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Evaluation of nutritional quality characteristics of selected uncultivated green leafy vegetables

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Abstract

Uncultivated plants are an integral part of food systems. The present study has investigated the nutritional quality characteristics of selected four most popular and commonly used traditional uncultivated green leafy vegetables such as *Aerva lanata* (L.) Juss., *Celosia argentea* L., *Corchorus olitorius* L. and *Leucas aspera* L. (Wild.). The selected four leaves were shade dried and stored for the analysis. The results of the study showed that leaves of *A. lanata* has high ash (17.26 g/100 g), total carotenoid (4400.44 µg/100 g), calcium (1272.05 mg/100 g), magnesium (811.45 mg/100 g), sodium (157.92 mg/100 g), bioavailable iron (56.70%) and zinc content (81.59%). Whereas, fat (4.74 g/100 g), crude fiber (15.90 g/100 g), ß-carotene (240.13 µg/100 g), zinc (4.32 mg/100 g), copper (1.65 mg/100 g), phosphorus (357.49 mg/100 g) and bioavailable calcium (71.52%) content of *L. aspera* was significantly (p=0.01) high than the other leaves. *C. argentea* found high protein (24.48 g/100 g), vitamin C (37.88 mg/100 g) and iron (15.02 mg/100 g) content while *C. olitorius* had high carbohydrate (53.90 g/100 g), energy (293.5 kcal/100 g), iron (15.04 mg/100 g), manganese (5.37 mg/100 g), potassium (1446 mg/100 g) and bioavailable iron (56.72%) content. The phenol, flavonoid, tannin, total antioxidant activity of all the leaves was ranged between 302.08-1443 mg GAE/100 g, 157.62-180.66 mg RE/100 g, 150.99-720.74 mg TAE/100 g, 11.57-95.77%, respectively. Henceforth, traditional green leafy vegetables with superior nutritional profile and antioxidant potential can be efficiently utilized as functional ingredients for the formulation of designer foods.

1. Introduction

According to Convention on Biological Diversity (CBD, 2019), currently only 12 plant and five animal species are contributing to 75% of total world food production. This kind of heavy dependence on the limited food sources could lead to gradual neglect of many local food sources, which in turn lead to depletion of cultural and nutritional significance associated with local traditional foods and decreases the agricultural diversity. Worldwide proliferation of convenience, processed foods, export-oriented agriculture, and widespread availability of fast-food chains have collectively led to the loss of culinary heritage and erosion of traditional food systems. This kind of dietary shift patterns could have a major impact on the health and nutritional wellbeing of the individuals. Therefore, it is important to document the regional cuisines and food sources at the risk of disappearance. Merging of traditionally significance foods with modern advanced techniques enhances the quality and could lead to nutritional security (Ghosh *et al*., 2023).

In many countries, traditional green leafy vegetables especially uncultivated species have been part of the culture and food system since a very long period of time. Traditional green leafy vegetables have high micronutrient content when compared to commonly consumed greens. Traditional greens are cheap and easily available in nature. Inclusion of traditional greens increase the diversity of local diet, improves micronutrient quality and decreases the hidden hunger. Due to migration of people to towns, lack of availability, poor knowledge on nutritional composition, health benefits and increased disinterest of the young generation towards traditional greens are some of the reasons for their underutilisation (Ejoh *et al.,* 2021).

Indigenous traditional foods are a rich source of vital nutrients such as dietary fibre, vitamins, minerals, and antioxidants that support people's general health and well-being in addition to serving as a representation of culture. These foods can serve to encourage better eating habits and prevent diet-related disorders by being incorporated into modern diets (Ghosh *et al*., 2023).

Understanding the significance, International Centre for Underutilised Crops (ICUC) encourages the production, application, and sale of underutilised crops. These crops are crucial for maintaining floral biodiversity as well as requires less financial and agricultural inputs like irrigation, fertiliser, and pesticides. They also have a strong resistance to both biotic and abiotic stresses (Singh *et al*., 2023).

