Ethnic Vegetables as Nutraceuticals: A Promising Source of Bioactive Compounds for Disease Prevention and Management

Anjali Kumari Jha^{*}

Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Bhagalpur, Bihar, India

*Corresponding author: Anjali Kumari Jha, Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Bhagalpur, Bihar, India, Tel: 06201205985; E-mail: anjalikjha.7@gmail.com

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Abstract

Ethnic vegetables are rich sources of essential nutrients, particularly vitamins and minerals, vital nutrients (e.g. Fe, Ca, Mg); and other non-nutritive phytochemicals. Thus, increased consumption of these vegetables may alleviate some micronutrient deficiencies. Ethnic vegetables play a critical role in the food culture of different regions and different peoples. Their micronutrients and other phytochemical contents are important for human health. The consumption of ethnic vegetables is recommended as a positive means of improving nutrition and potentially reducing the onset of chronic diseases. They also give health protection on account of the presence of secondary metabolites of therapeutic importance. The most important phytonutriceuticals in vegetables that have biological activity against chronic diseases are: Vitamins, minerals, dietary fiber, organosulfur compounds (glucosinolates and thiosulfides) and flavonoids. Each vegetable contains a unique combination of phytonutriceuticals. Phytochemicals are broadly described as phytoestrogens, terpenoids, carotenoids, limonoids, phytosterols, glucosinolates, polyphenols, flavonoids, isoflavonoids and anthocyanidins. Despite the huge nutritional, economic, agronomic and environmental potentials, their production, consumption and utilization have not been purposively pursued. This neglect has contributed to the under exploitation and underestimation of their potential value, invariably leading to loss of biodiversity, particularly the ethnic vegetables collected from the wild, because of extinction. A great diversity of vegetables should be eaten to ensure that individual's diet includes combination а of phytonutriceuticals and to get all the health benefits. They have tremendous impact on the health care system and may provide medical health benefits including the prevention and treatment of diseases and physiological disorders. So, ethnic vegetables need to be revitalized and brought back into the mainstream diet so that they can play their role in food security.

Keywords: Ethnic vegetables; Nutraceuticals; Bioactive compounds; Phytonutriceuticals

Introduction

India is one of the world's most populous nations, accounted for approximately one fifth of the world's population with more than 70 percent of agricultural households. In the near future, the population is projected to increase by roughly 1.8% per year, whereas the demand for food is anticipated to increase by at least 3% per year in the future. In order to satisfy the increasing demand for food, the country's food production should increase by approximately 3.5% per year. Self-sufficiency does not necessarily imply adequate nutrition. In fact, significant imbalances persist in terms of the availability of calories, proteins, minerals and vitamins. Moreover, malnutrition is a prevalent issue in the country. By increasing the availability of vegetables, these deficiencies could be mitigated to a significant degree. As we know, vegetables are the most important component of a well-balanced human diet and the primary drivers of global nutritional security. Vegetables alone account for 58.73% of India's total horticultural production. On a land area of 9.39 million hectares, India produced 162.89 million tonnes of vegetables [1]. This phenomenal increase in vegetable production has increased productivity to 16.45 tons per hectare and availability per capita to 280 grams. This remarkable increase was made possible by the development of improved varieties/hybrids/production and protection technologies as a result of systematic research and widespread adoption by producers. However, only a few main vegetables contributed to this remarkable production. Although India's diverse agroclimatic conditions allow for the cultivation of more than 60 cultivated and about 30 ethnic vegetable crops, but little attention has been paid to ethnic vegetables. Ethnic crops/plant species as "those species with underexploited potential for contributing to food security, health (nutritional/medicinal), income generation and environmental services" [2]. The vegetable crops that are neither commercially grown on a large scale nor extensively traded are considered underutilized/ethnic vegetables. Ethnic or underutilized vegetables may not be wellknown outside of a particular area or region and there is a perception that they are primarily cultivated in rural areas. In some communities, the consumption of these plants is socially unacceptable because they are viewed as food for the impoverished [3]. Underutilized vegetables are important at the

local or regional level, but lack national recognition and appreciation. The underutilized vegetable crops are plant species traditionally utilized for their sustenance, fiber, fodder, or medicinal properties. However, the potential for these species to assure food security, nutrition, health, income generation and environmental services is underutilized. Today, the nutritional security of our country depends on less than ten crops. Due to their limited means of existence, rural and mountain populations are most likely to feel the effects of species base reduction at the level of food security [1]. Diverse underutilized vegetables, such as Amaranthus spinous, Chenopodium album, Hibiscus sabdariffa L, Rumex asetose, Globin's coronaria, etc., are rich in vitamins, amino acids, minerals, protein, dietary fiber, etc. and have high antioxidant activities, allowing them to effectively combat malnutrition and nutritional insecurity.

