Leafy Vegetables of North-east India

DK Hore
National Bureau of Plant Genetic Resources, NBPGR Regional Station, Barapani-793103, Meghalaya

Leafy vegetables of north-eastern region attract considerable attention due to their rich food value. Tribal people in the remote localities are basically depending upon these vegetables which they harvest from the nature. Limited attempts have been made to bring these vegetables into cultivation. There is considerable scope to collect, evaluate and improve these vegetables. Systematic cultivation can also unfold the marketing potential of these plants among the rural communities of NE region.

Key Words: Collection, Conservation, Leafy vegetables, NE region and Cultivation, Use

The north-eastern (NE) region of India is inhabited by about 26 per cent tribal population, where 119 communities are distributed in seven states. Their staple food is rice, but they largely depend on the cultivation for various kinds of vegetables. Besides, they gather some plants from the wild habitats as food plants. The topography, altitude and rainfall pattern has made the region floristically rich and diverse. Many wild plants which occur naturally, are used by local people as food. Information about the use of various plant species as leafy vegetable were available in old world tropics (Sastrapradja & Kartawinata, 1973; Ochse, 1977; Oomen & Grubgen, 1977; Martin & Rubente, 1979). The contribution of horticultural crops particularly the leafy vegetables, have so far been underestimated in this region, but they have sufficient nutritive value. The importance and use of such native food plants used in diet by the tribes have been documented by Singh and Arora (1978), Arora (1981), Arora and Nayar (1984), Haridasan *et al.* (1990). Joshi (1992) studied the leaf and grain amaranths and chenopods in detail while Joshi and Paroda (1991) have emphasized the food value on buckwheat. A preliminary attempt was made by Jana (1989) on leafy vegetable for their cultivation practice and economics of Cooch Behar district, which is adjacent to this region. There are about 700 species belonging to 125 plant families, which contribute as leafy vegetable (Peter and Devadas, 1989). 78 species are used in this region as leafy vegetables and out of this, 45 species occur in wild habitat. These are tabulated separately under cultivated (Table 1) and wild species (Table 2). Their origin and diversity is based on Zeven and Zhukovsky (1975) while for the distribution of species, Willis (1982) was consulted. Farmers of the NE region are gradually becoming interested to produce such crops which can enable them to earn limited but quick money within a very short period. Compared to other vegetables, the leafy vegetables have a low economic value but they are good sources of carotene or provitamin-A, a reasonable amount of protein, ascorbic acid, iron, folic acid and calcium (Sloten, 1984). Nutritive value of a few leafy vegetables is provided in Table 3, which can substantiate their importance as a diet.

Preference and use is another factor for consumption of a particular vegetable in a particular tribal community. This has got direct relationship with local market demand. Conventional use, culture and beliefs also count for cultivation and conservation of some species among the tribals. In some communities, using the leafy vegetables as food is a custom, which makes the food a balanced diet.

Agro-climate of the Region and Cultivation

The climatic and edaphic factors and also growing season plays a vital role for the growth of such vegetables. The region constitutes the plains and hills where the topography and climate varies, mild summer to warm summer and cold to severe cold winter. Most of the crops are rainfed and their growing period is 270 days. The rainfall remains on an average range of 1600-2600 mm per annum. The soil is shallow to deep loamy, red, lateritic and yellow, with low fertility level. Depending upon the topography and locality, heterogeneous nature of soil is found. Thus there is a variation in pH, which ranges from 4.90 to 6.65.

Tropical leafy vegetables such as *Amaranthus, Spinacea, Basella, Pisum, Raphnus, Corchorus, Cucurbita, Lagenaria, Melia, Lathyrus, Chenopodium, Enhydra, Moringa, Nymphaea, Ipomoea* and ferns like *Diplazium, Pteridium* are dominantly used in plains of the region while temperate ones like *Brassica, Colocasia, Hibiscus, Sechium, Fagopyrum, Tetragonia, Tetrastigma, Lactuca, Sauropus, Houttuynia, Corydalis, Phytolacca,*

Clerodendron, Eryngium and *Sonchus* are commonly used in the region. Most of the cultivated species are grown during winter in plains; while in hills major cultivated as well as wild species grow luxuriantly in monsoon season. Species that occur in wild are generally harvested within a month of flushing.

