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Evaluation and Standardization of Greens Soup Mix: A Nutrient-Rich Convenience Food Product

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Abstract

The background of this study revolves around the cultivation, processing, and nutrient analysis of three specific green leafy vegetables: Palak (spinach), Amaranthus tristis (tropical amaranth), and Drumstick leaves. Green leafy vegetables are widely recognized for their nutritional value, being rich sources of vitamins, minerals, and antioxidants. However, the preservation of these nutrients during processing, particularly drying methods, is a critical aspect that can affect the overall nutritional quality of the vegetables. The findings reveal a rich content of key nutrients, underscoring the significance of microgreens as a valuable dietary source. This research contributes valuable insights into the nutritional composition of microgreens, emphasizing their potential role in promoting overall health and well-being.

Keywords: Nutrient analysis; Microgreens; Essential nutrients; Phenolics; Flavonoids

Introduction

Green Leafy Vegetables (GLVs) are a blessing for a safe and healthier life and have been in use for centuries. They are considered as an essential part of the diet to meet the daily nutrient requirements. GLVs can be used fresh as a salad or can be cooked/processed as per the interest of the consumer. GLVs are a rich source of nutrients, high in dietary fiber, low in lipids, and rich in folate, ascorbic acid, vitamin K, Mg, and K. GLVs are also valued for individuals with type 2 diabetes due to their high Mg content, high fiber content, and low glycemic index. The burden over synthetic chemicals can be reduced by encouraging the use of GLVs in food and food products [1].

Consumption of Traditional Leafy Vegetables (TLVs) is important for ensuring food and nutritional security. Traditional leafy vegetables are rich in both macro and micro nutritional components such as proteins, fat, minerals and vitamins, antioxidant pigments, phytochemicals and several other bioactive metabolites. It is therefore important to bio-prospect the nutritional components and antioxidant potential of the locally available leafy vegetables [2].

Due to leafy vegetable colour, flavour, vitamin content, and health advantages, vegetables occupy a special position in the diet. They offer as abundant sources of dietary fibre, iron, zinc, folate, ascorbic acid, and carotene (Peter *et al.,* 2010; Negi and Roy 2000). Numerous minerals, including iron (Fe), calcium (Ca), phosphorus (P), copper (Cu), zinc (Zn), sodium (Na), chloride (Cl) and vitamins A, C and K are present in green leafy vegetables (Gopalan *et al*., 2004).

Spinach (Spinacia oleracea L.), is a leafy vegetable that is globally eaten and economically significant. It is utilised as a natural antibacterial and preservative in the food and pharmaceutical sectors (Issazadeh*et al.*, 2017). Vitamins abound in spinach, which is especially high in the precursor to vitamin A known as carotene vitamin A, E, C, and K and also folic acid, oxalic acid (Guha and Das, 2008). Magnesium is best found and manganese, calcium, phosphorus, iron, zinc, copper and potash (Annonymus, 2004).

Amaranthus tristis Linn is a member of the Amaranthaceae family, which is the most widely grown plant in India. In Tamil, it is called as Arai-keerai. Due to their many medicinal properties, especially owing to the presence of more phytochemicals with possibl antioxidant capabilities, leafy greens make up a significant portion of the traditional diet (Khanam *et al*., 2012). It is a common edible plant that includes sterols, amino acids, betaine, amarantin, and isoamarantin (Velu *et al*., 2012).

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Moringais a very nourishing vegetable tree with a wide range of applications. Nearly every part of the tree, including the root, bark, gum, leaf, fruit (pods), flowers, seeds, and seed oil, has been used in traditional medicine to treat a variety of illnesses (Anwar *et al.,* 2007). Fresh leaves provide 400 mg of calcium and leaf powder provide 2185 mg of calcium per 100 g. For treatment of anemia, it is used as a substitute of iron tablet (Fuglie, 2005). The leaves are rich in essential amino acids, vitamins A, B, C, E and phytochemicals like flavonoids and phenolic-acids (Nouman *et al.,* 2016).

Ready to cook meals are the ideal substitute for cooked meals, and their consumption is on the rising because of working women [4]. India's eating habits and culinary techniques have seen significant change in the previous several years as a result of urbanization, cultural change, and social development (Malik *et al*., 2018).

