

Formulation and Sensory Evaluation of Fenugreek and Horse Gram Microgreens incorporated Value-added Products

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ABSTRACT: Microgreens are a popular food item right now because of their rich phytonutrient content and as a flavouring agent and garnishing and a rich source of phytonutrients. They can enhance food and nutritional security and conserve and improve biodiversity and environmental sustainability, either directly or indirectly. More than 150 plants have been designated as GRAS by the FDA, with no consumption restrictions. The nutrient content, antioxidant DPPH assay, and phytochemical screening of two microgreens namely fenugreek and horse gram were investigated. The current research revealed that a natural source of micronutrients and antioxidants against a variety of oxidative stress-related disorders can be found in microgreens. The findings of the present study revealed that fenugreek, and horse gram microgreens are potential sources of natural antioxidants. The biggest challenge in today's world is maintaining food of excellent quality. In the present research, ready-to-serve instant soup mix, instant chutney powders, and health mix were prepared using fenugreek and horse gram microgreen powders. All new value-added items went through sensory analysis. Due to their high nutrient content, microgreens can enhance the dietary value of humans. To prevent the occurrence of numerous deficiencies that are common in today's populations, using these nutrient-rich microgreens can be a viable alternative.

Keywords: Microgreens, Fenugreek, Horse gram, Instant mixes, and Sensory evaluation.

INTRODUCTION

The largest producer, consumer, and exporter of seed spices worldwide is India. Fenugreek, also known as methi or *Trigonella foenum-graecum* L., is a versatile crop that is grown in northern India throughout the cold season. It is an annual herb that is a member of the *Fabaceae* family and *Papilliaaceae* subfamily. It is a significant key seed spice in the nation (Husain *et al.*, 2022).

Horse gram (*Macrotyloma uniflorum*) is a leguminous plant that is mostly planted in tropical Africa and Southeast Asia. It is a largely unknown crop. It has a wide range of beneficial characteristics and can be employed in a wide range of culinary applications. The term "Macrotyloma" comes from the Greek words "makros" for large, "tylos" for knob, and "loma" for margin; it refers to the knobby statures on the pods. Horse gram, on the other hand, is indigenous to the southern part of India. The main producers of the crop are India, Malaysia, Myanmar, Nepal, Mauritius, and Sri Lanka. In Australia and Africa, it is grown as a fodder crop. Despite their important contribution to the food of the Indian populace, particularly in South India,

it is seen as a "poor man's meal" (Senthilkumar *et al.*, 2022).

People are becoming more familiar with and interested in microgreens as healthy eating options. Microgreens have a powerful potential to greatly reduce health issues. Following the sprouting of numerous vegetables, herbs, and grains, these are the young, immature greens and the edible seedlings since they protect against various lifestyle diseases, microgreens are highly valued as nutraceuticals. For example, broccoli sprouts and microgreens are more abundant in a range of bioactive components, have a better antioxidant capacity, and have higher anti-inflammatory and anticancer effects than their mature counter-adult plants (Dhaka *et al.*, 2023).

Microgreens are tiny, immature seedlings of common vegetables that are highly nutritious and flavored intensely. According to a recent study from the University of Maryland, the number of vitamins such as vitamin C, E, K, beta-carotene, and lutein in microgreens is typically 4 to 40% greater than in matured greens.

Microgreens, also known as vegetable confetti, are a new category of fresh functional foods that have

enormous potential to improve the human diet. Due to their powerful phytochemical content and flexibility to both localized small-scale cultivation and large-scale commercial production, it plays a part in correcting nutritional deficiencies. These are abundant in phytonutrients like Fe, Mn, Zn, Se, and Mo (Pinto *et al.*, 2015) carotenoids like β -carotene, lutein/zeaxanthin, neoxanthin, and violaxanthin (Brazaityte *et al.*, 2015; Samuoliene *et al.*, 2017). In terms of phenolic chemicals, they are abundant sources (Kyriacou *et al.*, 2016).

Even though the life cycle of microgreens is quite short, growing them is a relatively simple procedure, and as a result, some precautions are taken to enhance seed germination. They are carried out to identify a quicker stabilization and to encourage strong seedlings. Additionally, it is done to reduce greenhouse production, and consequently, production costs (Abraham and Vijayan 2022).