In plains, farmyard manure is applied, in addition to application of chemical fertilizer (N:P:K) @ 40kg : 60kg : 30kg/ha respectively. In hills, normally, humus soil and FYM are applied for the cultivation. The seeds are either broadcasted or grown on raised bund or sown by dibbling method according to the requirement of the crop. Irrigation or sprinkling of water is given depending upon the availability of soil moisture. Thinning and weeding is necessary in the herbaceous cultivated vegetable for their suitable growth. In climbers/trailing species, this requirement is very less but they need trellis for proliferation. Unfavourable climatic condition develops stresses; otherwise pest and disease problem is negligible and it can be controlled at appropriate stage, through proper care. Spraying of pesticides is not advisable for leafy vegetable, which are meant for diet. Most of these leafy vegetables are harvested when the leaves and twigs are in tender stage and suitable for consumption after cooking. When the plants start flowering, leaves are hardly used.

Preference and Use

Although, there are quite a good number of leafy vegetable occuring in this region, most of them are seasonal. Species of *Amaranthus, Raphnus, Brassica, Spinacea, Basella, Cucurbita, Pisum* are preferred over others in plain while in the hills *Brassica juncea* var. *cuneifolia* is most sought for after vegetable especially in Meghalaya, Nagaland, Arunachal Pradesh and Mizoram state. This forms an important side dish as boiled vegetable along with rice and meat, during the winter. Tribals of this region are mostly non-vegetarian, but this vegetable dish is perhaps meant for to compensate the required vitamins. The leaves of *Hibiscus subdariffa* are a delicacy to Garo tribes in Meghalaya, who often use it in dry-fish curry. Similarly, the tender twigs of *Clerodendron colebrookianum* are often used by the Mizos and consumed as vegetable stew. The leaves of *Houttuynia, Sechium, Tetragonia* and *Corydalis* are used by the Khasi tribes in fish curry preparation. The hill people of Arunachal Pradesh and Meghalaya relish the apical leaves of *Sauropus androgynus.* Dried leaves of *Colocasia esculenta* are often used in meat preparation during the off-season. Introduction of *Raphnus sativus* at high altitude of Tawang district of Arunachal Pradesh a successful, where the leaves of amaranth, buckwheat, chenopods and radish are the only leafy vegetables. The bitter leaves of *Corchorus, Azadirachta, Moringa* are used in plains of Assam and Tripura during hot summer. The twigs of *Enhydra, Ipomoea* and *Nymphaea* are succulent and consumed mostly by people residing in plains for culinary purposes. The Mikir has a preference over *Olax, Casearia, Pegia* and *Meliosma* over other wild species for various food preparations. Species belonging to Urticaceae family (Table 2) are used by the various tribes of Arunachal Pradesh after necessary processing. Both plains and hill tribes equally relish leaves of *Mentha, Coriandrum* and *Eryngium* as raw, thrashed or cooked condition as flavoring agent in curries. The fern species *Pteridium* is very delicious for its young circinate fronds, which is fried and consumed with rice.

Improvement for Better Varieties

Among these discussed species, the genetic improvement work has undertaken on *Amaranthus, Brassica, Beta, Raphnus* and *Spinacea* in India. Attempt for genetic improvement on leafy vegetable species are very little. Attention was concentrated on very limited species such as cabbage (*Brassica oleracea* var. *capitata*), lettuce (*Lactuca indica*) and radish (*Raphnus sativus*). In last decade, emphasis has been given on *Amaranthus, Fagopyrum, Chenopodium, Spinacea* for their improvement and a good number of germplasm were collected and screened under the AICRP on under-utilized plants. Leaves of many improved crop group such as millet, vegetable, tuber, bulb, pulse, fiber, condiments and medicinal plants are also used but they are particularly in leafy brassicae in this region. Cultivation of dwarf *Basella rubra* is becoming popular in cultivation in Assam plains. Similarly, the introduction of *Sauropus androgynus* can be brought under cultivation due to its popular use.

Conservation

There have been meager effort on the collection and conservation of leafy vegetable in particular in this region. However, since 1986, the NBPGR Regional Station, Umiam has collected several accessions of leafy vegetables, some of which are maintained in the field gene bank at Umiam. About 470 such accessions were assembled. These are – Cucurbits (Pumpkin and Bottlegourd) – 34; *Sechium edule* – 14; Leafy brassicae – 11; Buckwheat– 30; *Chenopodium* – 9; *Amaranthus* – 37; Spinacea – 01; *Coriandrum* – 15; *Pisum* – 5; *Allium* – 3; Radish– 02; Paederia *foetida* – 01 and *Phytolocca acinosa* – 01.