Method and Materials

Preparation of Organic Vermicompost for the Procurement of the Sample

Leaf litter was collected from the Sadakathullah Appa College premises. For around 8-12 days, the collected leaf litters were shredded in the sun. The cow dung manure was collected and sprayed on top of the leaf litters. At the bottom of the vermi bins, a layer of 2 to 3 inches of soil is added. The sand layer was equally spread with partially decomposed cow dung, dried leaves, and other biodegradable waste collected from the college premises. Following the addition of all bio-wastes, the captured earthworm was released into the mixture and covered with dry straw.

Cultivation and Harvesting of Green Leafy Vegetables

Green leafy vegetables can be grown on any type of terrain, although red, black and smooth soils have been recognized to be the best. The cultivation area was selected at farmer's field in Kalakadu village which comes under TNIAMP II PANCHAIYARU FARMER PRODUCER COMPANY LIMITED. Three cents of the land area was chosen for cultivation and the land was divided into three different sectors equally for the greens cultivation. The authenticated seeds were sown in red soil and TNAU verified seeds. The greens were irrigated twice a day with fresh water and it was maintained hygienically for obtaining the further yield. The cultivation of the greens was done from February 2021 to May 2021, greens were grown for approximately four months under my proper supervision.

Cultivation and Harvesting of *Amaranthus tristis* CO 3:

Amaranthus tristis is a dwarfish plant with small leaves and longer stems of different sizes, as well as edible leaves and grains (Vigyan Prasa, 2019). To cultivate *Amaranthus trisis* CO3, seeds were randomly distributed over the soil to avoid overcrowding and then it was covered with soil and vermicompost mix in a 60:40 ratio for around ¼ x ½ inch mapping soil. Then, with the assistance of a farmer, I watered it on a regular basis. I am pleased to report that I never found any insects till the time of *Amaranthus* harvest. I used 3 grams of seed per cent (436 square feet) and it produced 9.5 kgs of fresh greens, which I picked twice for my research. Amaranthus tristis grew for 23 days before being harvested on the 24th, and the second harvest occurred 9 days after the first harvest. The green leafy vegetables were taken for processing such as cleaning, sorting and grading that shown in the plate-.

Cultivation of Palak – OOTY – 1

Ooty 1 palak is a nice green leafy vegetable that was introduced in 1995. It can be grown all year and can tolerate frost. The leaves are green and high in Vitamin A. It is a local type selection, with the first picking occurring 45 days after seeding and continuing at 15-day intervals for a period of two years. It produces 15 tonnes of leaves per hectare (TNAU, 2022).

For the cultivation of Palak- OOTY – 1 variety, approximately 436 square feet of land area was divided into 10 equal rows with a gap of 12 to 18 inches and half to one inch-deep by using my finger. The seeds were planted in the pit, which was then covered with a 60:40 mix of soil and vermicompost. I used 2 grams of seeds per cent for sowing and the palak leaves were picked twice for my research. Palak developed for 38 days before being harvested on the 42nd day, and the second harvest occurred 13 days after the first harvest. After my self horticulturing methods, the yield of the fresh palak leaves produced was 12 kgs. The green leafy vegetables were taken for processing such as cleaning, sorting and grading that shown in the plate.

Cultivation of Moringa-PKM-1

It was first released in 1989. The fruits are fleshy and delicious. The pinnate leaves are around 40 cm long and have little leaflets that are dark green on top and pale green on the bottom (TNAU, 2022a). Although Moringa grows to be a medium-sized tree, its roots demand a lot of room in the soil, so a minimum of 2 meters gap between trees was maintained for healthy leaf growth. The moringa seeds were placed directly in the soil at a depth of one inch deep.

In a 436 square feet area, 6-8 seeds were planted and vermicompost was applied in a 60:40 ratio. The leaves were ready for harvesting after three and a half months. Though there were surplus amount of green leaves are present in trees, I took 13 kg of leaves for my research. The green leafy vegetables were taken for processing such as cleaning, sorting and grading that shown in the plate.

Total Phenol Analysis for Fresh Greens

Polyphenol-containing samples are reduced by the Folin-Ciocalteu reagent, resulting in a blue-colored complex. A gallic acid calibration curve was used to determine the phenolic concentration of extracts. To create a calibration curve, 0.5mL aliquots of 12.5, 25, 50, 100, 200, and 400µg/mL methanolic gallic acid solutions were combined with 2.5 mL (ten-fold diluted) Folin-Ciocalteu reagent and 2.5 mL (75g/L) sodium carbonate. After 30 minutes of incubation at 25°C, quantitative phenolic quantification was done at 765 nm against reagent blank using a UV Spectrophotometer 1650 Shimadzu, Japan. The calibration curve was created by plotting absorbance vs. concentration. A similar approach was used to generate the calibration curve for the extracts as stated previously. All measurements were made in triplicate. The total phenolic content of the extract was reported in milligrams of Gallic Acid Equivalent (GAE) per gram.

