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RESEARCH ARTICLE

Grasspea (*Lathyrus sativus* L.) - A Potential Leafy Vegetable of Eastern India

Kuldeep Tripathi[1*], Kumari Shubha[2], RK Pamarthi[1], A Mukherjee[2], Ramya KR[1], Rakesh Bhardwaj[1], Rinky Resma Panda[3], DP Semwal[1], KC Bhatt[1], PK Viswakarma[4], RK Gautam[1] and PK Singh[1*]

Abstract

Grasspea (*Lathyrus sativus* L.), locally known as "*Khesari,*" is extensively cultivated in Eastern parts of India, i.e., Eastern Uttar Pradesh, Bihar, Jharkhand, and West Bengal. This study focuses on the exploration, collection, and survey of grasspea as a leafy vegetable to revitalize traditional knowledge for practical applications. The data on collected grasspea samples (46 accessions) from five germplasm expedition missions were presented in the study. These were subjected to Garrett ranking and biochemical profiling along with organoleptic evaluation. The findings of the study elucidated the preference for grasspea consumption in the descending order: leafy vegetable > pulse > fodder > by-products/processed product. The nutritional profiling of leaves of selected accessions of grasspea was assessed for proximate parameters. This comprehensive study provides valuable insights into the use and preferences associated with grasspea consumption in Eastern India, paving the way for practical applications and the revival of traditional knowledge.

Keywords: Grasspea, Exploration, Collection, Leaves, Garrett ranking, Organoleptic.

[1]ICAR-National Bureau of Plant Genetic Resources, New Delhi 110 012, India

[2]ICAR-Research Complex for Eastern Region, Patna, Bihar, India.

[3]The Graduate School, ICAR-Indian Agricultural Research Institute, New Delhi 110 012, India.

[4]Krishi Vigyan Kendra (KVK), Sitamarhi, Bihar, India.