Leafy vegetables are an important part of the well-balanced diet and cheapest source of essential nutrients including carbohydrates, proteins, vitamins, carotenoids, minerals and strong antioxidants, helps to overcome nutritional deficiencies and ultimately reduce the health risks (Savage *et al*., 2013). Many nutrient rich green leafy vegetables are abundantly cultivated all over the world, especially in South Asia to fulfil dietary as well as medicinal requirement (Williams *et al*., 2009). World health organisation (WHO) and Indian Council of Medical Research, National Institute of Nutrition (ICMR NIN)

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recommended to consume at least 400 and 500 g/day of fruits and green leafy vegetables, respectively to achieve required supply of nutrients (Gowthami *et al*., 2016; Singh, 2020; ICMR, NIN, 2024) and protect from cardiovascular, diabetes, bone, genitourinary, neuro degenerative and inflammatory diseases (Rana *et al*., 2022).

Green leafy vegetables are seasonal and perishable. Hence, it is utmost important to explore suitable technique to preserve seasonal leafy vegetables and so, they can be used in off season also. Dehydration is the ancient technique that can preserve the food when they are available in abundance, can be stored and consumed for longer periods. Different drying techniques such as sun drying, shade drying, hotair drying, cabinet drying, solar drying and freeze drying are employed for drying of herbal/medicinal plant or leaves (Gupta *et al*., 2013; Yadav *et al*., 2023).

The nutritional composition of many traditional green leafy vegetables is not well-documented. Since the nutrient composition of foods plays a significant role in their cultivation and utilisation. Still there are significant gaps in our understanding of traditional food composition and their contribution to dietary intakes. Thus, the primary goal of this study is to analyze the nutritional quality of four uncultivated green leafy vegetables: *A. lanata, C. olitorius, C. argentea,* and *L. aspera*.

***Corchorus olitorius* L.** ***Celosia argentea* L.** ***Aerva lanata* (L.) Juss.** ***Leucas aspera* L. (Wild.)**

Figure 1: Pictorial description of selected uncultivated green leafy vegetables.

2. Materials and Methods

Edible portions of *A. lanata* (CAL0000008911)*, C. olitorius* (CAL0000003840)*, C. argentea* (CAL0000008907) and *L. aspera* (CAL0000008725) (Economic Botany Herbarium Details (bsi.gov.in) leaves collected were washed, blanched for 2 min (except *C. argentea,* as leaves turn to dark black colour during blanching), shade dried until samples became crisp and brittle to touch. After drying, the samples were powdered and stored in air tight pouches for the study. Analytical grade chemicals were used during the investigation. Chemicals and glassware were utilized from Post Graduate and Research Centre and Central instrumentation cell laboratory, Professor Jayashankar Telangana State Agriculture University, Rajendranagar, Hyderabad, Telangana, India.

2.1 Determination of proximate contents

The moisture protein, ash (AOAC, 2005), crude fiber (AOAC, 1995), fat (AOAC, 1997), carbohydrate and energy (AOAC, 1980) of all the samples were determined. The nitrogen value is used for the estimation of protein. Carbohydrate content and energy value was determined by difference and multiplying, respectively.

2.2 Estimation of vitamin and mineral content

β-carotene and total carotenoids content was analysed by using a standard protocol (Zakaria *et al.* 1979). Vitamin C content of all the samples were analysed by 2, 6- dichloroindophenol dye method (AOAC, 1997). Minerals like calcium, sodium, potassium, magnesium, manganese, iron, zinc and copper (AOAC, 2012) contentin all selected greens was done using atomic absorption spectrometer, whereas phosphorus content was determined by spectrophotometer (Piper, 1966). Standard protocols were followed to estimate the bioavailable calcium, zinc (Kim and Zemel, 1986) and iron (Narasinga and Prabhavathi, 1978) content.