Literature Review

Ethnic vegetables contribute significantly to the food security of families and serve as a means of survival during drought, famine, shocks and risks. Many underutilized fruits and vegetables, for instance, contain more vitamin C and pro-vitamin A than commercially available species and varieties. Many ethnic and underutilized vegetables such as African baobab, amaranth, tarragon, Malabar spinach, borage, Ethiopian rape, goosefoot, chicory, spider plant, mallow, sea kale, curcuma, squash, roselle, water spinach, bitter melon, drumstick, tassel hyacinth, prickly pear, parsnip, tomatillo, Indian poke, purslane, yellow cresses, black nightshade and water leaf are rich sources of food, fodder, oil and medicine. Similarly, underutilized legumes like jack bean, rattlepod, Hausa groundnut, lablab bean, pea vines, subabul, Andean lupin, horse gram, deer eye bean, stinky bean, winged bean, African yam bean, adzuki bean, bambara groundnut and rice bean are sources of proteins, essential amino acids, polyunsaturated fatty acids, dietary fibers, essential minerals and bioactive phytochemicals [2,3]. Due to their higher nutritional value, they can also supplement nutritional needs. Due to the alarming rise in human population and the depletion of natural resources, it has been considered necessary to investigate the potential use of these plant resources with potential for food, forage, energy and industrial applications. Many ethnic and underutilized species are nutrient rich and adapted to low input agriculture. The deterioration of these species may have immediate effects on the nutritional status and food security of the underprivileged. Their increased utilization can improve nutrition and combat hidden hunger. Many neglected and underutilized species contribute to the preservation of cultural diversity associated with dietary practices, health practices, religious rituals and social interactions. Focusing on neglected and underutilized species is an effective way to promote a diverse and healthy diet and combat micronutrient and deficiency, so called "hidden hunger" and other dietary deficiencies, especially among the rural poor and the most vulnerable social groups in developing nations. These ethnic vegetables and legumes are having considerable commercial value and thus can make a significant contribution to household income and sustainable agriculture.

Importance of ethnic vegetables

The ethnic vegetables are not only packed with protein, essential vitamins, micronutrients, health promoting nutrients, including antioxidants and other phytonutrients etc., but many of these vegetables have a better nutritional value compared to other known vegetables like tomato or cabbage. Ethnic vegetables are being used more widely and effectively to combat malnutrition, poverty and economic development. They are vital biological assets of the rural poor and have the potential to improve the well-being of millions of tribal people. Breeders from the private and public sectors have neglected traditional crops because they typically do not conform to modern standards for uniformity and other characteristics. As a result of their biotic resistance, tolerance to abiotic stress, yield and quality, traditional varieties have enormous potential to contribute to global food production. Vegetables that are underutilized are a rich source of nutrients, such as vitamins, minerals and other health promoting elements, as well as antioxidants, which contribute to the diversification of the diet and a more balanced source of micronutrients. In addition to stabilizing the eco system, these ethnic vegetables can aid in the development of the rural poor's economy. They are an important part of the local population's food and nutrition as many of them have traditionally been esteemed for their utilization in terms of medicinal, therapeutic and nutritional values since time immemorial and are consumed either as raw or as cooked vegetables as traditional delicacies and sales from the surplus of these vegetables contribute to the income of many rural people. Malnutrition and related food scarcity are prevalent among the poor rural population. They have the potential to help to poverty eradication through increasing employment and income production, as well as improving the efficiency and profitability of farm family labor utilization in both rural and urban settings. They can help to sustainable livelihoods by increasing household food security and expanding food edibility options. They are adaptable to harsh environment and can help to maintain the stability of agricultural ecosystems, particularly in dry and semi-arid plains, mountains, steppes and tropical forests.

Nutritional and medicinal values of ethnic vegetables

Pointed gourd (Trichosanthes dioica): Pointed gourd is an important perennial, dioceous crop of the Cucurbitaceae family that is widely produced on river banks in Bihar, Uttar Pradesh, West Bengal and Assam in India. The pointed gourd is referred to as the "King of gourds" due to its high nutrient content and medicinal potential. The juice of pointed gourd leaves is used as a tonic and febrifuge in edema, alopecia and in sub-acute cases of liver enlargement. Plant leaves are used as an antipyretic, diuretic, cardiotonic, laxative, antiulcer and other Ayurvedic remedies. *T. dioca* contains vitamin A, vitamin C, tannins, saponins, alkaloids, a combination of noval peptides, proteins, tetra and pentacylic triterpenes and other chemical constituents [4].