Table 1. Cultivated leafy vegetables of North-east India

Species	Family	Origin, diversity and distribution	Preferred by the community/ tribe(s) of this region	Availability in the state(s) of the region
Colocasia esculenta (L.) Schott.	Araceae	SE Asia, China, Japan	All communities of the region	Throughout the region from tropical to sub-tropical zones
Xanthosoma violaceum Schott.	Araceae	South America	All communities of the region	– do –
Xanthosoma sagittifolium (L.) Schott.	Araceae	South America	All communities of the region	– do –
Basella rubra L.	Basellaceae	South Asia	Assamese, Mizo	Assam, Manipur, Mizoram, Tripura
Beta vulgaris L.	Chenopodiaceae	Mediterranean	Khasi, Naga	Meghalaya, Nagaland
Chenopodium album L.	Chenopodiaceae	Europe	Assamese	Assam plains, Tripura
Spinacea oleracea L.	Chenopodiaceae	Afghanistan, Iran, Manchuria	Assamese	– do –
Brassica juncea Hook. f. & Th.	Brassiceae	Africa	Assamese, Mizos	Assam, Mizoram, Tripura
Brassica oleracea L. var. *capitata* L.	Brassiceae	Near eastern center	All people of plains & hills	Throughout the region from plains to 8000 ft. altitude
Brassica juncea (L.) Cz. & Coss. var. *cuneifolia* Roxb.	Brassiceae	India	All hill people	Throughout the hill region
B. campestris L. var. *sarson* Prain	Brassiceae	India	Assam and Tripura people	Plains of Assam & Tripura
B. campestris L. ssp. *Chinense* (L.) Makino	Brassiceae	China	People of high hill region	Nagaland, Arunachal Pradesh, Mizoram
Raphnus sativus L.	Brassiceae	Eastern Mediterranean	All communities of the region	Throughout the region from plains 10000 ft. altitude
Amaranthus caudatus L.	Amaranthaceae	South America, Asia	People of Assam hills & plain and Meghalaya	Tropical to sub-tropical zones of the region
Amaranthus tricolor L.	Amaranthaceae	Tropical Asia	Assam plains	Plain areas of Assam, Tripura
Corchorus olitorius L.	Tiliaceae	India, Middle east & Tropical Africa	Assam plains	Plain areas of Assam, Tripura
Pisum sativum L.	Papillionaceae	Ethiopia and Yemen	Assam, Meghalaya, Manipur	Throughout the region
Lathyrus sativus L.	Papillionaceae	West Asia and Mediterranean	Assam plains	Districts of lower Assam
Benincasa hispida (Thunb.) Cogn.	Cucurbitaceae	Java (Asia)	Almost all states	Throughout the NE region
Cucurbita moschata Duch. ex Poir.	Cucurbitaceae	–	Almost all states	Throughout the NE region
Cucurbita maxima Duch. ex Lam.	Cucurbitaceae	Secondary Center – India	Almost all states	Throughout the NE region
Lagenaria siceraria (Molina) Standl.	Cucurbitaceae	Tropical Africa	Almost all states	Throughout the NE region
Sechium edule Sw.	Cucurbitaceae	Mexico, Central America	All hill states of the region	Almost all hill states above 3000 ft. altitude
Hibiscus sabdariffa L.	Malvaceae	Africa	Meghalaya	Abundantly grown in Garo Hills
Moringa oleifera Lam.	Moringaceae	India	Assam plains	Sporadic occurrence in plains of Assam
Lactuca indica L.	Asteraceae	India, Japan, Philippines and China	All hills states	Grown in kitchen garden
Allium cepa L.	Liliaceae	Asia (Central)	Tropical to sub-tropical zones	Limited cultivation in tropical areas of the region

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Species	Family	Origin, diversity and distribution	Preferred by the community/ tribe(s) of this region	Availability in the state(s) of the region
Allium schoenoprasum L.	Liliaceae	Europe, Asia, N. America	Hills of Meghalaya, Mizoram and Nagaland	Occurrence above 4000 ft. altitude in Christian dominated states
Coriandrum sativum L.	Apiaceae	Mediterranean and West Asia	Throughout the region, irrespective of community	Tropical to sub-tropical areas of the region
Mentha arvensis L.	Lamiaceae	Europe	Hills with high rainfall area	Meghalaya, Nagaland, Mizoram, Arunachal Pradesh
Tetragonia expansa Murr.	Aizoaceae	Chinese-Japanese Center	Sub-tropical, sub-humid areas of the region	Well adapted and naturalized in Meghalaya
Fagopyrum esculentum Moench.	Polygonaceae	Central Asia	Plains to high hills of the region	Arunachal Pradesh, Meghalaya and Assam
Azadirachta indica A. Juss.	Meliaceae	South Asia	Assam plains	Sporadic occurrence in Assam plains and not in a mass cultivation or plantations