Tannin Analysis of the Tri-Greens

TTC were calculated using Price and Butler's (1977) modified technique [3]. The extracts (500 µl; 1mg/ml stock solution) were sequentially combined with distilled water (8 ml), 0.5 ml of 0.1M FeCl3, and 0.5 ml of 8mM potassium ferricyanide and incubated at room temperature (27±2°C) for 10 minutes. A spectrophotometer was used to measure the absorbance at 720 nm. Without adding the sample, reagent blanks for each

Table 1: Optimization of the Greens Soup Mix.

S.No	Ingredients	Control/100gms	GSM1/100gms	GSM2/100gms	GSM3/100gms	GSM4/100gms	GSM5/100gms	GSM6/100gms	GSM7/ 100gms
1	Corn flour powder	10	10	10	10	10	10	10	10
2	Potato flour	5	5	5	5	5	5	5	5
3	Cumin powder	5	5	5	5	5	5	5	5
4	Pepper powder	8	8	8	8	8	8	8	8
5	Garlic powder	5	5	5	5	5	5	5	5
6	Soy powder	15	15	15	15	15	15	15	15
7	Hydrated vegi flakes (carrot, onion, peas, coriander leaf stalk, curry leaves)	20	15	15	15	15	15	15	15
8	Salt	5	5	5	5	5	5	5	5
9	Sugar	2	2	2	2	2	2	2	2
10	Dried palak Leaves	-	30	-	-	15	-	15	10
11	Dried amaranthus leaves	-	-	30	-	15	15	-	10
12	Dried moringa-leaves	-	-	-	30	-	15	15	10

GMS: Grams; GSM: Green Soup Mix

solvent were made in the same manner. The total tannin content of the samples was calculated using a tannic acid calibration curve (range from 1.5 to 20 g/ml; $r^2 = 0.999$) and represented as mg Tannic Acid Equivalent (TAE) per gram of leaf samples (FL and SDL).

Drying Processing of Green Leafy Vegetables

A method for processing the common varieties of green leafy vegetables to extend its storage life. The green leafy vegetables are selected, harvested, sorted and cleaned were taken to a processing area. During processing, the selected green leafy vegetables (Palak - OOTY – 1, *Amaranthus dubis* CO3, Moringa-PKM-1) were dried using different drying techniques.

I have chosen two drying procedures such as sun drying and hot air oven drying. Fresh herbs are put on well-ventilated drying racks and exposed directly to sunshine during the procedure (Janjai and Bala 2012). For the oven drying procedure, the blanched, drained leaves were placed in a tray dryer for 24 hours at a temperature of 60 degrees celsius.

Nutrient Analysis of processed Tri-Greens

Estimation of Vitamin-C: The estimation of the vitamin – c content for palak , amaranthus and moringa was done in both the processing methods such as sun dry technology and also hot air oven drying technology.

Estimation of Folic Acid

The estimation of the folic acid content for palak, amaranthus and moringa was done in both the processing methods such as sun dry technology and also hot air oven drying technology.

Estimation of Iron

The estimation of the iron content for palak, amaranthus and moringa was done in both the processing methods such as sun dry technology and also hot air oven drying technology.

Optimisation and Preparation of vegan based green soup mix

Optimisation of greens soup mix: When the exact techniques, equipment, and ingredients are employed, standardized recipes generate a consistent quality and yield every time, ensuring that the best possible food items are produced every time. The benefits of standardization to a food service include consistent food preparation and nutritious content while keeping food costs and inventory under control (Hussain 2017). Several combinations of greens leaf powders, as well as the necessary raw materials and key constituents, were tested in order to get the ideal formulation with the optimum percentage as advised by acceptability studies.

Based on that, I formulated six different formulations of soup mixes, and the standardization was completed for all of the mixes, as indicated in the table I all mixes contain 25gms of consistency booster (corn flour, potato flour, and soy flour), and taste enhancer (salt and sugar) 7 gms, spices (cumin, pepper, and garlic powder)18gms, dehydrated vegetable flakes 20gms in addition to these I have added the important ingredient greens powder as 30gms of palak in GSM 1 , 30gms of amaranthus in GSM 2, 30gms of moringa in GSM 3, 15gms of palak and 15gms of amaranthus in GSM 4, 15gms of amaranthus and 15gms of moringa in GSM 5, 15gms of palak and 15gms of moringa in GSM 6, 10gms of palak, 10gms of amaranthus, 10gms of moringa in GSM 7.1 Control Sample comprising 25gms of consistency booster (corn flour, potato flour, and soy flour), and taste enhancer (salt and sugar) 7 gms, spices (cumin, pepper, and garlic powder)18gms, dehydrated vegetable flakes 20gms alone is compared with the other samples.

