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Nutritional Profiling of Microgreens

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ABSTRACT: As population grows at an unprecedented rate, food system must be revised to provide adequate nutrition while minimizing environmental impacts. Current malnutrition statistics high and one needs attention is mineral malnutrition like iron. So the inclusion of nutrient and mineral dense microgreens in the diet will help to prevent diseases like anemia. However, the use of microgreens is increasing due to increased consumer demand for healthier food products. This study was carried out for nutritional profiling of microgreens such as wheatgrass (*Triticum aestivum* L.*)* and basil (*Ocimum tenuiflorum*) on a dry weight basis. Both wheatgrass and basil were grown in trays and harvested between the 8th and 21st days respectively subjected to shade drying and made into powders. These micogreen samples were examined for proximate composition, minerals and antioxidant properties. The Moisture, ash, protein, fat, crude fiber, carbohydrate, energy, iron, calcium, zinc, vitamin C, TPC, TFC, and TAA were 6.753% and 7.42%, 8.4% and 2.92%, 20.20g and 4.69g, 0.27g and 1.16g, 8.21g and 6.14g, 45.07g and 35.29g, 203.1 kcal and 179.6kcal, 62.42mg and 89.8mg, 660.2mg and 200.2 mg, 4.16 mg and 7.1mg, 18.82 mg and 0.80 mg, 8.53 and 9.10 mg GAE/g, 4.09 and 6.81 mg QE/g, 0.74 and 0.98 mg DPPH/g respectively for wheatgrass and basil microgreens.

Keywords: Microgreens, Wheatgrass, Basil, Nutritional profile, Health food.

INTRODUCTION

Globally, the number of undernourished people has been increasing since 2014, reaching 821 million in 2017, with Asia having the highest number (515 million people) (FAO, 2018). In the past two decades, the definition of malnutrition has evolved to include "hidden hunger", caused by a lack of vitamins and minerals (Allen, 2003; WHO, 2004). One of the most viable, cost-effective and sustainable approaches advocated by the FAO to improve the nutritional quality of diet is the food-based approach (Thompson and Amoroso 2014).

In Recent studies have demonstrated that green leafy vegetables (GLVs) are effective natural supplements of iron and beta-carotene, and GLV-based meals may contain more bioavailable levels of micronutrients than cereal-legume meals alone. As an innovative culinary ingredient, micro greens, which are miniature versions of green leafy vegetables, have gained popularity in the past decade (Treadwell *et al.* 2010); Xio *et al.* (2012). Microgreens are defined as tender, immature grains produced from the seeds of the vegetables and herbs having fully developed cotyledons with or without the emergence of a rudimentary pair of first true leaves, approximately 1-3 inches tall (Xiao *et al.*, 2012). These are gaining interest as potential functional foods due to their relevant contents of micronutrients and bioactive compounds (Srinithya *et al.*, 2021).

The popularity of Microgreens has increased over the last two decades due to growing awareness of its nutritional value and health-promoting activities. However, Studies on the nutritional composition of microgreens are very limited. It is therefore essential to evaluate their nutritional quality and contribution to daily diets. Hence, in the present study two culinary microgreens named wheat grass (*Triticum aestivum* L) and Basil (*Ocimum tenuiflorum*) were selected to evaluate the nutritional composition.

Most people in the world consume wheat (*Triticum aestivum* L.) as their staple food. Wheat grains contain nutrients and phytochemicals with health-promoting properties (Zhu and Sang 2017). In wheat, sprouting and germination increase vitamin, mineral, phenolic compound, and antioxidant levels (Fortuna *et al.*, 2018). In addition to its rich nutrition, wheatgrass is also loaded with elements such as vitamins (A, B, C, and E), minerals, flavonoids, phenolics, chlorophylls, and enzymes that have therapeutic potential (Kulkarni *et al.*, 2006) Wheatgrass is mainly used to make juice, which is consumed raw or dried into a powder.

