



HEALTH PROMOTING PHYTOCHEMICALS OF MINOR VEGETABLES FROM NORTH EAST INDIA

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ABSTRACT

According to the Recommended Dietary Allowances of the Indian Council of Medical Research, per capita consumption of vegetable must be 280g, whereas availability of vegetable per capita per day is hardly 241g. In our country, where problem of malnutrition is prevailing, addressing the household nutritional security is very much necessary. North East States comprising of 8 states namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura has a total population of 75,587,982 (source –Census of India, 2011). In North East India 40.1% population is suffering from anaemia whereas in Arunachal Pradesh approximately 29.3% under age 3 in are suffering from Protein Energy Malnutrition. Minor vegetables are embedded with vitamins, minerals, fiber and phytochemicals are one of the most suitable options to address the problem of nutritional security. The intake of 350-400 g vegetables per capita per day is related with fewer incidences of different forms of cancer, and food rich in vegetable are also related with a reduced risk of cardio-vascular disease and slow ageing effect. Vegetables contain phytochemicals that have free radical scavenging and anti-inflammatory properties which bestow many health benefits. Dietary flavonoids have been inversely correlated with mortality from coronary artery disease, plasma total cholesterol and low-density lipoprotein. This review describes the recent literature regarding the health benefits of some selected minor vegetables from North East India.

KEY WORDS- Tree tomato, Tree bean, Fern, Mustard, Pea Eggplant.

INTRODUCTION

North east India has variety of flora and is one of the biodiversity hotspot in the world. About 50% of the total 17500 flowering plants hail from the region, and 40% of them are endemic (Mao *et al.*, 2009). National Bureau of Plant Genetic Resources (NBPGR) Regional Station, Shillong has so far collected over 10000 accessions of wild relatives of crop plants and the region is regarded as the place of origin of progenitors of many cultivated crops. The region is home to wide varieties of plants and some of it is consumed by the tribal communities. The people have inherited traditional knowledge of local plants used as food, fodder for animals, fibres for making garment, and religious ceremonies (Jadhav, 2006). The people of North Eastern Hill region generally grow rice which is a staple diet and grow some local vegetable for self consumption. Some vegetable like edible fern, *solanum* species and other leafy vegetables are collected from wild by the women folks and eaten along with rice. These traditionally used vegetables are cheap, easily available in the locality and the nutritional value of these plants is higher than several known common vegetables and fruits (Orech *et al.*, 2007). In developing countries, several types of edible wild plants are used as sources of food hence provide an adequate level of nutrition to the inhabitants (Aberoumand and Deokule, 2009). Vegetables are known as excellent sources of natural antioxidants (Chu *et al.*, 2002). These antioxidants help in scavenging free radicals produced in

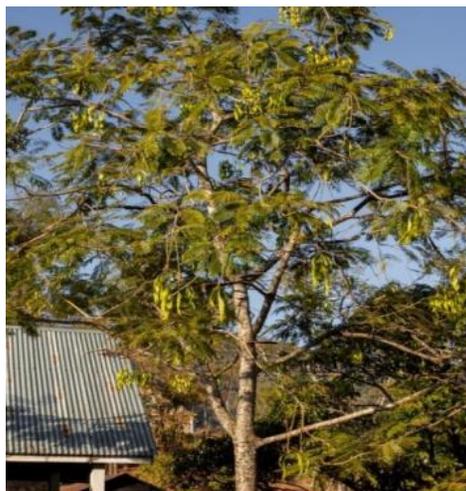
the human body which help in fighting against several diseases and maintain the human health (Idowu *et al.*, 2006). It is also reported that phytochemicals present in these locally available vegetable help in reducing blood cholesterol level and maintaining sugar balance in the body. In addition, they have anti-bacterial, hepatoprotective and anti-carcinogenic properties, and therefore have medicinal value (Heywood, 1999). Many people are not aware of the nutritional value of wild edible plants and many regard them as inferior (Shackleton, 2003 and Steyn *et al.*, 2001). Intake of traditionally consumed wild edible species is nowadays receiving renewed attention, due to the recognition of their potential benefit for human health (Khattak, 2011). Out of 3895 of economically significant plant species reported from North East India, nearly 7.34% are used as wild vegetables, fruits and ethno-medicine (Sarma *et al.*, 2010). Some of them sell the edible wild fruits and vegetables in nearby local markets, which are in high demand among the local consumers. This review describes the literature available regarding the health benefits of some minor vegetables of North East India and their phytochemicals.