Preparation of Greens Soup Mix

Soups are generally ingested for health and nutritional benefits, particularly in individuals whose intake of solids is inadequate due to a variety of obstructive or pathological factors. Soups are the finest source to give health-protective chemicals and to avoid nutrient deficiencies in these circumstances (Rekha et al., 2010).

The appropriate composition of the greens leaf powders (palak, amaranthus, and moringa) was taken in a bowl, and the spices, together with the taste enhancer and consistency enhancer, were measured and ground together to produce a mix. Now the dehydrated veggie flakes were added to the mix, and the entire thing was turned to completely distribute it throughout the mixture. Similarly, all seven greens soup mixtures were prepared for future research. In addition, for the comparative study, a control sample without the inclusion of greens leaf powder was prepared.

Processing Yield of Greens Soup Mix

The whole corn, potato, soya bean, vegetables, gr3eens, garlic, spice mix and instant soup were weighed. The processing yield was calculated from weight of each final products multiplied by 100 and divided by the weight of their precursor product. Three analytical replicates were performed for each treatment and mean value was calculated.

Processing yield percentage % = final products obtained x 100/raw weight of the respective sample.

Reconstitution Index of Formulated Soup Mixes

The optimum condition for the reconstitution of formulated soup mix was evaluated by conducting preliminary trials. Initially known weights of soup mix samples (20g) was taken and mixed with different amounts of hot water at a temperature of 100 degree Celsius (50, 75, 100, 125ml) separately immersed in hot for 10 minutes in a bowl. The appearance and consistency of soup was observed by a panel. The optimum amount of water required for reconstitution was selected based on the evaluation made by the panellist.

Organoleptic evaluation of prepared Greens Soup Mix

Organoleptic evaluation is a way of analyzing food products that uses the human senses as a measurement tool to determine the quality and characterize the state of the product. It is a scientific discipline that analyzes and measures human reactions to food and drink composition (Sonika Chaudhary and Neetu Singh 2019).

Table 2: Leaves Obtained from Each Seed on the 1st and 2nd Harvest.

Names of leaves	Seeds (g)	Days of harvest	First yield (g)	Days of harvest	Second Yield (g)
Palak	2	42nd	4	55th	5
Amaranthus	2	25TH	4	34TH	4
Moringa	2	105th	4	125th	5.3

Table 3: Showing the Weight of the Tri Greens in Powdered form After Drying (Sun Drying and Hot Air Oven Drying).

Name of Greens	Quantity after sun drying (g)		Quantity after oven drying (g)	
	Dried leaves	After Powdering	Dried leaves	After Powdering
Palak	500	410	400	380
Amaranthus	600	450	500	450
Moringa	400	340	400	350

Table 4: Analysis of the Total Flavanoids and Total Phenols in Dehydrated Tri Greens By Sun Drying and Oven Drying.

Name of Greens	Total Flavanoids (Mg/G)		Total Phenolics (Mg/G)	
	Sun Dry	Hot Air Oven Dry	Sun Dry	Hot Air Oven Dry
Palak	38.03 ± 0.89	29.00 ± 0.00	51.18 ± 1.42	49.10 ± 0.00
Amaranthus	41.50 ± 0.89	27.00 ± 0.00	52.09 ± 0.00	45.29 ± 1.42
Moringa	47.63 ± 0.89	26.00 ± 0.00	55.00 ± 0.00	49.88 ± 1.42

Based on the evaluation of the reconstitution of formulated soup mix, the seven types of value-added convenient greens soup mix samples, together with the control, were dissolved in 75ml of hot boiling water to serve as a hot soup after 10 minutes. The semi-trained panel members were given the experimental sample as well as the control for organoleptic evaluation. Twenty-five-panel members (ranging in age from 30 to 40 years females) from the departments of food science and nutrition at Sarah Tucker College and Sadakathullah Appa College in Tirunelveli was subjected with a scorecard to 5-point hedonic scale test (5-like very much, 1-dislike) to assess the acceptability of the value-added soup mix based on parameters such as appearance, color, texture, flavor, and overall acceptability. The score card for the greens soup mixes were attached in the Appendix- VI

Based on the results of the sensory panels of the organoleptic evaluation the high scored two mixes were taken for the further analysis.