***Author for correspondence:**

kdtripathi89@gmail.com; pksingh128@gmail.com

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Introduction

Green leafy vegetables have attracted global attention due to their significant role in promoting a healthy diet and offering various health benefits to humans. Vegetables are commonly referred to as "protective foods" in the human diet because of their diverse health advantages, stemming from their abundance in vitamins, essential fatty acids, minerals, amino acids, dietary fiber, and various essential bioactive compounds. Plants serve as primary sources of numerous bioactive compounds collectively known as phytochemicals, which are recognized as crucial for maintaining good health (Grusak *et al*., 1999; Dias, 2012). Phytochemicals can be broadly categorized as nutritional components, including essential fatty acids, proteins, vitamins, minerals, and phenolic compounds. Leafy vegetables stand out for their high mineral content, particularly iron and calcium, surpassing that of staple food grains. Their low caloric value makes them an ideal choice for weight management (Castorena-Torres *et al*., 2014). Encouraging the consumption, cultivation, and potential commercialization of these leafy vegetables is therefore recommended. Additionally, leafy vegetables are natural sources of folic acid, essential for the multiplication and maturation of red blood cells (Gopalan *et al*., 2004). The World Health Organization/Food and Agriculture Organization (WHO/FAO) published a report in 2003 recommending a minimum daily intake of 400 g of fruits and vegetables (excluding potatoes and other starchy tubers) to prevent chronic diseases such as heart disease, cancer, diabetes, and obesity, as well as to address micronutrient deficiencies (Lee, 2016; Healthy diet fact sheet, WHO, 2024). The dietary guidelines for Americans suggest five servings of vegetables per day, with one of those servings specifically emphasizing green leafy vegetables HHS/USDA, 2015 (Natesh *et al*., 2017). Incorporating these green leafy vegetables into daily diets may help fulfill the daily requirements of essential nutrients, particularly for individuals with marginal nutritional status. The nutritional composition varies among genera and species of different edible leafy vegetables. Currently, underutilized foods are gaining importance as a means to enhance per capita food availability (Gopalan *et al*., 2004; Edelman and Colt, 2016). In nature, numerous underutilized greens with promising nutritive value exist, and one such example is grasspea (*Lathyrus sativus* L.) as a source of green leafy vegetables. India, with its diverse natural surroundings, varying climates, and seasons, boasts a variety of leafy vegetable species. Commonly consumed leafy vegetables include spinach (*Spinacia oleracea*), amaranth (*Amaranthus gangeticus, A. viridis*), fenugreek (*Trigonella foenum graecum*), drumstick (*Moringa oleifera*), kangkong (*Ipomea aquatica*), mustard (*B. juncea* var. *rugosa*), jute (*Corchorus olitorius*), bathua/pigweed (*Chenopodium album*), among others. These greens are not only affordable and high-yielding but also integral to the local diet, often readily available. Grasspea is one of the oldest cultivated crops, with a long history of domestication (Smartt, 1984). The origin of the crop dates back to archaeological excavations in Turkey and Iraq (Jackson and Yunus, 1984; Lambein *et al*., 2019). The oldest excavations in India of 2500 BC and 8000 BC in the Balkans (Saraswat, 1980; Kislev, 1989; Tripathi *et al*., 2021). Grasspea is cultivated in northern states of India, especially in central and eastern regions, for both pulse and green leafy (Mehra *et al*., 1996). Grasspea is a climate-smart crop used for both food and feed, requires minimal inputs, has the ratooning capacity, and is used in conservation agriculture and also in pharmaceutical industries, thereby acting as an insurance crop to marginal farmers (Ramya *et al*., 2022; Dutta *et al.,* 2024; Singh *et al.,* 2024). It is considered one of the more profitable crops than boro or summer rice in West Bengal (Tripathi *et al*., 2022). The use of grasspea as a pulse has been well documented, but its potential as a leafy vegetable has received less attention. The leaves of grasspea are a rich source of protein, vitamins, and minerals and can be used as a fresh vegetable or as an ingredient in soups, stews, and other dishes. The young leaves and pre-flowering shoots of grasspea are consumed as leafy vegetables in Bangladesh (Arora *et al*., 1996). Usually, the tender young shoots of grasspea at the pre-flowering stage are sold as green leafy vegetables in West Bengal (Tripathi *et al*., 2022 and 2022a; Ramya *et al.,* 2024). The straw and residual biomass from grasspea production can be used as animal feed, providing a valuable source of protein and energy for animals. The rolled and dried leaves of grasspea are also used as off-season vegetables due to their delicacy (Bharati and Neupane, 1989; Tripathi *et al*., 2022). This present study discusses the collection and documentation of grasspea leaves in addressing food, nutritional security and dietary diversity of the people of the eastern parts of India and aims to evaluate the nutritional value of grasspea and their potential impact on the preference of consumption over another green leafy vegetable.

Materials and Methods

Study Area and Exploration

The exploration trips were planned and conducted in the eastern part of India, i.e., Bihar, Jharkhand, Uttar Pradesh and West Bengal where grasspea has been cultivated for a long time. The multi-crop explorations were undertaken in collaborative mode with crop-based institutes/State Agricultural Universities (SAU's)/Krishi Vigyan Kendra (KVK's) during 2020-21, 2021-22, 2022-23 and collected around 46 accessions from Bihar (Nawada, Banka, Kaimur, Rohtas, Bhojpur, Buxar, Sitamarhi, Darbhanga and Saharsa) and West Bengal (Paschim Medinipur, Purba Medinipur, Murshidabad). The diversity distribution pattern, cultivation status and frequency of use were also surveyed through fields, local mandi/markets, kitchen gardens and backyards/homesteads. The passport data was collected, which includes the details of state, district, village, latitude (N) and longitude (E). The number of accessions collected in different areas and years is given in Table 1.

In order to know the diversity distribution pattern, DIVA-GIS software version 7.5 (www.diva-gis.org) was used to

Table 1: List of explorations conducted for augmenting *Lathyrus* germplasm

S. No.	*Year*	*Site of collection*	*No. of accessions collected*	*Institute involved*
1	2020	East Medinipur, West Medinipur and Murshidabad (West Bengal)	21	(Bidhan Chandra Krishi Viswavidyalaya) BCKV Mohanpur, West Bengal
2	2021	Nawada and Banka (Bihar)	04	KVK, Nawada, Banka, Bihar
3	2021	Saharsa (Bihar)	02	KVK, Saharsa, Bihar
4	2021	Bhojpur, Buxar, Kaimur and Rohtas (Bihar)	08	KVK, Rohtas, Kaimur
5	2022	Darbhanga, Madhubani and Sitamarhi (Bihar)	11	KVK, Jale, Darbhanga, Sitamarhi, Bihar