Trigonella foenum-graecum, a legume, has been used as a spice to improve the sensory appeal of meals all over the world. It is well-known for its therapeutic properties, including anti-diabetic, anti-carcinogenic, hypocholesterolemic, antioxidative, and immunological activity. In addition to its therapeutic significance, it is utilized as a food stabilizer, adhesive, and emulsifying agent in the manufacture of numerous food products. More notably, it is employed in the creation of wholesome and nourishing extruded baked goods (Wani and Kumar 2018).

An underutilized and undiscovered edible legume is horse gram, also known as *Dolichos biflorus* (*Macrotyloma uniflorum* Lam. (Verdc.)). It is regarded as a reliable source of energy, carbohydrates, and protein. Horse Gram has a similar nutritional value to other pulse crops. In addition to serving as a traditional source of proteins and carbohydrates, horse gram also exhibits high levels of antioxidant and radical-scavenging activity. It has a wealth of different naturally occurring beneficial compounds, including phytic acid, fibre, and phenolic acid. These bioactive compounds offer great potential for treating a wide range of illnesses, including leukemia, the common cold, bronchitis, asthma, urinary stones, and fever and throat infections. BBIs, or proteinase inhibitors, are used to treat autoimmune and degenerative disorders, obesity, and anti-inflammatory conditions (Prasad, S. K and Singh, M. K., 2015). Hence the present study is undertaken with the objective to study the formulation and standardization of microgreens incorporated value-added products and sensory evaluation of microgreens incorporated value-added products.

MATERIALS AND METHODS

Selection and Cultivation of Microgreens: The seeds of fenugreek and horse gram were purchased from the Tamil Nadu Agricultural University Coimbatore. The seeds are weighed and cultivated on agricultural land which was situated in Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore. Fenugreek and horse gram microgreens require 7-10 days of time period to grows 7-10 cm

height. It takes a lesser time period of harvesting compared to other types of microgreens. The overall size of the microgreens is between 7 to 10 cm in 8 days in length. Harvested microgreens are shade dried for 7-10 days and made into fine powder for further analysis.

Extraction of microgreens: The microgreens powder is extracted using an aqueous medium in the following proportion of 3 grams of microgreens powder, added 120 ml of distilled water for 20 minutes at 20°C to 30°C in a water bath. The solution was chilled to 4°C and filtered using Whatman filter paper. The aqueous extraction of coriander and fennel powder is tested for qualitative analysis of phytochemical screening and quantitative analysis of antioxidants by DPPH assay.

Qualitative Analysis of Phytonutrients of Fenugreek and Horse Gram Microgreens: Alkaloids, flavonoids, sterols, terpenoids, anthraquinone, anthocyanin, proteins, phenolic compounds, quinones, carbohydrates, tannin, saponins, phytates, cardiac glycosides, lignin, glycoside's test, coumarins, and volatile oils. A total 18 metabolites were screened using phytochemical analysis using aqueous extraction.

Quantitative analysis of antioxidant activity-DPPH assay of Fenugreek and Horse gram microgreens: The aqueous extraction of microgreens powder was tested for DPPH assay and compared with standard ascorbic acid. In this spectrophotometric antioxidant experiment, the reagent is the DPPH (2,2-diphenyl-1-picrylhydrazyl) radical.

Nutrient analysis of Fenugreek and Horse gram Microgreens: Nutrients analysis for moisture, ash, protein, fat, calcium, iron, crude fibre, carbohydrate, energy, vitamin A, and vitamin C of the fenugreek and horse gram microgreens were carried out using the standard procedure by the National Institute of Nutrition, ICMR, Hyderabad, laboratory techniques of nutrient analysis.

Preparation of raw materials for Value Addition Products:

Instant Chutney Powder. Instant chutney powders were prepared from microgreens which include fenugreek and horse gram. Ingredients like black gram dhal, Bengal gram dhal, and cumin were dry-roasted separately to develop good flavor. All the roasted ingredients, garlic, and tamarind were powdered and mixed in a blender, and salt and different proportions of each microgreens powder were added.

Table 1: Standardization of Instant Chutney Powder.