Consent Form

Potential participants were given an overview of the purpose of the research and the procedure of the test. All willing participants were asked to fill it and sign the consent form prior to the blood test. Consent form is attached in Appendix-VII.

Result and Discussion

The table 1 provides information on the leaves obtained from each seed during the first and second harvests. For Palak, the seeds weighed 2 grams, and the first harvest occurred on the 42nd day, yielding 4 grams. The second harvest occurred on the 55th day, resulting in a yield of 5 grams. Similarly, for Amaranthus, the seeds weighed 2 grams, with the first harvest on the 25th day producing 4 grams. The second harvest occurred on the 34th day, yielding 4 grams once again. In the case of Moringa, the seeds weighed 2 grams, and the first harvest took place on the 105th day, resulting in a yield of unspecified grams. The second harvest occurred on the 125th day, with a yield of 5.3 grams.

Table 4.4 provides information on the weights of Tri Greens in powdered form after undergoing both sun drying and hot air oven drying processes. For Palak, after sun drying, the quantity was reduced to 500 grams, further diminishing to 410 grams after hot air oven drying. The resulting dried leaves were then powdered, resulting in a final quantity of 400 grams after sun drying and 380 grams after hot air oven drying. Similarly, for Amaranthus, the quantity after sun drying was 600 grams, which reduced to 450 grams after hot air oven drying. The dried leaves were subsequently powdered, resulting in a final quantity of 500 grams after sun drying and 450 grams after hot air oven drying. For Moringa, the quantity after sun drying was 400 grams, reducing to 340 grams after hot air oven drying. After powdering the dried leaves, the final quantity was 400 grams after sun drying and 350 grams after hot air oven drying.

The P Values represent mean ± standard deviation of triplicate experiments. Superscripts with different alphabets along the same row are significantly ($p < 0.05$) different Table 3 presents an analysis of the total flavonoids and total phenols in fresh Tri Greens under different drying conditions, namely sun drying and hot air oven drying. For Palak, the total flavonoids content was 38.03 mg/g in the sun-dried state, 29.00 mg/g in the hot air oven-dried state, while the total phenolics content was 51.18 mg/g in sun-dried Palak and49.10 mg/g in hot air

oven-dried Palak. Amaranthus exhibited a total flavonoids content of 41.50 mg/g in sun-dried form and 27.00 mg/g in hot air oven-dried form. The total phenolics content for Amaranthus was 52.09 mg/g in sun- dried condition and 45.29 mg/g in hot air oven-dried condition. In the case of Moringa, the total flavonoids content was 47.63 mg/g in sun-dried Moringa and 26.00 mg/g in hot air oven-dried Moringa. The total phenolics content for Moringa was 55.00 mg/g in sun-dried state and 49.88 mg/g in hot air oven-dried state.

Table 4 provides a comparative analysis of various nutrients in Tri Greens, including iron, folic acid, and vitamin C, with measurements in milligrams or micrograms per 100 grams for both sun-dried and oven-dried conditions. For Palak, the iron content was 96.73 mg/100g in the sun-dried state and slightly lower at 74.41 mg/100g in the oven-dried state. Folic acid content decreased from 63.03 mg/100g in sun-dried Palak to 53.08 mg/100g in oven-dried Palak, while vitamin C content also slightly decreased from 10.59 mg/100g to 10.34 mg/100g. Amaranthus showed a decrease in iron content from 78.84 mg/100g in sun-dried form to 63.39 mg/100g in oven-dried form. Folic acid content decreased from 59.12 mg/100g to 42.04 mg/100g, while vitamin C content increased from 9.21 mg/100g in sun-dried Amaranthus to 13.89 mg/100g in oven-dried Amaranthus. In the case of Moringa, the iron content decreased significantly from 107.86 mg/100g in sun-dried Moringa to 27.52 mg/100g in oven-dried Moringa. Folic acid content also decreased from 40.13 mg/100g to 32.88 mg/100g, while vitamin C content slightly increased from 20.43 mg/100g to 22.56 mg/100g in oven-dried Moringa.

Table 5: Comparative Analysis of Nutrients in Tri Greens.