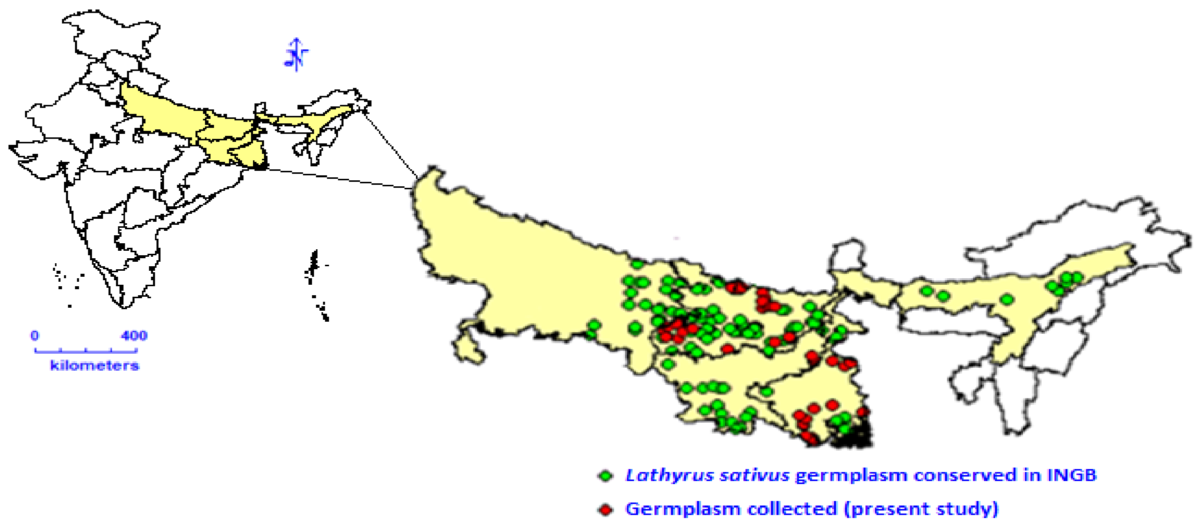

Figure 1: Grasspea germplasm collection sites in the parts of Bihar and West Bengal states and conservation in NGB in the parts of Bihar, Jharkhand, Uttar Pradesh and West Bengal states of Eastern India

generate the potential distribution map (Hijmans *et al*., 2001). DIVA-GIS software version 7.5, freely downloadable software from www.diva-gis.org was used to generate the potential distribution map. Grasspea germplasm collection sites in the parts of Bihar and West Bengal states (red color) in the present study and the regions where it has been collected already and conserved in ICAR-NBPGR national genebank (NGB) are given in Figure 1.

Garrett Ranking Technique

The Garrett ranking technique was used to rank the preferences for grasspea consumption among local consumers. The Garrett ranks were calculated using the appropriate formula, and the Garrett value was then determined. The Garrett tables and scores for each problem in the table were multiplied and added row-wise to obtain the total Garrett score.

$$\text{Percent position} = \frac{100(R_{ij}-0.5)}{N_j}$$

Where R_{ij} represents the rank given to the i^{th} variable by the j^{th} respondent, and N_j is the number of variables ranked by the j^{th} respondent. The percent positions were then converted into scores using the Garrett table (Garrett and Woodworth, 1969). The scores for each individual were then added for each factor, and the total and mean values were calculated. The factor with the highest mean value was considered the most important.

Biochemical Profiling

The preliminary biochemical analysis was done for the selected accessions, namely IC0634659, IC0634654, IC0634666, IC0634662, IC0634674, and IC0634754, for proximate components along with β-ODAP estimation. The nutritional composition of the leaves was determined using the standard methods (AOAC, 2016) viz. moisture (AOAC 934.01), protein (AOAC 2001.11), total soluble sugar (Anthrone reagent method) and total dietary fiber by AOAC Official Method 985.29 and mineral estimation (Iron, Copper, Zinc, Calcium and Magnesium) by atomic absorption spectroscopy (AAS) as per AOAC method 999.11 and β-ODAP (β-N-oxalyl-l-α, β-diamino propionic acid) estimation by ultra-performance liquid chromatography (UPLC) as per Fikre *et al*. (2008).

