

Indigenous and minor leafy vegetables

India is home to a large number of leafy vegetables which are blessed with enormous potential but practically very few information is available on their production and quality attributes. Consumption of these vegetables is mostly confined to the people living in the areas where they grow with little or no production on commercial scale. Though in the recent years few of them got attention by the growers and consumers worldwide, still most of them are in neglected state and need focused attention for achieving nutritional and health security.

DESPITE our great success towards vegetable production, India still faces challenges of nutritional security at household levels due to nutrient deficiencies such as vitamin A, iron, zinc, and calcium. As per the report of the State of the World's Children 2019, UNICEF, every second child in the age group of below 5 is affected by some form of malnutrition and every second women in our country is anemic. Leafy vegetables are those vegetables whose leaves or twigs are edible and are endowed with the best forms of phytochemicals needed to stay healthy. In India, where a large population is still living in remote areas and cannot afford to purchase high quality vegetables, indigenous wealth of leafy vegetables may serve as a stepping stone in our journey towards nutritional security. This would be particularly beneficial for poor/rural communities who live in marginal areas where major vegetable crops struggle to survive. Generally, leafy vegetables, normally found as wild or weedy can be grown easily with low production cost and high yield. They are highly climate resilient and one of the cheapest vegetables available in market, thus could be rightly described as climate smart as well as nutrition smart crop to be popularized and utilized globally. India is the home to a large number of leafy vegetables including Indian spinach (*Basella alba*), drumstick (*Moringa oleifera*), curry leaf (*Bergera koenigii* / *Murraya koenigii*), etc. and a number of lesser known leafy vegetables, which are available seasonally.

Leafy vegetables are closely associated with our culture and heritage

Leafy vegetables are commonly called as 'Saag' in most parts of the country and this appears to be derived from the Sanskrit nomenclature for all edible green leaves "SHAK". In our country, many leafy vegetables are related to social and cultural heritage. The best example is purslane (*Portulaca oleracea*), locally known as *noni saag* which is being used in Bihar during a festival called *Jivitputrica*. Another example is the 'Chauddo Shaak', where there is tradition to prepare 14 leafy vegetables in Bengal on 'Bhoot Chaturdashi', the night before Kali Puja. Likewise, Beary Muslims of coastal Karnataka prepare

Basalede kunhi pindi (small rice dumplings smeared in gravy prepared from Indian spinach and dried tuna; (a salt water fish). In Bengali cuisine, poi is widely used both in a vegetable dish; cooked with red pumpkin, and in non-vegetarian dishes; cooked with the heads of the Ilish fish and may also be cooked with shrimps. In Andhra Pradesh, a curry of *Basella* and Yam is popularly known as Kanda Bachali Koora (yam and *Basella* curry). In Maharashtra, the demand for greens is driven by festivals like Rishi Panchami, just before Ganesh Chaturthi, which venerates the sages who in Hindu mythology lived in the forests. Because many greens are foraged from the wild, they carry an aura of ancient sanctity, and are cooked as a special dish for the festival. We must respect and follow these traditions and cultures because these are one of the ways to conserve our bio-diversity.

Nutritional and nutraceuticals potential

Green leafy vegetables are blessed with tremendous nutritional and medicinal properties. They are well known sources of minerals (iron, zinc, calcium, potassium and magnesium), vitamins (vitamins A, K, C, E and B complex), essential amino acids, antioxidants, phytopigment (carotene, lutein and zeaxanthin) and dietary fibre which are beneficial for the maintenance of good health. The potassium content of leafy vegetables is good for control of diuretic and hypertensive complications. They play a key role in human health management particularly lowering the risk of chronic human ailments such a cancer, cardiovascular disease and other age related disorders. Leafy vegetables are also low in calories and thus now a day very commonly used as salad, steamed and soup due to increasing concern about calories. Leafy vegetables are the best source of iron as the presence of vitamin C and other minerals make iron easily available to our body, and thus may serve as a boon for eradication of anemia from our population. Moreover, leafy vegetables are the main source of folic acid in the rural and tribal communities where pregnant women are not able to fulfill their requirement of folic acid during pregnancy. The high level of vitamin K in greens makes them important for the production of osteocalcin, a protein essential for