Gherkin (*Cucumis sativus* var. anguria): Gherkin is a type of cucumber that contains almost all of the nutrients found in

cucumbers. It has an average number of calories and fats, which aids in weight maintenance and lowers the risk of significant issues like as heart disease and cancer. It aids in the absorption of important minerals such as folate, iron, salt, calcium and vitamin A. A large sweet gherkin has 114 micrograms of beta carotene. A tiny sweet gherkin contains 7.1 micrograms of vitamin K, which is 8% of the 90 micrograms of vitamin K required by women per day and 6% of the 120 micrograms required by men. A medium gherkin contains 12 miligrams of vitamin K, whereas a large sweet gherkin contains 16.5 micrograms.

Ivy gourd (*Coccinia grandis***):** Kundru is another name for ivy gourd. Fruits are high in lycopene (5.68 mg/100 g) and carotene (2.24 mg/100 g), whereas leaves are high in protein (3.3-4.9 g) and vitamin A (8000-18000 IU). Fruits have anti-diabetic and antioxidant properties. It is used in Ayurveda to treat skin eruptions, tongue sores and earaches.

Sweet gourd (*Momordica cochinchinensis***):** Sweet gourd is a Cucurbitaceae family member with tasty sensitive fruits and younger leaves. Fruits are high in protein, vitamin A and C. The fruit and leaves have therapeutic characteristics that can treat ulcers, lumbago, and bone fractures. The roots contain saponin and bessisterol, which can be employed in the pharmaceutical industry. Swelling, ulcers and abscesses are treated with the seeds.

Karchikai (M. cymbalaria): Karchikai is a vegetable that has excellent nutritional value. This plant is a perennial climber that grows only in the South Indian states of Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra and Tamilnadu during the Kharif and Rabi seasons. Initially considered a weed, the crop is now cultivated as a vegetable due to the medicinal properties of its tubers. Not only the fruits, but also the leaves, can be used as a leafy vegetable. It is not commercially grown due to a shortage of high-quality planting material. It contains a lot of vitamin C, fiber, beta carotene, iron and calcium. It has antidiarrheal, hepatoprotective, antidiabetic, nephroprotective, antiallergic, antimicrobial, other and therapeutic characteristics. Karchikai contains three times the calcium value of bitter gourd [5]. The ascorbic acid concentration of Karchikai is two times that of bitter gourd, which can be utilized to supplement vitamin C consumption. The potassium content is also twice as high as in bitter gourd. This crop's tubers and leaves, which include flavonoids, steroids, triterpenes, and saponins, are also utilized for therapeutic purposes. Sterols, triterpenes, cardiac glycosides and saponins are found in tubers. The crop has the potential to be employed as a weapon against malnutrition and famine.

Basella (Basella Alba, Basella rubra): Basella, sometimes known as vine spinach, is a popular tropical leafy green vegetable that is widely grown as a backyard herb in home gardens. Vine spinach is a member of the basellaceae family. *Basella alba* (green stem and deep green foliage) and *Basella rubra* (purplish stem and dark green leaves with pink veins) are its two main varieties. Adhikari, et al. and Kumar, et al., already reviewed the therapeutic efficacy of *Basella alba* [6]. It contains vitamin A, B, C, Ca, Mg, Fe and numerous important antioxidants. The plant contains vital amino acids such as arginine, iso-leucine, leucine, lysine,

threonine and tryptophan, as well as vitamins, minerals, and a low amount of soluble oxalates. Because of the presence of Bsitosterol and lupeol in the plant, *Basella alba* exhibits androgenic, anti-diabetic, anti-inflammatory, anti-microbial, antioxidant, anticancer, antiviral, CNS depressant, haepatoprotective and wound healing properties.

Elephant foot yam (Amorphophallus campanulatus): Amorphophallus campanulatus, commonly referred to as "Jimikand" or "Elephant foot yam," is an underappreciated aroid in the Araceae family. It is a tuberous, robust indigenous herb that is utilized in the Ayurvedic medicine system to cure a variety of human illnesses. The corms are dry, acrid and pungent; they increase appetite and taste; they are digestive, antihelmintic and aphrodisiac; they are useful in vitiated vata and kapha conditions, elephantiasis, inflammations, haemorrhoids, haemorrhages, dysentery, splenopathy, amenorrhea, seminal weakness, fatigue, anaemia. To treat acute rheumatism, fresh corms are used externally as an irritant. In the form of a pickle, the corm is a hot carminative. It contains sitisterol, stigmasterol, triacotane, lupeol and sitosterol palmitate. Because of the presence of a diterpenoid, salviasperanol, and amblyone, a triterpenoid, the corms are said to have antibacterial, antifungal and cytotoxic effects. Corm extracts in ethanol and aqueous form shown antioxidant and hepatoprotective effects (CCl₄ caused liver damage). The plant's tuberous roots have blood purifier characteristics and have traditionally been used to cure piles, gastrointestinal diseases and tumors, spleen enlargement, asthma and rheumatism.