Results and Discussion

Grasspea leaves have the potential to play an important role in contributing to improved food security and sustainable agriculture in several ways. Grasspea leaves are a nutrient-dense vegetable that is high in protein, fiber, and essential vitamins and minerals. By including grasspea leaves in the diet, people can increase their intake of important nutrients, which can help to improve their health and well-being. Grasspea is a drought-tolerant crop that can be grown in areas with low rainfall and poor soil quality. The stems of this plant are four-angled (quadrangular), which are very thin, featuring winged edges. Leaves are arranged pinnately opposite to each other and consist of one or two pairs of lanceolate leaflets, culminating in a single or branching tendril. These leaflets are sessile, whole, and wedge-shaped at the base, tapering to an acuminate point at the top. The stipules take on a triangular to oval shape with a basal appendage. Farmers commonly sell the tender leaves and branches of the grasspea in markets in India and Bangladesh (Ramya *et al*., 2022). By growing grasspea and utilizing leaves, farmers can produce a nutritious crop that is well-suited to the local growing conditions without requiring extensive irrigation or fertilization. Grasspea, as a drought-tolerant crop, offers resilience against climate change-related droughts. While its leaves provide a palatable leafy

Figure 2 (a): Field view of grasspea in West Bengal (West Medinapur) and (b). Field view of grasspea in Bihar (Madhubani)

vegetable option in mild drought conditions, extended drought can lead to tougher textures and increased fibrous content in the leaves, reducing palatability for human consumption. However, these hardy leaves remain valuable as a nutritious fodder option for livestock under challenging climatic conditions. By growing grasspea leaves, farmers can adapt to the changing climate and continue to produce food in challenging conditions. Growing grasspea leaves can provide an important source of income for farmers, especially in areas where other crops may not grow well. By diversifying their crops and selling grasspea leaves in local markets, farmers can improve their livelihoods and contribute to the local economy.

Exploration and Collection

A total of about 144 accessions of grasspea from the eastern parts of India were conserved in the National Genebank, ICAR-NBPGR, New Delhi (NGB Database, 2023). The diversity and distribution of these accessions across the areas of study and methods of use by the communities were also recorded. Geo-referenced maps were prepared using the WGS84 datum and Everest projection systems (Semwal *et al*., 2018). The field view of grasspea in West Bengal (west Medinapur) and Bihar (Madhubani) is given in Figure 2.

The passport data of 46 collected grasspea accessions are given in Table 2. The variability in grasspea leaves is given in Figure 3. Initially in the season, farmers can fetch a high income with prices ranging from Rs. 150 to 220/kg. However, as the season progresses, the prices typically decrease. To avoid transport charges, farmers sometimes sell their produce directly to local vendors in markets at a lower rate of Rs. 80 to 90/kg. During the survey, it was observed that local people mostly prefer grasspea leaves over other leafy vegetables available in the season. Additionally, leaves are used in some traditional medicine systems for their various health benefits. The comparative table of nutritional aspects of grasspea is also depicted in Table 3.

Garrett Ranking Technique

The preference ranking for grasspea consumption by the farmers of Bihar and West Bengal was calculated by combining incomplete order of merit ranking. The respondents were asked to rank their grasspea preferences for uses like leafy vegetable, use as pulse, use as powder/ pakora/other snack items and use as fodder (Table 4).

Figure 3: Variability in leaf shapes in the cultivated varieties of grasspea

Grasspea cultivation is a source of income for smallholder farmers, who can sell grasspea leaves in local markets or to processors who can pack and distribute them to wider markets. The findings of the study elucidated that the preference of grasspea consumption in the order are, in descending order: leafy vegetable > pulse > fodder > by-products. The preference for grasspea as a leafy vegetable can be attributed to its high nutrition and other traditional uses. However, the lower preference for grasspea by-products suggests the need for more innovative ways to promote its utilization and create value addition.

Grasspea is primarily used as a leafy vegetable during its vegetative stage, followed by its cultivation for pulses after harvest. In northern Bihar, as a leafy vegetable, it received Garrett's ranking scores of 61.6 and 70.85, while in southern Bihar, it was favored as a pulse in West Bengal with a ranking score of 61.76, closely matched by its ranking as a leafy vegetable at 60.71. Notably, no significant difference in ranking was observed between the northern and southern regions of Bihar despite their distinct agroecological characteristics.