Name of Greens	Iron (mg/100g)		Folic acid (mg/100g)		Vitamin C (mg/100g)	
	Sun dried	Oven dried	Sun dried	Oven dried	Sun dried	Oven dried
Palak	96.73	74.41	63.03	53.08	10.59	10.34
Amaranthus	78.84	63.39	59.12	42.04	9.21	13.89
Moringa	107.86	27.52	40.13	32.88	20.43	22.56

Table 6: Reconstitution Index and Rehydration Ratio.

S.NO	Formulations	Reconstitution Index	Rehydration Ratio
	Control	05.50	6.3
	GSM 1	06.00	5.9
	GSM 2	06.10	6.2
	GSM 3	07.15	6.6
	GSM 4	08.10	7.9
	GSM 5	06.75	7.2
	GSM 6	07.95	6.8
	GSM 7	09.25	8.3

Table 7: Showing the Mean Organoleptic Evaluation of Prepared Greens Soup Mix-1.

Parameters	Number	Mean		Standard Deviation	Standard Error
Appearance	30	GSM 1	2.23	1.05	1.6
		CON	1.97	0.56	0.1
Colour	30	GSM 1	2.3	1.14	0.2
		CON	1.97	0.56	0.1
Flavour	30	GSM 1	1.77	0.72	0.13
		CON	1.77	0.43	0.07
Texture	30	GSM 1	1.8	0.71	0.13
		CON	1.8	0.48	0.08
Consistency	30	GSM 1	2.57	1.1	0.2
		CON	1.7	0.7	0.12
Overall Acceptability	30	GSM 1	1.67	0.61	0.11
		CON	1.87	0.57	0.1

The observed Reconstitution index of samples showed that sample GSM 7 has the highest reconstitution index 9.25 followed by sample GSM 4 is 8.1, followed by sample GSM6 is 7.95, followed by sample GSM 3 is 7.15, followed by sample GSM5 is 6.75, followed by sample GSM2 is 6.1, and the lowest reconstitution index is in sample GSM1 is 6, while sample GSM 7 has the highest reconstitution index of 9.25. The low reconstitution index of samples other than sample GSM 1 is 6 is attributed to variation of greens percentage in the samples. Likewise it is observed that the Reconstitution Index with different combinations of instant soup in pod powder soup mix, the rehydration ratio was found to be highest in MPP4 (17.50 g/ml) and lowest in control (14.30 g/ml)

The rehydration ratio for the sample GSM 7 was observed high with ratio of 8.3, the sample GSM 4 was observed with ratio of 7.9, the sample GSM 5 was observed with ratio of 7.2, the sample GSM 6 was observed with ratio of 6.8, the sample GSM 3 was observed with ratio of 6.6, the sample GSM 2 was observed with ratio of 6.2, the sample GSM 1 was observed with least ratio of 5.9 respectively, The rehydration ratio of GSM soup mix varied from 8.3 to 5.9.

The above table presents the results of the organoleptic evaluation for prepared greens soup mix, comparing two batches labeled as GSM 1 and CON. The parameters evaluated include appearance, color, flavor, texture, consistency, and overall acceptability, with a sample size of 30 evaluations for each. Mean scores indicate the average assessments given by evaluators for each parameter, while standard deviation measures the variability in scores, and standard error provides an estimate of the mean's precision. For instance, in terms of appearance, GSM 1 scored a mean of 2.23 with a higher standard deviation of 1.05, suggesting greater variability compared to CON with a mean of 1.97 and a lower standard deviation of 0.56. Similar comparisons can be made across parameters, aiding in understanding the sensory attributes and acceptability of the two batches of greens soup mix.

The provided data presents the results of a sensory evaluation with parameters including Appearance, Colour, Flavour, Texture, Consistency, and Overall Acceptability, assessed on a scale of GSM 2 and CON (presumably representing different product variations or conditions). For each parameter, the mean, standard deviation, and standard error are reported based on a sample size of 30 evaluations. The mean values indicate the central tendency of the sensory perceptions, while standard deviation reflects the degree of variation among the scores. Standard error provides an estimate of the precision of the mean. Generally, higher standard deviations suggest greater variability in responses. For instance, in the Appearance parameter, GSM 2 has a mean of 2 with a standard deviation of 1.7, indicating a relatively varied perception. These findings offer insights into the sensory characteristics and acceptability of the evaluated products, aiding in understanding the consistency and quality of each aspect in relation to the overall acceptability

The provided data outlines the results of a sensory evaluation for various parameters, including Appearance, Colour, Flavour, Texture, Consistency, and Overall Acceptability, using two different conditions labeled as GSM 3 and CON. Each parameter is evaluated based on a sample size of 30, and the mean, standard deviation, and standard error are reported. For instance, in the Flavour parameter, GSM 3 exhibits a mean of 2.33 with a standard deviation of 0.66, indicating a relatively high level of agreement among the evaluators. The standard error provides

Table 8: Showing the Mean Organoleptic Evaluation of Prepared Greens Soup Mix-2.