Tree Bean (*Parkia timoriana*)

Parkia timoriana commonly known by the name tree bean is a lesser known leguminous tree which grows abundantly and luxuriantly in the north-eastern Himalayan region of India. It is an important multipurpose leguminous tree species having nutritious, commercial and ecological

significance. *Parkia timoriana* is generally seen growing wild in forests, jhum field and also in almost every backyard in the north-eastern states such as Meghalaya Nagaland, Manipur, Mizoram, and Assam (Kanjilal *et al.*, 1938). This tree species is found to adapt and grow well in different agro-climatic conditions from colder hilly regions to the warm foothill tracts without any special care and attention (Thangjam, 2014). Ethno botanically since yore, tree bean has been used in various folk medicine besides just a mere food source. The pods and kernels have been traditionally used as a supplementary food source in Manipur state (Longvah and Deosthale, 1998) and to treat leprosy and hypertension. Tender pods and barks are consumed to treat intestinal disorders, piles, dysentery and diarrhoea (Khumbongmayum *et al.*, 2005). Fruit paste is applied to heal wounds and scabies, fruit and juvenile shoots are eaten as a remedy against food poisoning, diarrhoea and dysentery (Bhardwaj and Gakhar 2005). Many reports pointed out that tree bean is undoubtedly a good source of various nutrients and supplements, in which the seeds was found to posses good amount of protein (albumins and globulins), minerals (potassium, iron, magnesium, zinc, phosphorus and manganese), essential amino acids (isoleucine, leucine, phenylalanine and tyrosine) and fatty acids such as oleic and linoleic acids (Mohan and Janardhanan, 1993). The protein content of tender pods exhibited 12.1% whereas in mature pods was found 18.8%. However, protein content

of kernels (28.8 %) was much higher than pods, revealing that the maturity of pods led to raise the protein and fat content accompanied by a decrease in carbohydrate content (Longvah and Deosthale, 1998). (Gopalan *et al.* 1989) observed that the pods and seeds of *Parkia timoriana* have better mineral content as compared to other grain legumes. They further assessed and observed that the essential amino acids level ranged from 33% in tender pods to 42% in kernels which escalate with maturity of kernels. Lysine content in both mature and immature pods as well as kernels was comparable to other legume crop such as soybean. Crude fibre content was reported to ranged from 10.16 % in tender pods and 19.28 % in matured pods, while seeds with 9.03 % of fibre (Salam, 2011). Different parts of *Parkia timoriana* such as leaf and seed extract have the capacity to inhibit the growth of pathogenic bacteria like *Streptococcus fecalis* and *Bacillus cereus* (Thongbam *et al.*, 2012). Seed oil extract of *Parkia timoriana* possesses insecticidal properties and holds promising agent in controlling a variety of insect pests. Percentage of mortality of aphids by seed oil extract was significantly increased with increase in time and concentration and vice versa under laboratory conditions (Salam *et al.*, 1995). Lectins isolated from the seed extracts of *Parkia timoriana* have inhibitory effect on proliferation of cancerous macrophage cell lines (Kaur *et al.*, 2005).



A



B



C



D



FIGURE 1 (A) Tree of *Perkia timora* (B) Pod of *Perkia timora* (C) Plant of Tree tomato (D) fruit of Tree Tomato (E) Plant of Indian Mustard (F) leaves of Indian Mustard (G) Plant of *Diplazium esculentum* (H) Edible leaves of *Delpizium esculentum* (I) Plant of *Solanum torvum* (J) Fruits of *Solanum torvum* (K) Women selling minor vegetable in local market

Tree Tomato (*Cyphomandra betaceae*)