Sr. No.	Ingredients	Instant Chutney Powder (g)
1.	Bengal Gram	50
2.	Urad Dal	50
3.	Chilli	20
4.	Micro Green Powder	20

Instant Soup Mix. For instant soup powder, garlic, onion, tomato, and ginger were tray dried, pulverized, and ground. After that, the microgreens namely fenugreek and horse gram were added to the powder.

Table 2: Standardization of Instant Soup Powder.

Sr. No.	Ingredients	Instant Soup Powder (G)
1.	Onion	50
2.	Garlic	50
3.	Ginger	50
4.	Micro Green Powder	20

Health Mix Powder. Boiled rice, atta, ragi, and roasted gram were the ingredients that were used for the preparation of the health mix. In the micronutrient health mix, microgreens were added which include fenugreek and horse gram.

Sensory analysis: Sensory analysis was done by a semi-trained panel of 30 members using a 9-point hedonic scale (Meilgaard *et al.*, 1999). The formulated instant chutney powder, instant soup mix, and instant health mix using selected microgreens were compared and scores were given according to their perception.

One of the best formulations of microgreens value-added microgreens products were selected for further studies.

Table 3: Standardization of Health Mix.

Sr. No.	Ingredients	Standard Health Mix (G)
1.	Boiled rice	50
2.	Flour	50
3.	Ragi	50
4.	Roasted Gram	50
5.	Micro Green Powder	20

RESULTS AND DISCUSSION

Qualitative phytonutrient analysis of Fenugreek and Horse gram Microgreens: Table 4 shows the qualitative analysis of fenugreek and horse gram microgreens under the aqueous extraction method.

Table 4: Quantitative Phytochemical Screening of Fenugreek and Horse Gram Microgreens.

Sr. No.	Metabolites	Presence/ absence	
		Fenugreek Microgreens	Horse gram Microgreens
1.	Alkaloids	+	+
2.	Terpenoids	-	-
3.	Proteins	+	+
4.	Flavonoids	+	+
5.	Anthraquinone	+	-
6.	Carbohydrates	+	+
7.	Saponins	+	+
8.	Cardiac glycosides	-	+

+ presence of phytochemicals, - absence of phytochemicals

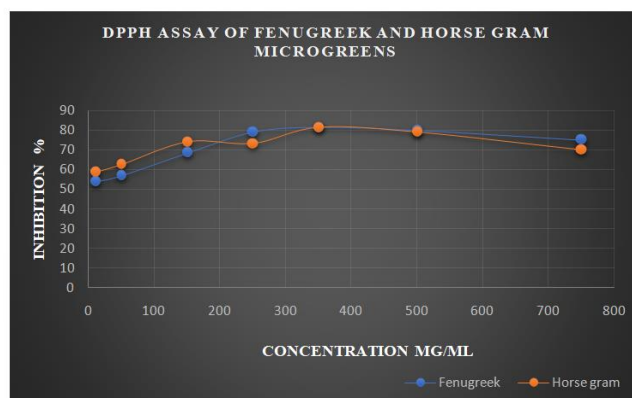
The Phytochemical screening of fenugreek and horse gram microgreens under aqueous extraction revealed the presence of alkaloids, proteins, flavonoids,

anthraquinone, carbohydrates and saponins were present in both microgreens as shown in above Table 4.

Quantitative analysis of antioxidant activity-DPPH assay of Fenugreek and Horse gram microgreens:

Table 5: DPPH Assay of Fenugreek and Horse Gram Microgreens.

Concentration (µl)	%Inhibition	
	Fenugreek	Horse Gram
10	54.10	59.02
50	57.38	63.11
150	68.85	74.59
250	79.51	73.77
350	81.97	81.97
500	80.33	79.51
750	75.41	70.49

**Fig. 1.** DPPH Assay of Fenugreek and Horse gram Microgreens.

DPPH assay results inferred that fenugreek microgreens are more effective in the concentration of 350 μ l and it showed the highest inhibition of 81.97 percent. Horse gram microgreens show 81.97 percent of inhibition in the same at 350 μ l concentration. In concentration of 500 μ l, both microgreens reveal the decline range of inhibition while comparing the concentration of 50 μ l, 150 μ l and 250 μ l shown in Table 5 and Fig. 1.