Organoleptic Assessment and Biochemical Profiling

The leaves were harvested at 50 to 60 days after sowing, specifically during the pre-flowering stage, and were subsequently used for cooking and sensory evaluation. The assessment involved 20 participants, including individuals from diverse backgrounds, such as scientists, students, project assistants, and daily wage laborers and the information was recorded through a structured/ semi-structured questionnaire method. The consensus among this group was that the taste of khesari as leafy vegetable (*L. sativus*) was greatly preferred over other available saag during that season, including *karamua* (*Ipomea aquatica*), mustard leaves, patsan (*Corchorus olitorius*), amaranthus and bathua (*Chenopodium album*). The feedback and recommendations from the individuals under study further validated the suitability of Khesari saag as a green leafy

Table 2: Grasspea germplasm collection sites from the eastern India

S. No.	*Accession/Collection no.*	*Village*	*Mandal*	*District*	*State*	*Lat*	*Long*
1	648849	Sukhnar	Kawakol	Nawada	Bihar	24.660	85.340
2	DPS/PKK-22-46	Giddha	Belhar	Banka	Bihar	24.890	86.600
3	648858	Uprama	Rajoun	Banka	Bihar	24.990	86.960
4	648860	Kaitha	Rajoun	Banka	Bihar	25.060	86.950
5	DP/SC/21-20	Alipur	Ramgarh	Kaimur	Bihar	25.30	83.69
6	641907	Sadallapur	Ramgarh	Kaimur	Bihar	25.27	83.70
7	641908	Panjrawn	Nuaon	Kaimur	Bihar	25.38	83.78
8	641909	Mokar	Sasaram	Rohtas	Bihar	25.01	84.03
9	641913	Karmainikhurd	Dinara	Rohtas	Bihar	25.22	84.18
10	641918	Nathupur	Kudra	Kaimur	Bihar	25.07	83.75
11	DP/SC/21-18	Fatehpur	Itarhi	Bhojpur	Bihar	25.290	84.443
12	DP/SC/21-32	Dhansoi	Rajpur	Buxar	Bihar	25.488	84.010
13	IC0470973	Premnagar	Sitamarhi	Sitamarhi	Bihar	26.59	85.54
14	IC0470975	Basatpur	Sonbarsa	Sitamarhi	Bihar	26.65	85.66
15	IC0470976	Ramnagar	Bathana	Sitamarhi	Bihar	26.58	85.45
16	IC0470977	Piprarhi	Bajpatti	Sitamarhi	Bihar	26.56	85.64
17	IC0470978	Birrakh	Sursand	Sitamarhi	Bihar	26.61	85.71
18	IC0470979	Sukhet	Jhanjharpur	Madhubani	Bihar	26.23	86.32
19	IC0470980	Berma	Lakhnaur	Madhubani	Bihar	26.26	86.32
20	IC0470981	Bullipatti	Jaynagar	Madhubani	Bihar	26.45	86.26
21	IC0470982	Samdhinia	Jale	Darbhanga	Bihar	25.96	86.23
22	IC0470983	Kortho	Ghanshyampur	Darbhanga	Bihar	26.03	86.34
23	IC0470984	Baika	Tardih	Darbhanga	Bihar	26.15	86.25
24	643774	Hempur	Nohatta	Saharsha	Bihar	26.02	86.49
25	643777	Barahsher	Satarkataiya	Saharsha	Bihar	25.99	86.55
26	634654	Baragrah	Debra	Paschim Medinipur	West Bengal	22.23	87.3400
27	KT/2020/16	Bhagwanpur	Debra	Paschim Medinipur	West Bengal	22.2900	87.3500
28	KT/2020/21	Radhakantapur	Debra	Paschim Medinipur	West Bengal	22.4500	87.3800
29	634655	Kamargeria	Naraingarh	Paschim Medinipur	West Bengal	22.6000	87.2300
30	634656	Horekhali	Sutahata	Purba Medinipur	West Bengal	22.7000	88.9000
31	634657	Begunaberia	Sutahata	Purba Medinipur	West Bengal	22.7000	88.9000
32	634658	Masuria	Mahishadal	Purba Medinipur	West Bengal	22.9000	88.1000
33	634659	Chandipur	Mahishadal	Purba Medinipur	West Bengal	22.8000	87.5900
34	634660	Subdi	Nandigram II	Purba Medinipur	West Bengal	21.8800	87.5200
35	634661	Subdi	Nandigram II	Purba Medinipur	West Bengal	21.8800	87.5200
36	634662	Sonachura	Nandigram I	Purba Medinipur	West Bengal	21.7900	87.5800
37	634663	Soudkhali	Nandigram I	Purba Medinipur	West Bengal	21.7900	87.5900
38	634664	Katkadevi Chak	Khejuri II	Purba Medinipur	West Bengal	21.7500	87.5200
39	634665	Deshduttapur	Contai I	Purba Medinipur	West Bengal	21.8200	87.4600
40	634666	Dholgada	Egra II	Purba Medinipur	West Bengal	21.9400	87.4000
41	634667	Galadaria	Jalangi	Murshidabad	West Bengal	24.1100	88.4200
42	634669	Ahiran	Suti-I	Murshidabad	West Bengal	24.3100	88.1000
43	634670	Harua	Suti-I	Murshidabad	West Bengal	24.3100	87.5900
44	634672	Kasim Nagar	Suti II	Murshidabad	West Bengal	24.3700	87.5900
45	634673	Gohalbari	Farakka	Murshidabad	West Bengal	24.4400	87.5400
46	634674	Jamalpur	Raninagar II	Murshidabad	West Bengal	24.2200	88.5400