Basil (*Ocimum tenuiflorum*) is one of the oldest herbs or spices and is well known for its medicinal value. It is a rich source of essential oils and has been used in confectionaries, condiments, sausages, and salad dressings. Basil reported having antiallergic, anticancer, antimicrobial, antiseptic, anti-inflammatory, and antiseptic (Suppakul *et al.*, 2003) properties. Natural antioxidants in basil help to prevent the consequences of oxidative damage.

MATERIALS AND METHODS

Procurement of Raw materials: Sharbat wheat (*Triticum aestivum* L) and Holy basil (*Ocimum tenuiflorum*) seeds were procured from local markets in Hyderabad. All The technical grade chemicals were procured from standard suppliers. The equipment available at PGRC and CIC, PJTSAU, Rajendranagar, and Hyderabad

Microgreen Cultivation:

Wheatgrass microgreen: 100g of wheat seeds were washed with distilled water and soaked for 12 hours. The soaked grains were tied in the muslin cloth and kept for sprouting up to 48 hours. The sprouted seeds were sown in a plastic tray containing soil and cocopeat mixture (2:1). Watering was done twice a day throughout the growth period and the tray was kept under natural sunlight (1-2 hours). The wheatgrass microgreen was harvested on the 8^{th} day of germination after it reached 7.5cms in height(3inches).

Basil microgreen: The tray was filled with a moistened mixture of soil and cocopeat (2:1). a quantity of 100g of Basil seeds was placed in a tray containing soil, watering was done thrice a day without hurting the seeds. The tray was kept in sunlight (4-5h) to provide warmness to ensure the proper germination. The microgreens were harvested on the 21^{st} day of germination after they reached 7.5cms of height (3 inches).

Proximate composition: Moisture, protein, fat, ash (AOAC, 2005), crude fiber (AOAC, 1995), Carbohydrate, and energy (AOAC, 1980).

The proximate composition includes, Moisture content (MC) was determined by oven drying at 105 °C, and Protein content (PC) was measured by Kjeldahl method (N × 6.25) and results were expressed as g/100g. Fat content (FC) by using a soxtherm extraction unit. Ash content (AC) was analyzed by burning organic matter in a muffle furnace at 550°C-600°C. Crude fiber content of samples was determined by boiling with 1.25% dilute H_2SO_4 washed with water, followed by boiling with 1.25% dilute NaOH and again washed with water. The remaining residue after digestion was taken as crude fiber. Carbohydrate content was computed by subtracting the total of moisture, protein, fat, ash, and crude fiber from 100. Energy content was computed by multiplying protein, fat, and carbohydrate values obtained from analysis by 4, 9, and 4 and expressed as Kcal/100g.

Mineral composition:

Sample preparation: 1.0g of each microgreen sample was added to the di-acid mixture containing HNO_3 and $HClO_4$ in a 9:4 ratio respectively for wet digestion. The mixtures were placed on a hot plate until all the fumes disappeared and the solution becomes clear and colorless. To this solution, 10-12 ml of distilled water was added and it was filtered using Whatman no. 1 filter paper to 50 ml volumetric flask, and volume makeup was done up to the mark (AOAC, 2012). The aliquot thus prepared was stored for estimation of minerals like Calcium (Ca), Iron (Fe), and zinc (Zn).

Ascorbic acid content: In a 100 ml conical flask, 5 ml of standard ascorbic acid solution was taken and 5 ml of 3 percent metaphosphoric acid was added. The dye solution was filled in a burette and the standard ascorbic acid solution was titrated. The endpoint was a pink color which persisted for about 10 seconds (AOAC, 2012).

Total phenol content (TPC) (Li *et al.* 2015). The known aliquot of the sample was made up to 1.5 ml with distilled water. Then added 0.5 ml of Folin-ciocalteu reagent and 10 ml of sodium carbonate and incubated at 37° for 1 hour and read the absorbance at 750 nm.