2.3 Determination of phytonutrient content

The phytonutrients like antioxidant screening(Harbourne,1993), total phenols (Slinkard and Slingleton, 1997), tannins (AOAC, 2005), total flavonoid (Zhishen *et al*., 1999), total antioxidant activity (Dorman *et al*., 2004; Tadhani*et al*., 2007) and phytic acid (Damilola *et al*., 2013) content of samples were analysed in triplicates.

2.4 Statistical analysis

During each experiment, three replications were maintained. The data obtained was analysed using one-way analysis of variance (ANOVA) at 1.0 per cent level of significance.

3. Results

3.1 Nutritional composition of uncultivated green leafy vegetables

The results of proximate content of *A.lanata, C. olitorius, C. argentea,* and *L. aspera* is presented in Table 1. The moisture content of *A. lanata, C. olitorius, C. argentea,* and *L. aspera* per 100 g was 10.18, 0.85, 11.64 and 8.40%, respectively, with a significant difference between them at $p \leq 0.01$. The highest ash content was observed in *A. lanata* (17.26 g/100 g) and lowest in *C. olitorius* (12.13 g/100 g). There was no significant difference was observed in the ash content of *C. argentea* and *L. aspera* leaves. Significant difference ($p \leq 0.01$) was observed in the fat content of the leaves. The *L. aspera* found high fat (4.74%) content, followed by *A. lanata* (3.39%), *C. olitorius* (3.31%) and *C. argentea* (2.23%). Fat content of *A. lanata* and *C. olitorius* were similar and no significant difference was observed.

Ascending order of protein content of leaves were 12.03 g/100 g (*C. olitorius*) < 12.60 g/100 g (*L. aspera*) < 18.27 g/100 g (*A.lanata*) < 24.48 g/100 g (*C. argentea*). Protein content of *C. olitorius* and *L. aspera* were similar and no significant difference was observed between them. Crude fiber content of *L. aspera* (15.90 g/100 g) was high while *C. argentea* (8.52 g /100 g) has low content. Based on the protein and fiber content, all the selected leaves could be a used as a potential green leafy vegetable in the human nutrition. Significant difference ($p \leq 0.01$) was observed in the carbohydrate content of selected leaves. Carbohydrate content of *A. lanata, C. olitorius, C. argentea,* and *L. aspera* were 37.64, 53.90, 39.14 and 43.89 g/100 g, respectively. Energy content of *C. olitorius* (293.5 kcal/100 g) was high than other leaves.

Carotenoids are known to be unique constituents of a healthy diet and have been associated with reducing the risk of several degenerative disorders (Stahl and Sies, 2003). Results of total carotenoids, β-carotene and vitamin C content of all the four leaves are given in Table 2. As per the results obtained, it was observed that there was significant difference ($p \leq 0.01$) was found in the total carotenoid and β-carotene content of selected leaves. The *A. lanata* recorded highest total carotenoids (4400.44 µg/100 g) content while *C. olitorius* (1230.91 µg/100 g) has low content. The β-carotene content of *A. lanata* (240.1 µg/100 g) and *L. aspera* (240.13 µg/100 g) was almost similar and no significant difference was observed between them. Vitamin C content of leaves is ranged between 37.88 -14.36 mg/100 g. Highest vitamin C content was observed in *C. argentea*, followed by *C. olitorius, L. aspera* and *A. lanata.*

Table 1: Nutritional composition of uncultivated green leafy vegetables (100 g)