Drumstick (Moringa oleifera): Moringa oleifera is a multipurpose tropical tree that is underappreciated for its nutritional and therapeutic benefits. Humans have used the Moringa plant in a variety of culinary ways over the centuries. Moringa oleifera leaves can be eaten fresh, roasted, or stored as a dried powder for many months without losing any nutritious content. Moringa oleifera leaves are a good source of nourishment and have anti-inflammatory, anti-ulcer, antiatherosclerotic, and anti-convulsant properties, according to epidemiological studies. Moringa has been used medicinally for centuries and in many cultures around the world to treat skin infections, anaemia, anxiety, asthma, blackheads, blood impurities, bronchitis, catarrh, chest congestion, cholera and many other illnesses. Moringa oleifera also has anti-inflammatory, antispasmodic, anti-hypertensive, anti-tumor, anti-oxidant, antipyretic, anti-ulcer, anti-epileptic, diuretic, cholesterol lowering, renal, anti-diabetic and hepatoprotective properties. Moringa oil was also determined to have been utilized in skin ointments since Egyptian times. Khawaja, et al., reported that the Moringa was the "most nutrient rich plant ever discovered" [7].

Winged bean (*Psophocarpus tetragonolobus*): Popularly known as winged bean or Goa bean, *Psophocarpus tetragonolobus* (L.) is a tropical legume that grows extensively in hot, humid equatorial countries such as India, Burma, Sri Lanka, Thailand and the Philippines. It is also referred to as a "wonder legume" due to the high protein content of its seeds, making it a versatile legume. The winged bean is a species that is underutilized but has the potential to become a significant,

multipurpose food crop. The complete plant of winged bean is edible. The leaves, flowers, roots and bean pods are edible uncooked or cooked; the pods are even edible when unripe and raw. The seeds can be consumed after heating. Each of these components contains, among other nutrients, vitamin A, vitamin C, calcium and iron. The tender pods, which are the most commonly consumed component of the plant, are best when consumed before they reach a length of 2.5 centimeters (1 inch). Similar to spinach, the immature leaves can be harvested and prepared as a leafy vegetable. The flavor of the nutrient rich, tuberous roots is savory. They contain approximately 20% protein, which is more than many other root vegetables. The leaves and flowers also contain 10%-15% protein. About 35% of the seeds are protein and 18% are lipids. By diminishing platelet aggregation, the high niacin content of winged beans aids in preventing blood clot formation. By maintaining the levels of lipoprotein, apolipoprotein under control, it will reduce the risk of cardiovascular disorders resulting from the condition.

Canavalia gladiata and *C. ensiformis* (Sword bean and Jack bean): Sword bean stalks and seeds are consumed as a green vegetable. SB (*Canavalia gladiata* Jacq.) is a tropical, underutilized edible legume that is widely distributed in the Eastern and Western Ghats of South India. Jack bean contains between 23 and 34 percent protein and 55 percent carbohydrates. After cooking, the Indian tribal sects kurumba, malyali, irula, and other Dravidian groups ingest the mature jack bean seeds. Both reproduce *via* spores. *Ipomoea muricata* (Clove bean) fruits used for cookery are tender. It is primarily used as a vegetable in Kerala. Fruits are rich in fiber, vitamin C, potassium, and calcium. Clove bean powder is a well-known remedy for fever. The juice of plants is sprayed to exterminate insects.

Mucuna pruriens (Velvet bean): Mucuna pruriens is one of the most favored legume vegetables among Nagaland's tribal people. Fresh, cooked shoots or legumes can also be consumed. *M. pruriens* is occasionally used as a substitute for coffee and is primarily propagated by seeds. In tribal communities, the plant and its compounds have been used for centuries as a toxin antagonist for various snakebites and as a viable source of dietary proteins [8]. Due to its high protein content (23%–35%) and comparable digestibility to other pulses such as soybean, rice bean and lima bean.