Total Flavanoid content (TFC). TFC of samples was analyzed by Zhishen *et al.* (1999). Taken known aliquot of sample and made volume up to 5 ml with distilled water. Then added 0.3 ml of 5% $NaNO_2$. After 5 min 3 ml of AlCl3 was added and after 6 minutes 2 ml of NaOH was added. The final volume was made up of 10 ml of distilled water. The solution was mixed well and the absorbance was measured against a blank at 510 nm with a spectrophotometer.

Total antioxidant activity by DPPH. TAA of microgreen sample was estimated by using DPPH (1,1-Diphenyl-2-picrylhydrazyl) free radical scavenging assay as described by (Dorman *et al.* 2004; *Tadhani et al.* 2007). Taken different concentrations of sample aliquot and made volume up to 1 ml with methanol. Added 3 ml of DPPH reagent to it and mixed the contents properly and incubated for 20 minutes at 37°

C. Read the absorbance of the resulting oxidized solution at 517 nm against methanol as blank.

RESULTS AND DISCUSSION

Proximate composition. Proximates composition per 100g in dried wheatgrass was found moisture(6.75%), protein (20.2g), fat (0.27g), ash (8.4%), crude fiber (8.21g), carbohydrate (45.07g), and energy (203.1kcal) which are in tune with the Kaur *et al.* (2021). The proximate composition of dried basil microgreens was moisture (7.42±0.005), protein (4.69±0.27), fat (1.16±0.5), ash (2.92±0.06%), crude fiber (6.14±0.02g), carbohydrate (35.29±0.23), and energy (179.6±5.4kcal). Moisture content is considered the most important property of food samples i.e., related to shelf life. The moisture content of powdered products within the range of 3–10 % was accepted by food industries on a practical basis (Li *et al.,* 2015). The detection of the highest ash content has represented the availability of minerals that indicated the existence of necessary elements responsible for chlorophyll biosynthesis. Photosynthetic activity is directly proportional to the amount of chlorophyll content that assisted to accumulate mineral content.

Mineral composition. Fe (Iron) is determined as an important part of the electron transport chain and acts as a cofactor in various enzymes like peroxidases, cytochromes, xanthine oxidases, etc. (Satyanarayana, and Chakrapani 2008) Calcium (Ca) participated as a cofactor in enzymatic reaction such as oxidation of fatty acids and maintained mineral homeostasis (Strain and Cashman 2009). The iron, calcium, and Zinc contents in wheatgrass were 62.42±0.04mg, 660.2±0.2mg, and 4.166±0.1mg respectively similar to Kaur *et al.* (2021) The mineral content of dried basil was found to be Fe(89.8±0.15mg), Ca(380.2±0.1mg), and Zn(7.1±0.15mg). A study conducted by Thakur *et al.* (2019) found mineral content of wheatgrass in the range of 6.68mg/100g(Fe), 17.32mg/100g(Ca), and 3.3mg/100g(Zn) which was very low compared to present study might due to environmental conditions, harvesting period.

Table 1: Nutritional composition of Microgreens(per 100g).

Nutrient	Wheatgrass	Basil
Moisture	6.753±0.03	7.42±0.005
Ash	8.4±0.19	2.92±0.06
Protein	20.20±0.13	4.69±0.27
Fat	0.27±0.6	1.16±0.5
Crude fiber	8.21±0.007	6.14±0.02
Carbohydrate	45.07±0.03	35.29±0.23
Energy (kcal/g)	203.1±0.7	179.6±5.4
Iron (mg/g)	62.42±0.04	89.8±0.15
Calcium (mg/g)	**660.2**±0.2	**380.2**±0.1
Zinc (mg/g)	**4.16**±0.01	**7.1**±0.15

Ascorbic acid: Vitamin C is an essential dietary nutrient required as a co-factor for many enzymes, and humans are among the few animals that cannot synthesize the compound from glucose. Several factors regulate vitamin concentrations in body tissues and fluids, including intestinal absorption, cellular transport, and excretion. According to population studies, individuals who consume high levels of vitamin C have a lower risk of chronic diseases such as heart disease, cancer, eye disease, and neurodegenerative diseases (Jacob and Sotoudeh 2002). Almost all drying methods significantly result in the loss of Vitamin C because vitamin C is highly pronetooxidative destruction in the presence of heat, light, enzymes, oxygen, moisture, and metal ions (Vyankatrao, 2014).