Drumstick leaves are the best source of nutrition

bone health. Some leafy vegetables like amaranth and *Basella* are rich in protein and contains several essential amino acids such as arginine, isoleucine, leucine, lysine, threonine and tryptophan. Purslane (*Portulaca oleracea*) has recently been identified as the richest vegetable source of linolenic acid, an essential omega-3 fatty acid. The lack of dietary sources of omega-3 fatty acids has resulted in a growing level of interest to introduce purslane as a new cultivated vegetable in several parts of the world. Drumstick leaves are perhaps the most nutritious vegetable and that is why it is commonly called as Miracle tree. The nutritional value of the leaves is equivalent to 7 times the vitamin C in oranges, 4 times the Ca in milk, 3 times K in bananas, 2 times the protein in milk, and 4 times the vitamin A in carrot. The leaves and pods are also helpful in increasing milk in the breast feeding mothers. *Basella* is used for its androgenic, antidiabetic, anti-inflammatory, antimicrobial, antioxidant, antiulcer, antiviral, CNS depressant, hepatoprotective and wound healing properties. Brahmi saag is used in the treatment of a number of disorders, particularly those involving anxiety, intellect and poor memory while Indian pennywort (*Centella asiatica*) is used as herbal remedy for skin

conditions, wound healing and memory improvement. Water Pennywort is a Chinese herbal drug for hepatoma. The juice of the plant is used in the treatment of fever, and paste made from the plant is applied externally to wounds and boils. A decoction of the plant is used in the treatment of abscesses, boils, bruises, cirrhosis, colds, coughs, hepatitis, hepatoma, influenza, itch, jaundice, sinusitis and sore throat. The leaves of *Oxalis corniculata* are used as an antidote to poisoning by the seeds of *Datura* spp, arsenic and mercury.

Potential to adapt under changing climate

Many leafy vegetables are endowed with a number of surprising morpho-physiological virtues which make them resilient to the adverse effect of changing climate. *Basella* exhibits C_4 photosynthesis under heat and drought stress, and they tolerate a variety of unfavorable abiotic conditions, including high tempered, making them resilient to the changing climate. In fact, C_4 photosynthesis is an adaptation of the C_3 pathway that overcomes the limitation of the photorespiration, improving photosynthetic efficiency and minimizing the water loss in hot, dry environments. *Portulaca oleracea* is one of the very few plants which are able to utilize both CAM and C_4 photosynthesis pathways. *P. oleracea* can switch from C_4 to CAM pathways during times of drought and there is transcription

regulation and physiological evidence for C_4 -CAM hybrid photosynthesis during mild drought.

Status and diversity of leafy vegetables in India

Though majority of the indigenous leafy vegetables are grown in wild, semi-wild or stray conditions, concentration of genetic diversity comprising native species and landraces occurs more in Werstern ghats, Eastern ghats and North-eastern Himalayas. Eastern India is a territory of diverse ethnic groups, tribes and culture among the ecological and geographical variations starting from coast of Odisha to hilly Terai of West Bengal through the lateritic plateau of Jharkhand and Bihar. The ecological diversity superimposed with tribal and ethnic diversification, plant usages and religious rituals has resulted into the richness of biodiversity. The biodiversity present in leafy vegetables are being used by tribals/rural communities for their day to day requirements of nutrition and herbal therapy. In most of the cases they just collect leaves and twigs from the forest areas or natural vegetation for their use or sometimes for selling. Though a large number of leafy vegetables are commonly consumed in our country, only amaranth, palak, spinach beet and fenugreek has attained

Table 1. Area of diversity and nutritional importance of indigenous leaf Vegetables