Sample	Moisture (%)	Ash (g)	Fat (g)	Crude fiber (g)	Protein (g)	Carbohydrate (g)	Energy (kcal)
A. lanata	10.18^b ± 0.32	17.26^a ± 0.10	3.39^b ± 0.04	13.28^b ± 0.22	18.27^b ± 0.21	37.64^d ± 0.01	254.1^c ± 0.00
C. olitorius	09.85^b ± 0.28	12.13^c ± 0.16	3.31^b ± 0.00	08.79^c ± 0.04	12.03^c ± 0.29	53.90^a ± 0.01	293.5^a ± 0.00
C. argentea	11.64^a ± 0.15	14.01^b ± 0.18	2.23^c ± 0.09	08.52^c ± 0.03	24.48^a ± 0.05	39.14^c ± 0.01	277.2^b ± 0.00
L. aspera	08.40^c ± 0.36	14.48^b ± 0.02	4.74^a ± 0.07	15.90^a ± 0.08	12.60^c ± 0.18	43.89^b ± 0.00	268.6^b ± 0.00
F value	64.32	271.44	247.96	896.30	823.49	807508.611	281.29
p value	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**

Table 2: Vitamin content of uncultivated green leafy vegetables (100 g)

Sample	*A. lanata*	*C. olitorius*	*C. argentea*	*L. aspera*	S. E	F value	*p* value
Vitamin C (mg)	14.36^d ± 0.01	31.51^b ± 0.00	37.88^a ± 0.28	23.05^c ± 1.00	2.67	1151.11	0.00**
Beta carotenoids (µg)	240.1^a ± 0.63	120.0^b ± 0.66	104.05^c ± 0.10	240.13^a ± 0.38	19.69	67492.66	0.00**
Total carotenoids (µg)	4400.44^a ± 0.69	1230.91^d ± 0.95	1312.29^c ± 0.27	3072.33^b ± 0.32	397.73	17894254.85	0.00**

Table 3: Mineral content of uncultivated green leafy vegetables (mg/100 g)

Sample	Calcium	Iron	Zinc	Copper	Magnesium	Manganese	Phosphorus	Potassium	Sodium
A. lanata	1272.05^a ± 0.01	14.55^b ± 0.16	1.25^d ± 0.04	1.63^a ± 0.03	811.45^a ± 0.24	3.12^d ± 0.00	334.40^b ± 0.24	1023.33^c ± 0.58	157.92^a ± 0.03
C. olitorius	1094.03^b ± 0.00	15.04^a ± 0.01	2.14^c ± 0.05	1.36^b ± 0.01	286.37^c ± 0.12	5.37^a ± 0.00	269.83^d ± 0.02	1446.00^a ± 1.00	109.08^b ± 0.01
C. argentea	1047.47^c ± 0.00	15.02^a ± 0.00	3.18^b ± 0.02	1.29^c ± 0.02	420.44^b ± 0.02	3.84^b ± 0.00	305.03^c ± 0.06	1203.00^b ± 1.73	085.38^c ± 0.33
L. aspera	0912.99^d ± 0.00	14.32^c ± 0.00	4.32^a ± 0.01	1.65^a ± 0.02	269.52^d ± 0.04	3.69^c ± 0.00	357.49^a ± 0.28	0985.67^d ± 1.15	75.30^d ± 0.28
Fvalue	7268262385	62.309	4719.76	245.67	10292577.80	949143.04	120712.53	93623.92	86818.49
*p*value	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**	0.00**

Note: Values are expressed as mean ± standard deviation of three determinations;Means within the same column followed by a common letter do not differ significantly at ($p \leq 0.01$); NS: not significant; ** significant at ($p \leq 0.01$); * significant at ($p \leq 0.05$).

Calcium, sodium and potassium are some of the important macro minerals whereas iron and zinc are the micro minerals, necessary for normal functioning of the body. Mineral content of all the four leaves were analysed and the results were presented in Table 3. Calcium is the most abundant minerals present in the body. Calcium content of *A. lanata* (1272 mg/100 g) is very high compared to other leaves. Iron content of uncultivated green leafy vegetables is ranged from 14.32-15.04 mg/100 g of powder. The RDA for Indians recommends 19 mg/day and 29 mg/day for adult men and women, respectively (ICMR-NIN, 2024). The present study revealed that selected uncultivated green leafy vegetables are the potential source of iron and thus, these leaf powders can be used in various food formulations as fortificant.