Tree Tomato (*Cyphomandra betacea*) also known as Tamarillo belong to the family Solanaceae is a perennial shrub, and can be found growing abundantly and commonly without much care and attention in every tribal home as backyard venture crop in the hills of North Eastern region especially in Nagaland, Meghalaya and Sikkim. *Cyphomandra betacea* is a semi woody shrub with the tree up to 2-3m high. The flowers are pentamerous and are pink in colour. The colour of the fruit is orange, red or reddish brown depending upon the stage of maturity and have a diameter of about 9-12cm. Pulp and seed constitute about 87% of total fruit weight and the rest of its total weight is contributed by the skin of the fruit (Hassan *et al.*, 2013). The fruit is oval with smooth skin and has high content of juice. The fruit has similar taste as tomato and the ripe fruit is usually eaten either raw or made *chutney* by local community. It is used in desserts for making jams, jellies, juices, pickles and preserves *etc.* the slices are served as sandwich-filling and also used in salads. *Cyphomandra betacea* is a good substitute for tomato because it shows higher antioxidant activity as compared to common and cherry tomato (Noor Atiqah *et al.*, 2014). It is a good source of protein (1.60 g/100g), vitamin A (4.80 mg/100g DW), vitamin C (55.90 mg/100 DW) and minerals like calcium (11.20 mg/100g), sodium (17.80mg/100g) and phosphorus (410.60mg/100g) (Mutalib *et al.*, 2017). Sodium and potassium are important for ion exchange in cells. Na is responsible in the control of plasma volume, muscle contraction and nerve signalling while K helps in proper functioning urinary function (Dawes, 1972). It also contains good amount of pectin and fibre that helps to prevent constipation, reduce the rate of cholesterol in the blood and control sugar level of people with diabetes (Mutalib *et al.*, 2017). Ascorbic acid is a water-soluble vitamin, and it is known as an oxygen scavenger, acting as reducing agent (Vasco *et al.*, 2009). Literature has reported that the ascorbic acid content in tamarillo range between 25 to 30 mg/100 g FW and displays a significantly greater reactive oxygen scavenging capacity, because of the presence of anthocyanins (Roberts *et al.*, 2003). Many researchers have identified number of phytochemical in *Cyphomandra betacea* fruit like 2-Methyl (1, 3, 4) oxadiazole, 2, 3-Dihydro-3,5-dihydroxy-6-methyl-4H-pyran-4-one and thiazole. These have a role in anti-inflammatory effects while hexadecanoic acid may have a role in antioxidant activities. 1, 3, 4-Oxadiazole products are well-known for their anti-inflammatory (Tan *et al.*, 2006), antibacterial, antifungal (El-Emam *et al.*, 2004) and HIV replication inhibition (Sahlin *et al.*, 2004). Furthermore, thiazole was also reported to have anticancer properties. Therefore, the fruits *Cyphomandra betacea* is considered as one of the richest sources of antioxidant and has anti-cholinesterase properties that can enhance human health (Hassan *et al.*, 2013).

Indian mustard (*Brassica juncea*)

Brassica juncea generally referred to as Indian mustard belongs to family Brassicaceae. *Brassica juncea* is an economically important plant vastly utilized as green leafy vegetables in the north-eastern states of India. This species has been enumerated in traditional remedies in the ancient manuscripts (Manohar *et al.*, 2009). It possesses numerous

phyto-nutrients owning health promotional and disease prevention attributes. Mustards are reported to have high Vitamin K, with very low in calories and fat content. It is a rich source of flavonoids, carotenes, lutein and zeaxanthin. In addition, fresh mustard leaves are an excellent source of vitamin C along with several essential minerals such as calcium, iron, magnesium, potassium, zinc, selenium, and manganese (Banerjee *et al.*, 2012). Food prepared from Indian mustard leaves is vital in alleviating the cost for diabetic patients suffering with comorbid anxiety disorders (Thakur *et al.*, 2013). The green leaves were also reported to have anti-depressant effects in diabetic patients (Thakur *et al.*, 2014). The methanolic extracts of *Brassica juncea* leaves were found to possess anti hyperglycemic activity (Rahmatullah *et al.*, 2010; Valavala *et al.*, 2011). Dried methanolic extracts were found to reduce diabetes related mental health problem (Kumar *et al.*, 2011; Thakur *et al.*, 2013). The leaves of *Brassica juncea* are utilized to generate medicines which act as diuretics, stimulants and expectorants (Farrell *et al.*, 1999). Indian mustard is also known for its therapeutically pharmacological uses owing to its active bio-constituents (Kumar *et al.*, 2011). Glucosinolates and isothiocyanates are reported to be abundant in *Brassica juncea* (Mc Naughton and Marks, 2003) which act as anti-cancerous and anti-microbial compounds (Luciano and Holley, 2009; Okulicz, 2010; Zhang, 2010).

Vegetable fern (*Diplazium esculentum*)