In fenugreek microgreens, the concentration has increased in 10 μ l, 50 μ l, 150 μ l, 250 μ l, 350 μ l, 500 μ l and 750 μ l it shows inhibition of 54.10 %, 57.38 %, 68.85, % 79.51 %, 81.97 %, 80.33 %, and 75.41% respectively. In horse gram microgreens the concentration has increased in 10 μ l, 50 μ l, 150 μ l, 250

μ l, 350 μ l, 500 μ l, and 750 μ l. It shows inhibition of 59.02 %, 63.11 %, 74.59 %, 73.77 %, 81.97 %, 79.51 %, and 70.49 % respectively shown in Table 5 and Fig. 1. The comparison of fenugreek and horse gram microgreens extract horse gram microgreens shows the highest inhibition rate compared to fenugreek microgreens are concluded.

Nutrient Content of Fenugreek and Horse gram Microgreens: Table 6 presents data on the analysis of nutrients such as moisture, energy, calcium, iron, ash, protein, fat, crude fiber, carbohydrate, and vitamins A and C of the cultivated fenugreek and horse gram microgreens (per 100g).

Table 6: Nutrient Content of Fenugreek and Horse Gram Microgreens.

Nutrients	Unit	Fenugreek Microgreens	Horse gram Microgreens
Moisture	%	14.60	10.25
Total Ash	%	13.69	12.42
Protein	%	36.575	22.85
Fat	%	6.27	7.75
Crude fibre	%	6.12	5.87
Carbohydrate	%	26.865	46.73
Energy	Kcal/100g	318.19	348.07
Calcium	mg/100g	296.52	239.78
Iron	mg/100g	36.81	6.9
Vitamin-A	μ gRE/100g	530	23
Vitamin-C	mg/100g	12	4.26

Sensory Evaluation: An essential factor influencing consumer acceptance of a product on the market is the sensory quality of the product. A product with better

sensory qualities is typically in more demand. Using a 9-point hedonic scale, 30 expert judges assessed the value-added products.

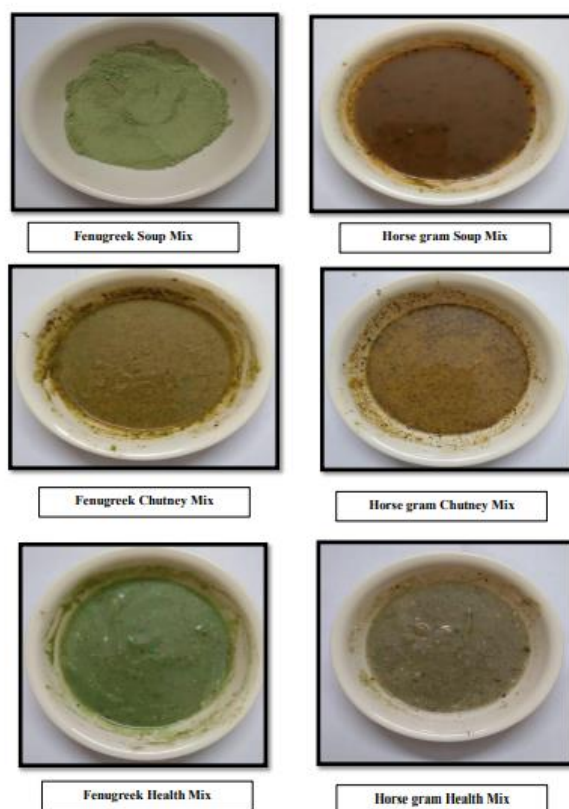


Fig. 2. Microgreens Incorporated Instant Soup Mix, Instant Chutney Powder, and Health Mix Powder.

Table 7: Sensory Evaluation of Value-Added Products using Selected Microgreens.