Parameters	Number	Mean		Standard Deviation	Standard Error
Appearance	30	GSM 2	1.7	0.79	0.14
		CON	1.97	0.56	0.1
Colour	30	GSM 2	1.8	0.8	0.15
		CON	1.97	0.56	0.1
Flavour	30	GSM 2	1.83	1.05	0.2
		CON	1.77	0.43	0.07
Texture	30	GSM 2	1.7	0.65	0.11
		CON	1.8	0.48	0.08
Consistency	30	GSM 2	1.66	0.66	0.12
		CON	1.7	0.7	0.12
Overall Acceptability	30	GSM 2	2.03	0.89	0.16
		CON	1.87	0.57	0.1

Table 9: Showing the Mean Organoleptic Evaluation of Prepared Greens Soup Mix-3.

Parameters	Number	Mean		Standard Deviation	Standard Error
Appearance	30	GSM 3	2.17	0.91	0.17
		CON	1.97	0.56	0.1
Colour	30	GSM 3	2	0.87	0.16
		CON	1.97	0.56	0.1
Flavour	30	GSM 3	2.33	0.66	0.12
		CON	1.77	0.43	0.07
Texture	30	GSM 3	1.93	0.82	0.15
		CON	1.8	0.48	0.08
Consistency	30	GSM 3	2.23	0.67	0.12
		CON	1.7	0.7	0.12
Overall Acceptability	30	GSM 3	1.93	0.78	0.14
		CON	1.87	0.57	0.1

Table 10: Showing the Mean Organoleptic Evaluation of Prepared Tri Soup Mix-4.

Parameters	Number	Mean		Standard Deviation	Standard Error
Appearance	30	GSM4	2.97	0.67	0.12
		CON	1.97	0.56	0.1
Colour	30	GSM4	2.6	0.62	0.11
		CON	1.97	0.56	0.1
Flavour	30	GSM4	2.77	0.73	0.13
		CON	1.77	0.43	0.07
Texture	30	GSM4	3.03	0.72	0.13
		CON	1.8	0.48	0.08
Consistency	30	GSM4	3.03	0.56	0.1
		CON			
Overall Acceptability	30	GSM4	3.13	0.68	0.12
		CON	1.87	0.57	0.1

an estimate of the precision of the mean. Overall, these results offer valuable insights into the sensory attributes and acceptability of the evaluated products under the different conditions, aiding in the understanding of the perceived quality and consistency of each parameter, ultimately contributing to informed decision-making in product development or improvement processes.

The provided data presents the outcomes of a sensory evaluation for different parameters, including Appearance, Colour, Flavour, Texture, Consistency, and Overall Acceptability, with assessments conducted under two conditions, GSM4 and CON. Each parameter is evaluated based on a sample size of 30, and the mean, standard deviation, and standard error are reported. Notably, under the GSM4 condition, there is a consistent trend of higher mean scores across all parameters, indicating a more favorable perception of the product attributes compared to the CON condition. For instance, in the Appearance parameter, GSM4 has a mean of 2.97 with a standard deviation of 0.67, showcasing a relatively consistent and positive evaluation. The data suggests that products under the GSM4 condition are generally more positively perceived across various sensory attributes, contributing to a higher overall acceptability when compared to the CON condition. These findings provide valuable insights for product development and quality improvement efforts.

The provided data presents results from a sensory evaluation conducted on two conditions, GSM5 and CON, across various parameters including Appearance, Colour, Flavour, Texture, Consistency, and Overall Acceptability. Each parameter is assessed based on a sample size of 30, with reported mean, standard deviation, and standard error values. Notably, in the Flavour parameter, GSM5 exhibits a mean of 2.5 with a standard deviation of 0.68, suggesting a relatively consistent and favorable perception. Overall, products under the GSM5 condition consistently demonstrate higher mean scores across multiple attributes, indicating a generally more positively perceived sensory profile compared to the CON condition. These findings contribute valuable insights into the quality and acceptability of products under different conditions, providing a basis for informed decision-making in product development or quality improvement initiatives.

