned in Table 3.

Crude fibre consists largely of cellulose (60-80%) and lignin (4-6%) plus some mineral matter (Madhu *et al*., 2017) [10]. Adding to this leafy vegetables with highest level of crude fibre (12.11 to 33%) could be useful for their active role in the regulation of intestinal transit, increasing dietary bulk due to their ability to absorb water (Jenkins *et al*., 1986) [7]. In present study micro green stages of all five leafy vegetables were showing high values where Red Amaranth micro green being the best one with the highest crude fibre content (27.88 %) (Table 3). Green Amaranth micro green showed 23% which is higher than the Amaranthus digitata in research conducted by Patricia *et al*. (2014) [11].

This study has shown that micro greens included in this study have an appreciable content of vitamins, minerals and other nutrients. This result suggests that micro greens if consumed in sufficient amount would contribute to human nutritional requirement for normal growth and immunity against disorders arising from malnutrition. Micro greens are perfect when time and space becomes a barrier. Growing micro greens in vertical gardening is the best idea as it won't consume much of our time and space and also micro greens are extremely easy to grow. Micro greens are the super healthy foods as they do not include any chemical spraying activities during their growth.

Table 1: Mean calcium, phosphorous and iron content of five commercially grown micro greens

Micro green name	Calcium (mg/100g)	Iron (mg/100g)	Phosphorous (%)
Dill	52.15	3.98	0.022
Fenugreek	60.85	1.19	0.033
Green amaranth	81.50	4.10	0.060
Red amaranth	69.33	1.42	0.018
Spinach	48.60	2.89	0.046
CD	1.266	0.102	0.001
SE(d)	0.589	0.047	0.000

Table 2: Mean vitamin a, vitamin c, total carotenoids and β carotene content of five commercially grown micro greens

Micro green name	Vitamin A (µg/g)	Vitamin C (mg/100g)	Total carotenoid (mg/100g)	β carotene (mg/100g)
Dill	0.66	46.00	15.43	3.35
Fenugreek	0.66	14.66	24.93	11.94
Green amaranth	0.63	23.33	15.16	2.43
Red amaranth	0.66	18.67	13.67	2.25
Spinach	0.63	80.00	18.25	2.93
CD	0.019	1.18	0.432	0.18
SE (d)	0.009	0.55	0.201	0.08

Table 3: Mean carbohydrate, protein, total phenol and crude fibre content of five commercially grown micro greens

Micro green name	Carbohydrate (g/100g)	Protein (g/100g)	Total phenol (mg/100g)	Crude fibre (%)
Dill	1.89	3.10	60.73	20.11
Fenugreek	2.63	2.89	65.53	18.50
Green amaranth	1.06	1.26	77.53	23.00
red amaranth	2.04	1.55	84.74	27.88
Spinach	1.72	1.37	58.32	14.20
CD	1.416	0.042	2.199	0.701
SE (d)	0.677	0.019	1.022	0.326

Reference

1. Adelanwa, Esther, M Medugu. Variation in the nutrient composition of red and green cabbage (*Brassica oleracea*) with respect to age at harvest. Journal of Applied Agricultural Research 2015;7:183-189.
2. Ahamad MN, Saleemullah M, Shah HU, Khalil IA, AJS Saljoqi JoA. Determination of beta carotene content in fresh vegetables using high performance liquid chromatography 2007;23(3):767.
3. Ebert A, Wu T, Yang R. Amaranth sprouts and microgreens– a homestead vegetable production option to enhance food and nutrition security in the rural-urban continuum. Proceedings of the Regional Symposium on Sustaining Small-Scale Vegetable Production and Marketing Systems for Food and Nutrition Security (SEAVEG), Bangkok, Thailand 2014.
4. Frei B, MGJRr, Traber. The new US Dietary Reference Intakes for vitamins C and E 2001;6(1):5-9.
5. Hedge J, Hofreiter B, Whistler RJAP. New York. Carbohydrate chemistry 1962.
6. Jackson MJL, New Delhi. Soil Chemical Analysis, Wisconsin Prentice Hall of India Pvt 1973;46:128.
7. Jenkins DJ, Jenkins AL, Wolever T, Rao A, Thompson LUJAJoG. Fiber and starchy foods: gut function and implications in disease 1986;81(10).
8. Lowry OH, Rosebrough NJ, Farr AL, Randall RJJobc. Protein measurement with the Folin phenol reagent 1951;193:265-275.
9. Lukaski HCJN. Vitamin and mineral status: effects on physical performance 2004;20(7-8):632-644.
10. Madhu C, Krishna KM, Reddy KR, Lakshmi PJ, EJIJPR, Kelari HS. Estimation of crude fibre content from natural food stuffs and its laxative activity induced in rats 2017;5(3):1703-1706.
11. Patricia O, Zoue L, Megnanou RM, Doue R, Niamke SJESJ. Proximate composition and nutritive value of leafy vegetables consumed in Northern Cote d'Ivoire 2014;10:6.
12. Piper CJPBAE. Soil and plant analysis, Hans 1966, P368-374.
13. Robards K, Prenzler PD, Tucker G, Swatsitang P, Glover WJFC. Phenolic compounds and their role in oxidative processes in fruits 1999;66(4):401-436.
14. Sadashivam S, Manickam A. Biochemical methods. India 1996;2.
15. Wu GJF. Function. Dietary protein intake and human health 2016;7(3):1251-1265.
16. Xiao Z, Lester GE, Luo Y, Wang QJJOA, Chemistry F. Assessment of vitamin and carotenoid concentrations of emerging food products: edible micro greens 2012;60(31):7644-7651.