Particulars	Instant Soup Mix			Instant Chutney Powder			Health Mix Powder		
	Control (Mean ± Standard Deviation)	Variation I	Variation II	Control (Mean ± Standard Deviation)	Variation I	Variation II	Control (Mean ± Standard Deviation)	Variation I	Variation II
Appearance	8.97±0.18	7.80±0.41	8.33±0.55	8.40±0.56	7.53±0.63	8.97±0.18	8.97±0.18	8.33±0.55	8.67±0.48
Colour	8.97±0.18	7.90±0.31	8.33±0.55	8.43±0.50	7.53±0.63	8.87±0.34	8.97±0.18	8.33±0.55	8.67±0.48
Flavour	8.40±0.50	7.70±0.65	8.33±0.55	8.43±0.50	7.67±0.61	8.93±0.25	8.40±0.50	8.33±0.55	8.67±0.48
Texture	8.90±0.31	7.13±0.51	8.33±0.55	8.43±0.50	7.57±0.73	8.93±0.25	8.90±0.31	8.33±0.55	8.67±0.48
Taste	8.90±0.31	7.13±0.51	8.33±0.55	8.43±0.50	7.63±0.67	8.77±0.43	8.90±0.31	8.33±0.55	8.67±0.48
Overall Acceptability	8.83±0.38	7.13±0.51	8.33±0.55	8.43±0.50	7.67±0.61	8.83±0.38	8.83±0.38	8.33±0.55	8.67±0.48

Variation I- Fenugreek and Variation II- Horse gram

The overall acceptability of the value-added products namely instant soup mix which was incorporated with selected microgreens variations. Variation I is Fenugreek microgreens incorporated with instant soup mix and variation II is horse gram microgreens incorporated with instant soup mix. In this sensory evaluation, appearance, colour, flavor, texture, and taste were determined. Variation II is highly acceptable in horse gram microgreens incorporation. The mean score for overall acceptability is 8.33±0.55.

The overall acceptability of the value-added products of instant chutney powder which was incorporated with fenugreek and horse gram microgreens variations separately. Variation I is Fenugreek microgreens incorporated with instant chutney powder and variation II is horse gram microgreens incorporated with instant chutney powder. In this sensory evaluation, appearance, colour, flavor, texture, and taste were determined. Variation II is highly acceptable in horse gram microgreens incorporated instant chutney powder. The mean score for overall acceptability was 8.97 ± 0.18, 8.87 ± 0.34, 8.93 ± 0.25, 8.93 ± 0.25, 8.77 ± 0.43, and 8.83 ± 0.38 respectively.

The overall acceptability of the value-added products of health mix powder which was incorporated with fenugreek and horse gram microgreens variations separately. Variation I is Fenugreek microgreens incorporated health mix powder and variation II is horse gram microgreens incorporated health mix powder. In this sensory evaluation, appearance, colour, flavor, texture, and taste were determined. Variation II is highly acceptable in horse gram microgreens incorporation. The mean score for overall acceptability is 8.67±0.48.

CONCLUSIONS

The potential antioxidant phytochemical and nutrient content of fenugreek and horse gram microgreens have been assessed in the current study using their aqueous extracts. Microgreens and other natural sources of antioxidant compounds are excellent sources of antioxidant activity for use as natural supplements. The extract from both microgreens may have strong antioxidant properties because of the high amount of phenolic content in it. Therefore, it would be advised to combine mature leafy equivalents with micro greens to receive enough amounts of phytochemicals for a healthy diet in order to obtain the greatest benefits in

terms of dietary antioxidants. Thus, incorporation of these microgreens in food would aid or reversing several oxidative stress-related ailments and prevent the occurrence of various metabolic disorder.

In addition, the potential antioxidant benefits of medicinal plants make them valuable sources for the food business. If fenugreek and horse gram microgreens can be employed as a food preservative and an antioxidant nutraceutical, more study is needed to confirm this.

Because of their perishable nature, it can be inferred from the current study that microgreens have a very short shelf life and can be dehydrated using various methods. Following dehydration, the product can be added to a variety of ready-to-serve food additives, including instant soup mix, instant chutney powder, and health mix. Because the prepared fenugreek and horse gram microgreens were so well received, instant soup mix, rapid chutney powders, and health mix were added.

FUTURE SCOPE

The findings of this study may help in the development of food products that incorporate more microgreens. Furthermore, due to their nutritional value and health advantages, microgreens have the potential to become everyday food in the future, giving these items the opportunity to survive in the market.

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Conflict of Interest. None.

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