Parkia roxburghii (Tree bean): It is one of the most common multipurpose tree species of the Mimosaceae family in the North Eastern region of India, particularly in the states of Manipur and Mizoram. Locally known as "Yongchak" in Manipur and "Yontak" in Assam, its tree flourishes in every hill region household. The tree bean is a branched, medium-height (10 m-12 m) legume with bipinnate leaves. The inflorescence head or capitalism's arise terminally with clusters of tiny yellowish-white flowers, drooping from the branches at the top of long stalks. Early stage fruits are soft, tender and vibrant green in color. In March-April, when entirely mature, they acquire a blackish hue. Pods form in clusters of 10-15, each measuring 25-40 centimeters in length and 2-4 cm in width. In Manipur, Assam, Nagaland, Tripura and Mizoram, tree beans long, tender beans are the most popular and delectable vegetable. It is primarily spread by spores. Depending on regional preferences, pods are consumed at various phases of maturity, either raw or processed. The mature and tender legumes are used in a variety of dishes. After removing the membrane from the beans, they are sliced for use in various chutney (Iromba) preparations. Additionally, mature blossoms and young shoots are utilized in curries and salads. The leaves are an excellent source of both forage and verdant manure. The tree is also of immense medicinal value. We use a decoction of bark, fruit skin and leaf to treat diarrhea and dysentery.

Vigna angularis (Adzuki bean): As a vegetable, sprouted beans are utilized. The sprouts are high in folic acid, vitamin A, and vitamin B. Duke found that the seeds contain 19.9 g of protein per 100 g of seed [9]. The seeds and leaves are both therapeutic. It spreads mostly by seeds.

Vigna umbelata (Rice bean): Rice bean, also known as climbing bean, mountain bean, oriental bean, haricot bean, red bean and Jerusalem pea, is a viny erect, semi-erect stem annual. It is recognized by various vernacular names in India, including moth, rajmoong, and satrangi mash. It has an axillary raceme inflorescence with clusters of bright yellow blooms. Pods are slim and slightly bent. Rice bean is a multifunctional legume that is often overlooked and underutilized. Young pods, leaves and sprouting seeds are consumed as vegetables after being boiled. Its distribution in India is primarily restricted to the tribal regions of the hilly sections of the north-eastern hills and the Western and Eastern Ghats. Rice bean has been reported to have the highest nutritional quality of any traditional pulse. Because of its high protein content and significant amounts of two limiting amino acids: Methionine and tryptophan. It spreads mostly by seeds. It contains vitamins of high grade, including thiamine, niacin, and riboflavin. Calcium and iron levels are also quite high. This bean has a low phytin-phosphorus content, which restricts phosphorus availability and decreases protein digestion in most Asian pulses. The bulb is consumed after cooking by peeling off the hard back. Aerial yam has been used as a traditional treatment for a variety of diseases, including conjunctivitis, diarrhea and dysentery. Effective against syphilis, gonorrhea and hydrocele. Goiter, piles and diarrhea are all possibilities. South Indian states consume it as a vegetable. It is spread via bulbil.

Momordica cochinchinensis and *M. dioica* (Kakrol and Kartoli): Both are dioecious perennials found in Assam and the Garo hills of Meghalaya. Both have great nutritional and therapeutic value, as well as economic worth. Their tender green fruits are prepared as a vegetable when they are immature. Young leaves, flowers and seeds can all be eaten. Fruits are also used to treat ulcers, piles, sores, and liver and spleen blockage. They offer a variety of therapeutic characteristics and are useful in the treatment of coughs and indigestion. Both crops' unripe fruits serve as an aperitif and an astringent. The seeds are used to treat chest pain and to induce urine discharge.

Amaranthus spinosus: Amaranth spinosus is an annual or short-lived perennial plant found in warm, humid climates around the world. The leaves and fragile stems are incredibly nutritious and grow quickly. *Amaranthus* leaves have been shown to have 17.5%-18.3% protein (dry weight basis), with 5%

of that being lysine, an important amino acid that is deficient in most cereal and tuber-based diets. Amaranthus is high in protein and dietary fiber and a good source of vitamins, particularly pro-vitamin A, C, K and folate. Amaranthus spp. has three times the vitamin C, calcium, iron and niacin of spinach and eight times the vitamin A, twenty times the calcium, and seven times the iron of lettuce. Amaranthus leaves have high antioxidant qualities due to the presence of carotene and micronutrients such as sodium, copper, manganese, chloride and phenolic compounds. By scavenging free radicals, antioxidants aid in the prevention of illnesses such as cancer, arteriosclerosis and aging. Quercetin, a flavonoid, has been reported to be a powerful antioxidant. In vitro investigations have revealed that it can chelate metals, scavenge oxygen free radicals and inhibit oxidation of low-density lipoprotein. For people suffering from constipation, vegetable amaranthus is advised as a healthy source of fiber [10].