Zinc is another important micromineral that forms part of more than 300 metalloenzymes and is essential in metabolism of various nutrients (King and Keen, 2003). The copper (1.65 mg/100 g) and zinc (4.32 mg/100 g) content of *L. aspera* was significantly high then the other leaves. Magnesium content of *A. lanata, C. olitorius, C. argentea,* and *L. aspera* is 811.45, 286.37, 420.44 and 269.52 mg/100 g, respectively. Significant difference ($p \leq 0.01$) was observed between the manganese content of the leaves. The *C. olitorius* leaves found highest manganese content (5.37 mg/100 g) while *A. lanata* (3.12 mg/100 g) has low content. Ascending order of phosphorus content of leaves is *C. olitorius* (269.83 mg/100 g) < *C. argentea* (305.03 mg/100 g) < *A. lanata* (334.40 mg/100 g) < *L. aspera* (357.49 mg/100 g). Highest potassium content was found in *C. olitorius*and lowest in *L. aspera*. Sodium content of *A. lanata, C. olitorius, C. argentea,* and *L. aspera* was 157.92, 109.08, 85.38 and 75.30 mg/100 g, respectively.

3.2 Bioavailable mineral content of uncultivated green leafy vegetables

The term bioavailability is defined the amount of total nutrient in a food or meal that is utilised for the normal metabolic functions.

Great variation exists with the bioavailability of micronutrients when compared to the macronutrients (Gupta *et al*., 2006; Mamiro *et al*., 2016). Many minerals inefficiently absorbed from the foods: calcium (25-30%), iron (<1-30%) and zinc (<15-50%) (Gupta *et al*., 2006). Various factors like dietary composition, physicochemical form of minerals, luminal interactions and gastrointestinal secretions influence the bioavailability of minerals (Gupta *et al*., 2006; Wang*et al*., 2020). Green leafy vegetables are the source of appreciable amount of minerals like calcium, iron and at the same time they are also contain high amount of oxalic acid, tannins, phytic acid and dietary fiber which inhibits minerals absorption. Therefore, bioavailability of *A. lanata, C. olitorius, C. argentea,* and *L. aspera* was analysed and presented in Table 4. Among the four leaves, *A. lanata* found high bioavailable zinc (81.59%) whereas highest calcium content was seen in *L. aspera*. Percentage of bioavailable iron content of *A. lanata* (59.70%) and *C. olitorius* (56.72%) was almost similar and no significant difference was observed.

Table 4: Mineral bioavailability of uncultivated green leafy vegetables

Sample	Bioavailable calcium		Bioavailable iron		Bioavailable zinc	
	mg/100 g	%	mg/100 g	%	mg/100 g	%
A. lanata	874.30[d] ± 1.00	68.73	8.25[b] ± 0.01	56.70	2.35[d] ± 0.00	81.59
C. olitorius	753.00[c] ± 0.60	68.83	8.52[d] ± 0.03	56.72	1.66[b] ± 0.00	54.24
C. argentea	723.90[b] ± 0.60	69.14	8.37[c] ± 0.12	55.72	1.52[a] ± 0.00	32.75
L. aspera	653.00[a] ± 0.60	71.52	7.81[a] ± 0.12	54.53	2.16[c] ± 0.00	56.39

Note: Values are expressed as mean ± standard deviation of three determinations; Means within the same column followed by a common letter do not differ significantly at ($p \leq 0.01$); NS: not significant; ** significant at ($p \leq 0.01$); * significant at ($p \leq 0.05$).

3.3 Antioxidant screening and phytonutrient content of uncommon green leafy vegetables

Plants produce various non-nutritive secondary metabolites called as phytonutrients or bioactive compounds that have defensive mechanism as well as disease preventive properties. Major bioactive compounds include alkaloids, phenols, carbohydrates, flavonoids, tannins, terpenoids and steroids (Moond*et al*., 2023; Devi *et al*., 2023). The methanolic extracts of all the flour leaves identified the presence of phenols, flavonoids, tannins, alkaloids, terpenoids, saponins, glycosides, proteins, amino acids, carbohydrates, phlobatinins and steroids.