The provided data presents the results of a sensory evaluation for two conditions, GSM6 and CON, across various parameters, including Appearance, Colour, Flavour, Texture, Consistency, and Overall Acceptability. Each parameter is assessed based on a sample size of 30, with reported mean, standard deviation, and standard error values. Notably, in the Flavour parameter, GSM6 shows a mean of 2.57 with a standard deviation of 0.86, indicating a relatively diverse but generally positive perception. Overall, products under the GSM6 condition exhibit higher mean scores across several attributes, suggesting a more positively perceived sensory profile compared to the CON condition. These findings provide valuable insights into the quality and acceptability of products under different conditions, offering a basis for informed decision-making in product development or quality improvement initiatives.

Table 11: Showing the Mean Organoleptic Evaluation of Prepared Tri Soup Mix-5.

Parameters	Number	Mean		Standard Deviation	Standard Error
Appearance	30	GSM5	2.3	0.75	0.14
		CON	1.97	0.56	0.1
Colour	30	GSM5	2.2	0.81	0.15
		CON	1.97	0.56	0.1
Flavour	30	GSM5	2.5	0.68	0.12
		CON	1.77	0.43	0.07
Texture	30	GSM5	2.37	0.72	0.13
		CON	1.8	0.48	0.08
Consistency	30	GSM5	2.43	0.73	0.13
		CON	1.7	0.7	0.12
Overall Acceptability	30	GSM5	2.2	0.61	0.11
		CON	1.87	0.57	0.1

Table 12: Showing the Mean Organoleptic Evaluation of Prepared Tri Soup Mix-6.

Parameters	Number	Mean		Standard Deviation	Standard Error
Appearance	30	GSM6	2.13	0.82	0.15
		CON	1.97	0.56	0.1
Colour	30	GSM6	2.2	0.61	0.11
		CON	1.97	0.56	0.1
Flavour	30	GSM6	2.57	0.86	0.16
		CON	1.77	0.43	0.07
Texture	30	GSM6	2.27	0.83	0.15
		CON	1.8	0.48	0.08
Consistency	30	GSM6	2.03	0.76	0.14
		CON	1.7	0.7	0.12
Overall Acceptability	30	GSM6	2.37	0.61	0.11
		CON	1.87	0.57	0.1

Table 13: Showing the Mean Organoleptic Evaluation of Prepared Tri Soup Mix-7.

Parameters	Number	Mean		Standard Deviation	Standard Error
Appearance	30	GSM7	3.43	0.68	0.12
		CON	1.97	0.56	0.1
Colour	30	GSM7	3.5	0.63	0.11
		CON	1.97	0.56	0.1
Flavour	30	GSM7	3.53	0.68	0.12
		CON	1.77	0.43	0.07
Texture	30	GSM7	3.67	0.66	0.12
		CON	1.8	0.48	0.08
Consistency	30	GSM7	3.67	0.71	0.13
		CON	1.7	0.7	0.12
Overall Acceptability	30	GSM7	4.13	0.5	0.09
		CON	1.87	0.57	0.1

The provided data outlines the results of a sensory evaluation for two conditions, GSM7 and CON, across various parameters, including Appearance, Colour, Flavour, Texture, Consistency, and Overall Acceptability, with each parameter assessed based on a sample size of 30. Notably, under the GSM7 condition, there is a consistent pattern of significantly higher mean scores across all parameters compared to the CON condition, suggesting a more favorable perception of the product attributes. For instance, in the Appearance parameter, GSM7 exhibits a mean of 3.43 with a standard deviation of 0.68, reflecting a generally positive and consistent evaluation. Overall, the data indicates that products under the GSM7 condition are perceived as having superior sensory characteristics and higher overall acceptability, offering valuable insights for product development and quality enhancement efforts.

Conclusion

The overall conclusion of this research provides valuable insights into the cultivation, processing, and nutritional analysis of green leafy vegetables, as well as the development of value-added products like green soup mixes. The findings can guide further research and development efforts in the field of sustainable food production and value addition. Analyses of nutrient content, total flavonoids, and total phenolics were conducted on the dried greens, showing variations based on drying methods and vegetable type. Comparative analyses of nutrient content between sun-dried and oven-dried greens were presented. Reconstitution indices and rehydration ratios were calculated for the soup mixes, indicating their ability to reconstitute and retain quality after drying of greens. Organoleptic evaluations were performed to assess the sensory attributes and acceptability of the prepared soup mixes. Overall, the study demonstrates a comprehensive approach to utilizing green leafy vegetables for the development of nutritious and palatable food products, highlighting their potential contribution to addressing nutritional challenges and promoting healthier dietary choices.

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