Scientific name	Common name/vernacular name	Area of diversity	Nutritional/medicinal importance
<i>Basella alba</i>	Indian Spinach/Poi Saag	Uttar Pradesh, West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala	Good source of vitamins and minerals particularly calcium, iron, vitamin A and folic acid.
<i>Moringa oleifera</i>	Drumstick/Tree of Miracle	Foothills of the Himalayas in North-western India; tropics of Southern India; tropical forests of Barak valley in Assam	Rich in vitamin A, vit B such as folic acid, pyridoxine and nicotinic acid, vit C, Ca, Fe, K and Zn; vitamin D and E also present, prevent digestive and urinary disorders, cardiac diseases, bronchitis and tuberculosis.
<i>Bergera koenigii</i> L./ <i>Murraya koenigii</i> Spreng	Curry leaf/Meetha Neem	Tarai region of Uttar Pradesh, Shivalik hills of North-western Himalaya, Southern parts of the country; foothills and plains of the Himalayas from Kumaon to Sikkim	Rich in vitamin A, vitamin B2, vitamin C, Ca and Fe; known for anti-diabetic and cholesterol reducing property, antimicrobial, antiulcer, antioxidative, cytotoxic, anti-diarrhoea and phagocytic activity.
<i>Hydrocotyle sibthorpioides</i>	Water Pennywort/ Lawn Pennywort/ Laghu Brahmi	Wet valleys, grassy places and stream banks in the Himalayas, Western Ghats	Good source of minerals and vitamins, stigmasterol, daucosterol, hibolactone, genistein, daidzein, methyl-3, 4-dihydroxybenzoate, caffeic acid, isorhamnetin, quercetin.
<i>Oxalis corniculata</i>	Creeping Wood Sorrel/ Amrul	Western Himalayas, hilltops of the Northern Western Ghats.	Good source of vitamin C, used in the treatment of scurvy; leaf juice is applied to insect bites, burns and skin eruptions.
<i>Polygonum plebeium</i>	Knot Weed (Chemti saag)	It is native to the Himalayas, Kashmir to Bhutan.	Good source of protein, fibre and minerals like Ca, Mg, K, Fe etc.
<i>Lasia spinosa</i>	Kohila/Kantakochu	Moist places in tropical and subtropical forests including Assam	Rich in Mg, Fe, Zn, Mn, Cu, Mo; recommended for treating colic, tuberculosis of lymph nodes, swollen lymph nodes, rheumatism/rheumatoid arthritis, injuries, snake bites and insect bites.
<i>Portulaca oleracea</i>	Summer Purslane/ Noni Saag	Northern and eastern parts of India	Rich in omega-3-fatty acid, beta carotene, ascorbic acids.
<i>Diplazium esculentum</i>	Edible fern	Western Ghats	Rich in micronutrients, beta-carotene, folic acid and minerals such as Ca, Fe and P.
<i>Solena amplexicaulis</i>	Creeding Cucumber/Ban Kundari	Tamil Nadu, Karnataka, Kerala. (Endemic)	Known for antioxidant, antidiabetic and antibacterial agent. Used for inflammation, skin lesions, skin diseases and to cure jaundice.
<i>Centella asiatica</i>	Indian Pennywort /Gotu Kola	Assam, Bihar, Kerala, Madhya Pradesh, Manipur, Odisha, Rajasthan, Tamil Nadu	Used as herbal remedy for skin conditions, wound healing and memory improvement.
<i>Bacopa monniera</i>	Brahmi saag	Assam, Andhra Pradesh, Bihar, Madhya Pradesh, Odisha, Rajasthan, Tamil Nadu, Uttar Pradesh	Contains many active constituents, including a number of alkaloids and saponins, however, the major constituents are the steroidal saponins, Bacosides A and B.

commercial status. Moreover, out of the indigenous leafy vegetables, very few species like *Basella*, drumstick, curry leaf has gained attention by the researchers and a large number of species are still, remain neglected. Some of the important plants which are commonly used as leafy vegetables are presented in Table 1. These vegetables are generally used as day to day vegetables with small area of cultivation. Apart from this a number of species like *Bacopa monnieri*, *Boerhavia diffusa*, *Centella asiatica*, etc. are also used as leafy vegetables basically for therapeutic value. Rural people from North-eastern parts of India prefer non-traditional vegetables like runner and petioles of *Colocasia spp* and *Xanthosoma spp*, bamboo shoots, elephant foot yam petiole, and leaf vegetables like fern shoot (*Ceratopteris*).