Table 3: Comparative nutritional profile of grasspea with other leafy vegetables

Nutritional parameters	*Major leafy vegetables*					
	Grasspea	*Kangkong*	*Mustard*	*Jute*	*Amaranthus*	*Pigweed*
Protein (%)	28.42	23.6–27.6 (Adedokun *et al*., 2019)	18.58–33.38 (Pant *et al*., 2020; Bhandari *et al*., 2021; Priyanka *et al*., 2021; Tiwari, 2023)	*12.54 ± 0.10 - 16.26 ± 0.34 (Ndlovu and Afolayan, 2008;* Idris *et al*., 2009	11.59–29.06 (Andini *et al*., 2013; Pathan *et al*., 2019)	27.84 ± 0.36–37.05 (Pathan *et al*., 2019; Villacrés, *et al*., 2022)
Fibre (TDF) (%)	20.41	5.40 ± 0.20 -17.67 ± 0.35 (Umar *et al*., 2007; Shariff *et al*., 2019)	3.20 (Paula Filho *et al*., 2018)	2.03 ± *0.1(Ndlovu and Afolayan, 2008)**	14.04 ± 0.35 *(Umar et al., 2011)**	36.37 ± 2.34 (Villacrés, *et al*., 2022)
Moisture (%)	13.84	4.75 (Adedokun *et al*., 2019)	68 to 88 (Pant *et al*., 2020)#	7.48 ± 1.36 (Traoré *et al*., 2017)	7.38 ± 3.84 (Traoré *et al*., 2017)	5.23 ± 0.17 (Villacrés, *et al*., 2022)
Ash (%)	8.81	10.83 ± 0.80 (Umar *et al*., 2007)	10.94-15.48 (Pant *et al*.,2020)	18.38 ± 0.32 (Idris *et al*., 2009)	16.43–21.05 ± *0.30 (*Kachiguma *et al*., 2015; *Umar et al., 2011)*	2.1–20.0 (Pathan *et al*., 2019; Villacrés, *et al*., 2022)
Calcium (mg/100 g)	156.544	416.70 ± 5.77 (Umar *et al*., 2007)	123.25–240 (Paula Filho *et al*.,2018; Pant *et al*.,2020)	30.55 ± 0.05 to 1650 ± 0.83(Zeghichi *et al*., 2003; Idris *et al*., 2009)	110.67–*1483 (Umar et al., 2011; Kachiguma et al., 2015; Kambabazi et al., 2021)*	147–1535.0 (Yadav *et al*., 2018; Pathan *et al*., 2019; Villacrés, *et al*., 2022)
Iron (mg/100 g)	52.101	210.30 ± 2.47(Umar *et al*., 2007)	30.56–37.52 (Priyanka *et al*., 2021; Bhandari *et al*., 2021)	19.53 ± 0.09 to *55.9* ± 3.22 (Zeghichi *et al*., 2003; Idris *et al*., 2009)	19.82–419 ± 68.81(Umar *et al*., 2011; *Kachiguma et al., 2015; Kambabazi et al., 2021)*	7.6–148 (Yadav *et al*., 2018; Pathan *et al*., 2019)
Copper (mg/100 g)	1.125	0.36 ± 0.01(Umar *et al*., 2007)	45.2–48.9 (Kumar *et al*., 2017)	2.52 ± 0.02 to 22.5 ± 1.74 (Zeghichi *et al*., 2003; Idris *et al*., 2009)	2.87 ± 1.23 (Umar *et al*., 2011)	1.0–1.12 (Pathan *et al*., 2019)
Magnesium (mg/100 g)	295.589	301.64 ± 12.69(Umar *et al*., 2007)	26.82 (Paula Filho *et al*., 2018)	76.69 ± 0.13 to 340 ± 1.11(Zeghichi *et al*., 2003; Idris *et al*., 2009)	40.3.13 ± 34.27 to 462 (Umar *et al*., 2011; *Kachiguma et al., 2015*)	2.26 ± 0.23 to 902.0 (Pathan *et al*., 2019; Villacrés, *et al*., 2022)
Zinc (mg/100 g)	5.271	2.47 ± 0.27(Umar *et al*., 2007)	5.73–5.83 (Bhandari *et al*., 2021; Priyanka *et al*., 2021)	4.71 ± 0.01 to 11.2 ± 0.57(Zeghichi *et al*., 2003; Idris *et al*., 2009)	1.30 ± 0.70 to 1.76 (Umar *et al*., 2011; *Kachiguma et al., 2015)*	1.3–9.8 (Yadav *et al*., 2018; Pathan *et al*., 2019)