Ferns grow wild in tropical, subtropical and temperate forest and generally are used as an ornamental plants by people but some are edible and eaten either raw or cooked in different parts of the world due to their nutritive values. *Diplazium esculentum* belonging to the family Athyriaceae and is one of the top preferred rhizomatous edible ferns in North Eastern India. *Diplazium esculentum* falls in the class of Pteridophyta and does not bears flower or bear fruits but is propagated through spores. This plant grows in gregarious colonies in open marshy areas, stream banks and canals from sea level to 2,300 m (Akter *et al.*, 2014, Evans, 2009). The vernacular name of this plant is *ningru* in Sikkim and *dheki saak* in other north-eastern states. People use this edible species by cooking the upper shoots as vegetables. Available literature indicates that the edible fronds are rich in iron, phosphorus, potassium and protein, richer than that of many conventional vegetables and many wild edibles. The mineral content has also been reported to be several times greater than that present in many commercial fruits (Badola, 2010). The proximate analysis of *Diplazium esculentum* indicated that the fresh edible leaves contain 91.82 ±0.43 % moisture, 1.42 ±0.10 % ash, 0.28 ±0.004 % crude fat, 0.87 ±0.004 % crude protein, and 0.72 ±0.05 % crude fiber while oven dried plant samples contain 17.39 ±0.82 % ash, 3.40 ±0.05 % crude fat, 10.67 ±0.05 % crude protein, and 9.06 ±0.67 % crude fiber (Tongco *et al.*, 2014). The fern is believed to contain various medicinal properties and some of them are evaluated and confirmed by research. It act as mast cell stabilizer and can prevent anaphylactic shock (Das *et al.*, 2012), decoction of the plant can be used to treat hemoptysis and cough (Rahmat *et al.*, 2003). Young fronds are boiled and eaten for laxative effect (Kagyung *et al.*, 2010). The plant is traditionally used for the treatment

of dysentery, glandular swellings, indigestion, diarrhoea and various skin infections (Lense, 2012).

Pea Egg Plant (*Solanum torvum*)

Solanum torvum commonly known as 'Turkey berry', another major traditionally used wild vegetable plant among the tribal populace of north-east region of India belongs to the family solanaceae. The plant is short (about 2- 4 m tall), erect shrub with numerous branches. The fruits of *Solanum torvum* are borne in clusters of tiny green spheres (about 1 cm in diameter) which turns yellow when fully ripen. Fruits are thin-fleshed and contain numerous flat, round, brown seeds. The fruits of *Solanum torvum* are regularly utilized in many tribal local cuisines because of the fact of belief that they are very nutritious. The small fruits and tender leaves of the plant are used as vegetable after stir frying or boiling and it is considered as a good source of minerals such as calcium and iron hence, it is mostly recommended by locals to take the juice of *Solanum torvum* to prevent anaemia (Akoto *et al.*, 2015). *Solanum torvum* possess both sedative and diuretic therapeutic effect. Phytochemical studies discovered that fruits of this species have as good concentrations of diverse alkaloids, flavonoids, saponins, tannins, and glycosides sufficient enough to give pharmacological effects. Therefore, fruits are not only used for nutritive purposes but also fruit decoctions are regarded to be effective for cough ailments and in cases of liver and spleen enlargement (Kala, 2005). The methanolic extracts of both leaves and fruits were reported to have antimicrobial activities against human and animal clinical isolates (Chah *et al.*, 2000). Reports on isolation of antiviral isoflavonoid sulfate and steroidal glycosides from fruits were also confirmed as per (Arthan *et al.*, 2002). In addition, *Solanum torvum* exhibited an antioxidant activity and DNA-repair capability in oxidative DNA damage caused by free radicals (Abas *et al.*, 2006). Further, an aqueous extracts from the various parts of *Solanum torvum* exhibit promising analgesic and anti-inflammatory properties (Ndebia *et al.*, 2007).

CONCLUSION

A vast range of plant resources exists in natural conditions in the north-eastern region of India. Many plant species are still untapped and yet to be exploited commercially and it is perceived that the inaccessibility of the region has helped preserve its biodiversity particularly the indigenous minor vegetables. In spite of the importance of minor vegetables in the lives of local people of the region, their production and consumption is still hindered by general lack of awareness among the societies. Though, these minor vegetables help the rural populace in mitigating the malnutrition by contributing food and nutritional security through supplementation of vitamins, minerals and other nutrients. Yet, they remain largely underutilized and people are unaware of the nutritional factor though inadvertently consuming a good amount of nutrients from these crops. Although studies have been done in the recent years on the nutritional aspects and specific compounds, yet many functions and interactions still needs to be investigated. Further, more research need to be conducted extensively to understand and confirm its potential for health promotion and promising drug discovery to

augment our knowledge for the utilization of these minor vegetables in daily diet. There is need to develop an integrated approach for utilization of the rich genetic resource of indigenous minor vegetables for ensuring food and nutritional security of the people, health, income generation and maintain ecological balance. Hence, there is an obvious need for collaboration among the scientists, researchers, institutions, government departments, local organizations and communities etc. to come forward under one umbrella and pay more attention towards research and ways of conserving these genetic resources. This will add a new dimension towards its management and conservation of natural plant wealth of the region.

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