Bioactive compounds in methanolic extracts of all the four leaves were estimated and the results were mentioned in Table 5. Total phenol content of *A. lanata, C. olitorius, C. argentea,* and *L. aspera* were 302.08, 403.14, 817.12 and 1443.65 mg GAE/100 g, respectively. Phenolic compounds serve as the potent antioxidants and reduces the risk oxidative stress related diseases (Kumar and Goel, 2019; Devi *et al*., 2023). Total flavonoid content was analysed and expressed as rutin equivalents. The *C. argentea* found high flavonoid content (180.66 mg RE/100 g) whereas *A. lanata* has low content (157.62 mg RE/100 g). Statistically significant difference was observed in the tannin content of leaves. Tannin content of leaves was ranged between 150.99-720.74 TAE mg/100 g. Tannin content of *L. aspera* was very high compared to other leaves. The total antioxidant of the leaves was estimated using DPPH (2,2-diphenyl-1-picrylhydrazyl). Among the four leaves, *L. aspera* (95.77%) leaves exhibited highest antioxidant activity, followed by *C. argentea* (75.21%), *C. olitorius* (40.30%) *and A. lanata* (11.57%). Phytic acid content of *A. lanata, C. olitorius, C. argentea,* and *L. aspera* was 946.00, 334.64, 855.00 and 786.33 mg/100 g, respectively.

Table 5: Phytonutrient content of uncultivated green leafy vegetables

Sample	Phenols (mg GAE/100 g)	Flavonoids (mg RE/g)	Tannins (mg TAE/100 g)	Antioxidant activity (%)	Phytic acid (mg/100 g)
A. lanata	302.08[d] ± 0.55	157.62[d] ± 0.30	150.99[d] ± 0.23	11.57[d] ± 0.15	946.00[a]± 1.00
C. olitorius	403.14[c] ± 0.33	170.84[c] ± 0.26	201.37[c] ± 0.35	40.30[c] ± 1.22	334.64[d]±0.38
C. argentea	817.12[b] ± 0.51	180.66[a] ± 0.42	408.08[b] ± 0.16	75.21[b] ± 0.28	855.00[b]± 1.00
L. aspera	1443.65[a] ± 0.76	177.94[b] ± 0.35	720.74[a] ± 0.59	95.77[a] ± 0.79	786.33[c]± 2.51
F value	2562732.80	7032.33	1174341.05	250.31	104643.86
p value	0.00**	0.00**	0.00**	0.00**	0.00**

Note: Values are expressed as mean ± standard deviation of three determinations: Means within the same column followed by a common letter do not differ significantly at ($p \leq 0.01$); NS: not significant; **significant at ($p \leq 0.01$); *significant at ($p \leq 0.05$).

4. Discussion

Previous studies stated that the *A. lanata, C. olitorius, C. argentea,* and *L. aspera* has been using in the traditional medicine since centuries (Biswas *et al*., 2020; Baiyeri *et al*., 2022; Isuosuo*et al.,* 2019; Omotoso *et al*., 2017; Kanu *et al.,* 2017; Manokari *et al*., 2016; Devi *et al*., 2013). Beyond pharmaceutical usage, there is a wide spread trend to use herbal/medicinalplants as dietary additions to enhance quality of life and to prevent various types of diseases (Devi *et al*., 2023). Statistically significant difference ($p \leq 0.01$) was observed in the proximate composition of all the leaves. The ash, fat, crude fiber, protein, carbohydrates and energy content of selected uncultivated green leafy vegetables are ranged between 12.13-17.26 g, 2.23-4.74 g, 8.52-15.90 g, 12.03-24.48 g, 37.64-53.90 g 254.1-293.5 kcal/100 g, respectively. Gupta and Prakash (2011) found significant increase in ash, calcium, iron content of dehydrated *C. argentea* than the fresh leaves (Gupta and Prakash, 2011). Among the four leaves, dried *C. argentea* is a good source of plant protein. Nowadays, there is an increased demand for the plant-based foods which provides more than 12% of their calorific value from the protein are the remarkable suppliers of protein in vegetarian and vegan diets (Bravo *et al*., 2021; Neeharika and Vijayalaxmi, 2023). The *A. lanata, C. olitorius, C. argentea,* and *L. aspera* provides 28.76, 16.39, 35.32, 18.76% of their total calories from protein, respectively. Hence, all the selected leaves are can be considered as a remarkable source of protein.