wet basis, * crude fibre/ protein

vegetable. The sensory (organoleptic) assessment has confirmed that the knowledge regarding the utilization of leaves as saag and the preparation of dishes from them may have been passed down through generations within a traditional culture by trial-and-error approach. The preference for grasspea as a leafy vegetable is consistent with its high nutritional value, as it is a good source of protein, iron, and other essential nutrients (Bogale *et al*., 2015). The use of grasspea as a pulse is also popular due to its unique taste and versatility in various dishes (Sawar *et al*., 1996; Campbell, 1997). The preliminary biochemical analysis of grasspea leaves showed the higher nutritional value of the crop and the values are given in Table 5. The nutritional profiling of grasspea for its leaves is as follows: protein content ranged from 26.49 to 31.47%; sugar – 3.07 to 4.61%; phenols – 0.42 to 0.5%; TDF- 16.35 to 24.69%; Moisture – 11.90 to 15.60%; ash content- 7.38 to 11.31%. The Duncan multiple range test (DMRT) of different proximate parameters of grasspea leaves is given in Table 5.

In the present investigation, the protein content in grasspea was different for the accessions, where low protein was grouped in group a and middle range of protein in group ab and higher values were grouped as b and c group. Similarly, the parameters like sugar, zinc, and calcium

Table 4: Preference ranking for grasspea consumption by the consumers of Eastern states of India (n = 50)

S.N.	*Preferences*	*Garrett score*	*72*	*56*	*43*	*28*	*Total*	*Average*	*Rank*
		Rank frequency	*1*	*2*	*3*	*4*			
1	*Bihar*								
A	***Northern Bihar (n =15)***								
a	Leafy vegetable		7	7	0	1	924	61.6	I
b	Pulse		6	5	4	0	884	58.93	II
c	By-product (Powder/*Pakoda*/other snacks item)		0	2	7	6	581	38.73	IV
d	Fodder		2	1	4	8	596	39.73	III
B	***Southern Bihar (n = 14)***								
a	Leafy vegetable		13	1	0	0	992	70.85	I
b	Pulse		1	12	1	0	787	56.21	II
c	By-product (Powder/Pakoda/other snacks item)		0	1	0	13	420	30	IV
d	Fodder		0	1	12	1	600	42.85	III
2	***West Bengal (n = 21)***								
a	Leafy vegetable		7	13	1	0	1275	60.71	II
b	Pulse		10	8	3	0	1297	61.76	I
c	By-product (Powder/*Pakoda*/other snacks item)		0	0	1	20	603	28.71	IV
d	Fodder		4	0	16	1	1004	47.80	III
3	***Pooled***								
a	Leafy vegetable		27	21	1	1	3191	63.82	I
b	Pulse		17	25	8	0	2968	59.36	II
c	By-product (Powder/Pakoda/other snack items)		0	3	8	39	1604	32.08	IV
d	Fodder		6	2	32	10	2200	44	III