Table 2. Wild species used as leafy vegetables in North-east India

Species	Family	Origin and diversity/ distribution	Preferred by the community /tribe(s)	Availabi lity in the state(s) of the region
***Amaranthus spinosus* L.**	Amaranthaceae	America	Village & Hill people of Assam & Meghalaya	Throughout the region
Cichorium intybus L.	Asteraceae	Europe, Mediterranean	– do –	Assam, Meghalaya, Manipur, Tripura
Enhydra fluctuans Lour.	Asteraceae	India, Malayam		Meghalaya
Sonchus oleraceous L.	Asteraceae	Eurasian	Khasi	Arunachal Pradesh
Spilanthes acmella (L.) Murr.	Asteraceae	Asia & New Guinea	Bhangni	Assam and Manipur, Tripura
Ipomoea aquatica Forsk.	Convolvulaceae	Throughout the tropics	Assamese, Manipuri	Assam
Coccinia cordifolia (L.) Cogn.	Cucurbitaceae	Tropical S. Africa	People of Lower Assam dist.	Meghalaya and Arunachal Pradesh
Sauropus androgynus (L.) Merr.	Euphorbiaceae	Southeast Asia	People of Arunachal Pradesh and Meghalaya	Assam
Paederia foetidal L.	Rubiaceae	Tropical Asia	Assamese	Arunachal Pradesh
Mussaenda roxburghii Hook. f.	Rubiaceae	Palaeotropic	Arunachalis	Assam
Dentella repens (L.) Forst.	Rubiaceae	Indomalayan	Assamese	Assam
Centella asiatica (L.) Urb.	Apiaceae	Tropical Asia	Assamese, Arunachalis and Khasis	Nagaland, Meghalaya
Eryngium foetidum L.	Apiaceae	South America	All communities of Hills	Assam hills
Oenanthe javanica (Bl.) A. Dc.	Apiaceae	Indo-China to Malaya	Assamese, Mikirs	Manipur, Assam, Tripura
Nymphaea nouchali Burm.f.	Nymphaeaceae	Tropical Asia	Manipuri, Assamese	Manipur
Tetrastigma muricatum Blanch.	Vitaceae	SE Asia	Manipuris	Arunachal Pradesh

Contd.

Species	Family	Origin and diversity/ distribution	Preferred by the community /tribe(s)	Availabi lity in the state(s) of the region
Amplectrum assamicum Clarke	Melastomataceae	Hindustani	Tribes of Arunachal Pradesh	Arunachal Pradesh
Begonia palmata L.	Begoniacea	Tropical & Sub-tropical America	Tribes of Arunachal Pradesh	Khasi Hills of Meghalaya
Houttuynia cordata Thunb.	Saururaceae	Indo-China, China, Vietnam	Khasi	Mizoram
Clerodendron colebrookianum Walp.	Verbenaceae	Indo-Burma	Mizos	Meghalaya
Lippia alba (Mill.) N.E. Br. ex Britt.	Verbenaceae	Tropical Africa	Khasi	Meghalaya
Corydalis sibiricus Pers.	Fumarieaceae	Temperate Himalaya	Khasi	Mikir Hills of Assam
Olax acuminata Wall.	Olacaceae	Indomalayan	Mikirs	Manipur
Lysimachia candida Lindl.	Primulaceae	Eastern Asia	Manipuri	Mizoram
Lepionurus oblongifolius Mast.	Opiliaceae	Indochina, Java	Mizos	Mizoram
Dysoxylum procerum Hiern.	Meliaceae	Indomalayan	Mizos	Mikir Hills of Assam
Meliosma pinnata Roxb.	Sabiaceae	Warmer part of Asia	Mikirs	Khasi Hills of Meghalaya
Campanula parviflora Benth.	Campanulaceae	Mediterranean	Khasi	Khasi Hills of Meghalaya
Zanthoxylum oxyphylla (Edgn.) Engl.	Rutaceae	Subtropical East Asia	Khasi	Meghalaya and Arunachal Pradesh
Phytolacca acinosa Roxb.	Phytolaccaceae	Tropical Asia, China, Japan	Khasi, Arunachalis	Arunachal Pradesh
Rumex nepalensis Spreng.	Polygonaceae	Nepal Himalaya	Arunachalis Hills	Arunachal Pradesh
Debregeasia longifolia (Burm. f.) Wedd.	Urticaceae	Indomalayan	High hills of Arunachal Pradesh	Arunachal Pradesh
Elatostema platyphylla Wedd.	Urticaceae	Old World	High hills of Arunachal Pradesh	Arunachal Pradesh
Laportea crenulata (Roxb.) Gaud.	Urticaceae	East Asia	High hills of Arunachal Pradesh	Arunachal Pradesh
Sarcochlamys pulcherrima Gaud.	Urticaceae	Indomalayan	High hills of Arunachal Pradesh	Throughout the region
Poikilospermum suaveolens (Bl.) Merr.	Urticaceae	E. Himalayan	Most hill tribes of the region	Meghalaya, Assam, Tripura
Alocasia macrorrhiza Schott.	Araceae	Srilanka, SE Asia	Tropical areas of Assam, Meghalaya	Arunachal Pradesh
Gnetum gnemon L.	Gnetaceae	Indomalayan	Tribes of Arunachal Pradesh	Arunachal Pradesh
FERNS				
1. *Diplazium esculentum* (Retz.) Sw.	Athyriaceae	Tropical World	Hill people of Arunachal Pradesh	Arunachal Pradesh
2. *Tectaria coadunata* (Hook. & Grev.) C. Chr.	Aspidiaceae	Pan tropical	Sikkimese	Sikkim
3. *Pteridium aquilinum* Kuhn.	Dennstaedtiaceae	Northern hemisphere and Africa	Peoples of Himalayan belt and NE region	Throughout the tropical to subtropical zones of the region