Significant difference ($p \leq 0.01$) was found in the ascorbic acid, total carotenoid and β-carotene of selected leaves. Dehydrated *A. lanata* is the good source of total and beta carotenoid content. Dehydration led to only 1-14% retention of vitamin C, 49-73% of total carotene and 20-69% of beta carotene (Gupta *et al*., 2013). Ascorbic acid, total carotene and beta carotene content was decreased in dried *C. argentea* than the fresh leaves (Gupta and Prakash, 2011). Micronutrients content of all the selected leaves was increased upon drying. Drying removes the moisture content and increases density of minerals. Irrespective of loss of vitamins take place during drying, dried greens are the concentrated source of micronutrients (Oulaï *et al*., 2016; Khatoniar *et al*., 2019).

All the selected leaves found good bioavailable calcium (*L. aspera)*, iron (*C. olitorius*) and zinc (*A. lanata*) content. The term bioavailability goes beyond the absorption from the gut, it also includes usage and storage in the body tissues (Melse-Boonstra, 2020). A number of dietary components influences the mineral bioavailability. Oxalic acid is an antinutritional factor that is widely distributed in plant foods effect the mineral bioavailability (Gupta *et al.* 2006). Heat treatment is the best treatment to decrease antinutritional contents in green leafy vegetables, as this heat treatment ruptures the plant cell and leaches out the soluble compounds into the blanching medium. Cooking and blanching methods effectively leaches out the oxalates and phytates (Natesh *et al.,* 2017).

The methanolic extracts of leaves identified the presence of phenols, flavonoids, tannins, alkaloids, terpenoids, saponins, glycosides, phlobatinins, steroids, proteins, amino acids, and carbohydrates. Significant differencewas found in the phytonutrient content of leaves. Among all the four leaves, highest phenol (1444.65 mg GAE/ 100 g), tannin (720.74 mg TAE/100 g) and total antioxidant activity (95.77%) was found in *L. aspera* than other leaves. Among various classes of bioactive compounds, phenolic compounds have strong antioxidant and antimicrobial activity (Krishnarao and Rajeswari, 2023). Phytochemicals present in plants are responsible for the its medicinal properties and physiological effects on people (Moond*et al*., 2023).

5. Conclusion

The present study evaluated the nutritional and phytonutrient composition of traditional uncultivated green leafy vegetables. India had rich knowledge on the culturally and nutritionally rich foods. Community forests provide plant species of high economic value which significantly contributes food and nutritional security. Selected uncultivated green leafy vegetable are the valuable sources of nutrients like carbohydrates, crude fiber, protein, β-carotene, ascorbic acid, total carotenoids, micronutrients like calcium, iron, zinc and phytonutrients.Integrating indigenous leafy vegetables into diet is one of the best strategies to combat micronutrient deficiencies and helps to achieve micronutrient security. Uncultivated green leafy vegetables are the powerhouse of phytochemicals and can be used by the people of all ages. Nutritional programmes based on the local available resources will be best reached to all sections of the people. Drying is a simplest convenient process for preserving micronutrients and so, these greens can be advocated as a feasible food-based approach to combat micronutrient malnutrition.

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Conflict of interest

The authors declare no conflicts of interest relevant to this article.

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