Some of the most potential and popular indigenous leafy vegetables are discussed here under:

Indian Spinach

Basella alba, commonly known as Indian spinach/ Malabar spinach is cultivated throughout the country in one or other season. However, it is more popular in eastern and southern parts of India including Tamil Nadu, Pondicherry, Maharashtra, Odisha, West Bengal, Bihar, Madhya Pradesh, Uttar Pradesh, Rajasthan and Gujarat. There are two types of *Basella* under cultivation: green type (*Basella alba* var *alba*) and red type (*Basella alba* var *rubra*). Indian spinach is mostly seen in the home gardens and on a small scale the landraces are under cultivation in tribal, rural and peri-urban vegetable farming systems



Kashi Poi-3, a new variety of *Basella* with delayed flowering habit

by small and marginal farmers of southern and eastern India. Indian spinach is commonly grown for its leaves and young shoots, which make an excellent vegetable after cooking. The soft succulent leaves may be eaten raw as salad. In Thailand, flower spikes are sold as vegetable. Colours obtained from the leaves and stems are used for dying fabrics and in paintings in north eastern parts of India, particularly Manipur. Indian Spinach is quite a good source of vitamins and minerals and 100 g of fresh leaves contain calcium (109 mg), iron (10 mg), vitamin A (8000 IU), vitamin C (102 mg) and folic acid (140 µg). Since, it is a rich source of folic acid, it recommended to pregnant women to avoid neural tube defects in the foetus. *Basella* has long been neglected by the researchers, but in the recent years some attention has been given for improvement and utilization of this potential crop. At ICAR-IIVR, Varanasi, a total of 70 accessions are being maintained, and recently three varieties, Kashi

Poi-1, Kashi Poi-2 and Kashi Poi-3 have been released and notified.

Drumstick

Moringa oleifera Lam., commonly known as Drumstick/Horseradish tree/Saijhan/Sajna/Ben oil tree/Tree of Miracle, possess one of the most nutritious leaves but not yet properly exploited due to lack of awareness. Moringa can withstand both severe drought and mild frost conditions and hence, widely cultivated across the world. In India, its cultivation is mainly concentrated in Tamil Nadu, Kerala, Karnataka and Andhra Pradesh. However, it is also becoming popular in Rajasthan, UP, Bihar, West Bengal, etc. It is cultivated in home gardens and fields for its leaves, flower buds and tender fruits. Every part of the tree is enriched with high nutritive and medicinal values, particularly the leaves are rich in minerals, vitamins and other essential phytochemicals that can be easily absorbed and no allergy has ever been reported so far. As most of the nutrients are retained in dry leaves, leaf powder is commonly used to add nutrients in kids' food. Leaf powder contains 27% protein that can serve as a substitute for meat. Moringa powder can be used as a substitute for iron tablets, hence used as a treatment for anemia. Drumstick leaves are given to pregnant women as well as lactating mother as they provide all the nutrients required for them. Most of the research and development activities in Moringa has been taken place at various SAUs and ICAR institutes like TNAU, Tamil Nadu; ICAR-IIHR, Bengaluru; ICAR-IIVR, Varanasi. However, TNAU is



Drumstick plant in kitchen garden



Kashi Poi-1, a nutrition rich *Basella* variety



Kashi Poi-2, a new bush type *Basella* variety

pioneer in varietal development of moringa. Moolanur Moringa, Chemmurungai, Jaffina type, Kattumurungai, Palmurungai, Punamurungai and Palamedu moringa are locally known ecotypes of perennial moringa cultivated in Tamil Nadu. PKM-1, PKM-2 and KM-1 are high yielding annual moringa varieties released from Tamil Nadu Agricultural University. Looking into the potential of this crop various govt initiatives have also taken place. The Madhya Pradesh and Chhattisgarh governments have already accorded the tree enough importance in their annual plantation exercises. Uttar Pradesh government embarks on a mission to plant 22 crore saplings during 2019, a huge demand has been witnessed for the “sahjan” saplings. Uttar Pradesh might be the first state in North India to have picked up the tree for promotion and to curb malnourishment.

SUMMARY

Indigenous leafy vegetables have great potential to eradicate malnutrition prevalent in poor/rural section

of our population. Many of these leafy vegetables are resilient to the changing climatic and can be raised at lower management costs even on poor marginal lands. Despite all these, this group of vegetables was largely ignored by the scientific world. However, their potential has now been realized and the growers and consumers are showing keen interest in its proper utilization. With the increasing awareness among the consumers, it is essential to increase their production to meet the growing demand. Though, domestication and cultivation of these species are very less but recent awareness about the immense nutritional cum medicinal benefit of these vegetables among the conscious people creating new market niches and are projecting the farmers to cultivate on larger extent.

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