Table 5: DMRT of proximate parameters of grasspea leaves

Acc.no	*Protein*	*Sugar*	*Phenol*	*TDF*	*Moisture*	*Ash*	*Cu*	*Fe*	*Zn*	*Ca*	*Mg*
IC0634659	26.49^{a}	3.06^{a}	$.42^{a}$	16.35^{a}	11.90^{a}	7.38^{a}	0.98^{a}	37.25^{a}	3.89^{a}	84.25^{a}	252.56^{a}
IC0634654	27.29^{ab}	3.31^{ab}	$.43^{a}$	17.48^{a}	13.27^{ab}	7.67^{a}	1.09^{b}	51.14^{b}	4.87^{b}	91.93^{b}	253.17^{a}
IC0634666	27.50^{ab}	3.58^{bc}	$.47^{a}$	17.49^{a}	13.36^{ab}	7.84^{a}	1.10^{b}	51.78^{b}	5.06^{c}	106.57^{c}	291.17^{b}
IC0634662	28.36^{ab}	4.04^{cd}	$.49^{a}$	23.20^{b}	13.92^{bc}	8.22^{a}	1.11^{b}	53.96^{bc}	5.56^{d}	173.33^{d}	293.54^{b}
IC0634674	29.39^{b}	4.24^{de}	$.49^{a}$	23.22^{b}	15.01^{bc}	10.44^{b}	1.21^{c}	56.22^{c}	5.95^{e}	223.78^{e}	312.91^{c}
IC0634754	31.47^{c}	4.61^{e}	$.50^{a}$	24.69^{b}	15.60^{c}	11.31^{b}	1.26^{c}	62.27^{d}	6.29^{f}	259.41^{f}	370.19^{d}

Protein, sugar, phenol, TDF, moisture, and ash are expressed in %; minerals Cu, Fe, Zn, Ca and Mg are expressed in mg/100g

showed significant differences with each other and each fell into different groups. Parameters like TDF, moisture, ash, copper, iron and magnesium showed significant differences between the accessions and fell into a group of 2, 4, 2, 3, 5, 4, respectively. The phenol content did not show any significant difference with each other and all the accessions were grouped in a single group. The biochemical analysis highlighted that grasspea leaves contain a high amount of protein and other proximate components. Research consistently indicates that the β-ODAP content in grasspea is generally higher during the vegetative stage compared to the seed stage (Barpete *et al.,* 2022). This increase in β-ODAP levels is attributed to environmental stressors like drought (Han *et al.,* 2024) and nutrient depletion, which tend to boost the biosynthesis of ODAP in grasspea leaves during the vegetative growth phase. These findings suggest that while grasspea is valuable as a leafy vegetables, monitoring ODAP levels is crucial, especially in early stages under stressful conditions. However, β-ODAP needs to be validated over the years and locations.

Conclusion

The research findings highlighted the widespread preference for grasspea as a green leafy vegetable in the Eastern states of India. The traditional use of grasspea as a leafy vegetable provides a foundation for the development of research, policies and strategies to promote grasspea cultivation and consumption, ultimately enhancing nutritional security. It also underscores the importance of understanding local preferences and the need to promote crop diversification to ensure food and nutrition security in the face of climate change and other challenges. Extensive studies are required to validate the greater number of accessions from the national genebank for nutritional parameters because of reported use as pulses, vegetables, confectionaries and fodder. The exploratory traits, cultivation technology, and package of practices to be developed for this leafy vegetable having low ODAP content, even under harsh climatic conditions. A high-yielding grasspea with superior nutritional quality as green leafy vegetables can be a boon for farmers of eastern India. A smart value addition and processing technology, strengthening the linkage can also help in promoting and upliftment of this crop.

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