Chenopodium album or Bathua: Chenopodium is a weedy annual herb that grows quickly and is tall, branching and strongly scented. It grows in nearly any sort of nitrogen rich soil, including wastelands. In the shoots, the mean values for carbs, protein and fiber were 7.0, 29.2 and 36.5 (g/100 g), respectively. Shoots had calcium, potassium and magnesium levels of 18,213.2, 49,028.6 and 13,821.5 mg/1000 g, respectively. Immature plants had a sodium content of 68.0 mg/100 g. Fe, Zn and Cu microelement concentrations in immature shoots were 120.4, 23.0 and 9.1 (mg/1000 g), respectively. In mature plants, vitamin C levels were 5.2 mg/100 g and carotene levels were 68 mg/100 g, respectively. It has a moderate amount of iron. *Chenopodium album* is high in amino acids, including leucine, isoleucine, lysine, and vitamin C. It has a high iron content as well as fibre (4-6 g/100 g).

Roselle (Hibiscus sabdariffa L.): Hibiscus sabdari a, sometimes known as "red sorrel" or "roselle," is a malvaceous plant. It is a well-known medicinal plant with over 300 varieties found worldwide in tropical and subtropical climates. Organic acids found in roselle include citric, malic, tartaric and all hydroxy citric acids. Beta carotene, vitamin C, protein and total sugar are all found in the plant. Roselle is well known for its nutritional and therapeutic qualities due to the presence of many medically essential substances known as phytochemicals. Roselle calyces contain considerable levels of calcium, iron, niacin and riboflavin, according to nutritional analysis. It includes anthocyanins, which function as free radical scavengers and reduce lipid peroxidation [11,12]. Consumption of roselle products rich in anthocyanin, such as fresh juice, tea, jam, jelly, or capsules, protects the human body from the detrimental reaction of free radicals through antioxidant activity.

Glebionis coronaria: Crown daisy is a flowering plant species of the daisy family native to the Mediterranean region. Crown daisy is a type of green vegetable. Other common names for this plant include Chrysanthemum greens, Garland chrysanthemum, Crown daisy, and others. It is an annual plant with hairless stems that develop multiple complex branches. It has fragrant or bipinnately lobed leaves and yellow ray florets gathered in tiny flower heads. It has a high concentration of chlorogenic acid, flavonoids, carotene, potassium, minerals and vitamins, as well

Inyiri (Malabar Spinach, Basella alba): *B. alba* has both nutritional and medicinal properties. According to nutritional claims, *B. alba* is a good source of vitamins and minerals. The assertions were backed up by laboratory testing, which found *B. alba* to be a high source of minerals and vitamins. The average mineral values were determined to be 134.11, 13.4, 524.5 and 13.4 mg/100 g for calcium, iron, magnesium, and zinc, respectively. In addition, the mean vitamin contents, specifically vitamins A, B₁, B₂, B₃ and C, were 6.67, 182.95, 0.54, 0.43 and 198.08 mg/100 g. Medicinally, the veggies were said to enhance blood supply and hunger. These effects were ascribed to the iron and vitamin levels of the foods. Because of its fiber nature, they reduce constipation, ease ulcerative pains and prevent constipation.

Solanum torvum (Turkey berry): The edible fruits of Solanum torvum or wild brinjal, which grows wild in North East India, are consumed as a vegetable. The immature fruits and flowers are used for making the delicious local dish called Gwdok. The plant is sedative and diuretic and the leaves are used as haemostatic. Fruits have thin meat, many seeds, are born in clusters, are green in color, and become yellow when ripe. The little fruits (1 cm in diameter) are eaten after being stir-fried or boiled, and they are high in calcium and iron. According to the researchers, fruits have a high moisture content (86.23%) and carbohydrate values of 7.033%, protein 2.322%, fat 0.278%, and crude fiber 3.993%. Iron (76.869 mg/kg) and calcium (221.583 mg/kg) concentrations were higher, as were manganese (19.466 mg/kg), copper (2.642 mg/kg), and zinc (21.460 mg/kg) [13]. The vitamin A and C concentration is 0.078 mg/100 g and 2.686 mg/100 g, respectively. The significant iron content of the fruit demonstrates that the fruits do indeed have hematinic properties. It is used in traditional medicine to treat fever, wounds, tooth decay, reproductive difficulties, and arterial hypertension. A decoction of fruits is given for cough ailments and is considered to be useful in cases of liver and spleen enlargement. The high iron content of the fruits proves the fact that the fruits truly have hematinic property.