Table 3. Nutritive value of some wild edible leafy vegetable

Species	Moisture %	Protein %	Fat %	Carbohydrate %	Mineral Matters %	Ca %	P %	Fe+ mg/100g	Fiber %	Ash % (g)	Starch	Vitamin Rich
Amaranthus spinosus	85.0	3.0	0.3	8.1	3.6	0.8	0.05	22.9	–	–	–	–
Colocasia esculenta	93.4	0.3	0.3	4.1	1.2	0.06	0.02	0.5	0.6	–	–	–
Ipomoea aquatica	90.3	2.9	0.4	4.3	2.1	0.11	0.05	3.9	–	–	–	A, B, C
Alocasia macrorrhiza	–	–	–	–	–	–	–	–	–	–	20–45%	–
Allium cepa	86.8	1.2	0.1	11.6	–	0.18	0.05	0.7	–	–	–	–
Basella rubra	–	1.2	–	–	–	0.15	–	1.4	–	–	–	A. B_1. B_2
Hibiscus sabdariffa	86.2	1.7	1.1	10.0	–	0.18	0.04	0.0054	–	–	–	–
Moringa oleifera	75.0	6.7	1.7	13.4	2.3	4.4	7.0	7.0	0.9	–	–	A and C
Paederia foetida	–	44.6%										
(dry basis)	–	–	–	–	–	–	–	–	–	C		
Pisum sativum	–	23.6	0.6	13.0	–	0.28	0.06	–	5.4	0.9	–	–
Rumex dentatus	89.3	3.5	–	4.11	–	11.5	3.8	3.4	–	2.0	–	A, C
Sauropus androgynus	73.6	6.8	–	11.6	3.4	0.57	0.2	28.0	1.4	–	–	A, C
Sechium edule	92.6	–	2.2	–	–	6.0	4.7	0.3	–	0.8	–	A
Fagopyrum esculentum	–	4.6	0.9	–	3.6	–	–	–	8.0	–	–	–
Spinacea oleracea	92.1	2.0	0.7	2.9	1.7	7.3	21	10.9	0.6 Complex	–	–	A, K and B

Besides above accession(s) of various species of *Colocasia, Xanthosoma, Sechium, Fagopyrum, Eryngium, Clerodendron* are being maintained at the station. Rapid genetic erosion among these leafy vegetables was also found as the indigenous vegetables are replaced by the introduced species. Due to change of local environment and surrounding habitat destructions, many wild species are also facing problem to survive. Tribal are the inventors of many wild species, which are edible. Attention is to be given seriously on such new plants having nutritive value, which can broaden the avenue for possible introduction and utilization extensively. According to their propagative plant parts, endeavor can be made for their conservation either in their habitat or in *ex-situ* and *in-vitro* conditions.

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