Vitamin C contents of wheatgrass and basil microgreens were 18.82±0.23 and 0.8±0.0mg/100g respectively. These findings on wheatgrass and basil are similar to the results reported by Niroula *et al.* (2021).

Total phenolic content: TPC levels in wheatgrass and basil were 8.53±0.21mg GAE/g and 9.10±0.86mg GAE/g respectively. Akbas *et al.* (2017) found lower TPC levels in their investigation *i.e.*, 6.73mg GAE/g these differences may be due to wheat genotypes, harvesting periods, and environmental conditions. Foods having high TPC levels were found to have high antioxidant levels (Benincasa *et al.* 2015).

Total Flavonoid Content: Flavonoids have gained recent attention due to their broad biological and pharmacological activities. Flavonoids have been reported to exert multiple biological properties including antimicrobial, cytotoxicity, anti-inflammatory as well as antitumor activities but the best-described property of almost every group of flavonoids is their capacity to act as powerful antioxidants which can protect the human body from free radicals and reactive oxygen species (Tapas *et al.* 2018). The total flavonoid content in wheatgrass was found 4.09±0.33 mg QE/g whereas in basil 6.81±0.36 mg QE/g which is closely related to the findings reported by Tandon *et al.* (2011). Pandey *et al.* (2014) stated that basil is the richest source of total flavonoids.

Total Antioxidant activity by DPPH: The term "antioxidant" refers to substances that delay, control, or inhibit oxidation and the degradation of food quality when they are present in food.Plants may possess antioxidant properties due to their phenolic compounds (Cook and Samman 1996). Several chronic and degenerative diseases, including atherosclerosis, cardiac and cerebral ischemia, cancer, neurodegenerative disorders, diabetic pregnancy, rheumatoid arthritis, and DNA damage, can be prevented and treated using natural antioxidants (Doughari *et al.*, 2009).

Antioxidant activity of wheatgrass was found 0.74±0.04mg/ml whereas in basil 0.98±0.51mg/ml. Akbas *et al.* (2017) in their study reported that wheatgrass has the highest antioxidant activity content i.e., 0.67mg DPPH/g which is similar to the present study. Moreover, Basil is a good source of free radical scavenging compounds that have their traditional medical applications, which may be successful for future modern medical applications as well.

Table 2: Antioxidant properties of Microgreens.

Nutrient	Wheatgrass	Basil
Vitamin C (mg/g)	**18.82**±0.23	0.80±0.0
TPC (mg GAE/g)	8.53±0.21	9.10±0.86
TFC (mg QE/g)	4.09±0.33	6.81±0.36
TAA (mg DPPH/g)	0.74±0.04	0.98±0.51

CONCLUSION

Microgreens are gaining popularity in the market due to a change in lifestyle patterns and health consciousness among consumers today. The antioxidants, vitamins, and minerals in microgreens promote good health. Microgreens have more nutrients compared to GLV. Microgreens such as wheatgrass and basil were found to be the most nutrient-dense. Nutritional profiling of microgreens reported in this study would be helpful to guide consumers in their dietary choices. The information from this study can be used by Food engineers, Food processors, and Food scientists. As microgreens become more popular on supermarket shelves, it would also assist producers in promoting nutrient-dense microgreens.

FUTURE SCOPE

There is a great demand for microgreens in the market due to their high nutritional profile. The future development will complement the great advances from previous years in understanding microgreen production and consumption. Due to increasing consumer demand, the microgreen industry is a growing field with good research prospects. In addition to quality parameters, nutritional loss in different drying methods, physical, functional information of microgreens will help the consumers in a better way.

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Conflict of Interest. Nil.

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