Sechium edule (Chow-chow): Chow-chow is a common cucurbitaceous vegetable in the North Eastern United States. The fragile branches and tuberous roots, which originated in tropical America, are also consumed by people. It is high in amino acids and is known locally as "squash." It is a robust, scrambling perennial plant with tuberous roots that is farmed for its starchy edible fruits and seeds. It grows profusely in the high hills of Meghalaya, Manipur, Mizoram, Nagaland and Sikkim with little care and attention. Chow-chow is high in minerals and vitamins (calcium, phosphorus, vitamins A and C). The fruits and seeds are rich in various key amino acids (aspartic acid, glutamic acid, alanine, arginine, cystein, phenylalanine, glycine, histidine, isoleucine, leucine, methionine, proline, serine, tyrosine, threonine and valine) and have increased antioxidant activity. Because of the softness of the fruit flesh, it is ideal for adding consistency to infant foods, liquids, sauces, and pastes. Many of these nutritional properties make it appropriate for hospital meals. The low calorific value of chow-chow fruits may be an excellent

supplement to potatoes, particularly for diabetic individuals. The leaves and fruit are diuretic, cardiovascular and antiinflammatory and a tea made from the leaves has been used to treat arteriosclerosis and hypertension, as well as to dissolve kidney stones.

Polygonum chinense (Syn. Persicaria chinensis (L.)/(Chinese knotweed): Chinese knotweed is a rhizomatous herbaceous twining perennial plant that grows 70 cm to 1 m tall when not climbing over other plants or structures, and can climb up to 10 m high when climbing over other vegetation. The Polygonaceae family includes Madhusoleng in Assamese, Angom yensi in Manipuri and Jaryndem in Khasi. Young leaves are cooked with other vegetables, dal, fish curry and so on. Polygonum chinense leaves are astringent, rubefacient and vermifuge. Polygonum chinense is a popular detoxifying element in Chinese cold tea. Hecogenin, aurantiamide, stigmastane-3, 6-ione, and 25-r spirost-4-ene-3, 12-dione are anti-inflammatory and anti-allergic ingredients. Terpenoids, flavonoids, tannins, saponins and glycosides were discovered through phytochemical screening. Polygonum chinense shown promising in vitro cytotoxicity, antibacterial activity and antioxidant activity. Kamferol, Quercetin, Kampferol-7-O Glycosides, -Sitosteroid, and acids have been discovered in the leaves. The plant is said to have antibacterial and antipyretic properties [14,15]. The plant has been used for centuries to cure fever, whooping cough, chest sickness, and wounds. The aqueous and methanolic extracts have been shown to have analgesic, anti-inflammatory and antibacterial properties. It is a common plant in Malaysia and Vietnam, where it is used in herbal medicines for diarrhea, enteritis and sore throat.

Murraya koenigii (Curry leaves): The plant is a member of the Rutaceae family and is coveted for its leaves, which are used to flavor and spice cuisine. Locals utilize a famous spice herb recognized for its scent in dal, curry and as chutney. The leaves have been shown to have a high carbohydrate content, a fair amount of protein and fiber, a low fat content, a fair quantity of vitamin A and vitamin B_3 (niacin) and a trace amount of potassium and zinc. The presence of these minerals helps to maintain nerve electric potential, strong bone and tooth formation, electrolyte balance in the body, promote immunity and restore dehydration. Leaves contain phytochemicals such as flavonoid, phenols, saponins, alkaloid, tannins, and glycosides. Curry leaf has anticancer, cardioprotective and antitumor properties due to its high antioxidant, flavonoids and phenol content. Murraya koenigii is a plant that exhibits hepatoprotective, cardioprotective, antioxidant, anti-diabetic, anticancer, antibacterial and antiviral effects. Curry leaves are the highest source of carbazole alkaloid extracts such as koenigine, mahanimbine and muonline, which have been shown to have anticancer and antioxidant activities. People in the North East believe that curry leaves are helpful for their health. It protects the kidneys.

Colocasia esculanta (Arvi/Kochu): Colocasia esculanta corms, runners, and tender leaves are eaten as a vegetable that belongs to the Araceae family and is particularly popular in North East India. Taro tubers are an important source of carbohydrates, with 70%-80% starch, a low protein (1.5%) and fat (0.2%)

content, a good source of ash (1.2%), thiamine, riboflavin, iron, phosphorous, zinc and a very good source of vitamin B₆, vitamin C, niacin, potassium, copper, and manganese. Taro leaves are also high in protein (23%), minerals such as Ca, P, Fe and vitamins. The taro leaf's high amount of dietary fiber is also beneficial for its active function in the management of intestinal transit, boosting dietary bulk and faecal consistency due to its ability to absorb water. Taro starch is easily digestible and beneficial to people suffering from peptic ulcers, pancreatic illness, chronic liver disease, inflammatory bowel disease and gall bladder disease. Because taro corm has a significant level of beta carotene, it provides vitamin A and antioxidant properties to the body. The tubers contain anthocyanins, cyanidin 3glucoside like flavonoids, the related anthocyanins are said to improve blood circulation by decreasing capillary fragility, to improve eyesight, to act as potent antioxidants, to inhibit human cancer cell growth. Koch-Rajbongshi, Bodo and Rabha tribes of Assam's North Kamrup region utilize Colocasia (curry from corms and runners) as a cure for piles and tonsillitis [16].

Alternanthera sessilis (Ponangani greens/Alternanthera): Alternanthera sessilis is a significant green leafy vegetable species in the Amaranthaceae family. As vegetables, the leaves and delicate shoots are used. Carbohydrates, proteins, carotene, vitamin C, riboflavin, niacin and crude fiber are abundant in the leaves. Sodium 95%, potassium 94.6%, calcium 63.7%, phosphorus 6%, magnesium 66%, zinc 89%, iron 98%, copper 80%, manganese 98% and chromium 32.5% were found in A. sessilis, indicating that the plant contains a higher concentration of iron, manganese, sodium and potassium, moderate levels of copper and zinc and lower levels of phosphorus. A. sessilis may be advantageous to diabetes people since it contains the minerals Mn, Zn, Mg, Cu, Fe, Na, K, Ca and traces of chromium in suggested quantities. The plant's leaves have traditionally been used to heal skin and eye problems, cuts and wounds and as an antidote to snake bite. Subhasini and colleagues. Also used to chill the body and is beneficial in cases of diarrhoea, fever and anemia [17].

Cyphomandra betacea (Tree tomato/tamarillo): It is a semi woody perennial shrub in the Solanaceae family with a height of 2-3 m with pink pentamerous blooms. The fruit is a berry with orange, red and reddish brown hues that is oval and has a diameter of 9-12 cm. Fruits have a higher juice content and ripe fruits are consumed either raw or as chutney by the local tribal people. It has a high protein content of 1.60 g/100 g, vitamin A (4.80 mg/100 g DW), vitamin C (55.90 mg/100 g DW), calcium of 11.20 mg/100 g, sodium of 17.80 mg/100 g and phosphorous of 410.60 mg/100 g. It also has a good quantity of pectin and fiber, which aid in preventing constipation, lowering cholesterol levels in the blood and controlling blood sugar levels in diabetics. Tree tomato has more antioxidant activity than common and cherry tomato, making it an excellent option for tomato. Researchers have discovered many phytochemicals in Cyphomandrea, including 2-methyl (1, 3, 4) oxadiazole, 2,3-dihydro-3,5dihydroxy-6-methyl-4H-pyran-4-one and thiazole, which have anti-inflammatory, antibacterial and antifungal activities. Thiazole has also been linked to anticancer activities. According to the literature, C. betacea contains a high concentration of phenolics, flavonoids, anthocyanin and carotenoid, all of

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which contribute to the antioxidant activity of the fruit extracts. The presence of an acceptable number of phytochemicals in the fruits demonstrated that *C. betacea* is one of the greatest sources of antioxidants, phytonutrients and anti-cholinesterase capabilities that can benefit human health.

Vegetable fern Diplazium esculentum: It is a popular rhizomatous edible fern in the Athyriaceae family that grows wild in tropical, subtropical, and temperate forests in North East India. It is known as "ningru" in Sikkim and "dhekia saak" in other areas of the North Eastern region. Upper shoots are cooked and eaten as a vegetable high in iron, phosphorus, potassium, and protein. Mineral content has also been observed to be several times higher than that of several commercial fruits. 2010 (Badola). On a dry weight basis, the edible portion contains ash 14.42 0.01 g/100 g, moisture 71.74 0.417 g/100 g, crude protein 18.32 0.028 g/100 g, crude fiber 4.45 0.013 g/100 g, ascorbic acid 23.59 0.05 mg/100, carotenoid 4.650.03 mg/100 g and minerals like iron 38.20 0.07, zinc 4.30 0.26, manganese 21. The fronds also have therapeutic qualities, such as acting as a mast cell stabilizer and preventing anaphylactic shock, as well as a laxative action. The decoction of plants is used to treat hemoptysis and cough. According to the literature, the herb is also used to cure dysentery, glandular swelling, indigestion, diarrhea and other skin infections.

Enhydra fluctuans (Water cress): Enhydra fluctuans is a type of hydra. Lour, a tropical herb belonging to the Asteraceae family and often known as helencha/harkuch or helosi (Assamese), is gaining popularity for its therapeutic properties. This is a semi-aquatic herbaceous vegetable plant with serrate leaves that is usually accessible in the summer. The plant is a prostrate herb, glabrous with pubescent glandular hairs. The tender leaves and stem are fried or cooked before being served with boiled potato, salt, and mustard oil. Protein, ß-carotene, saponins, cholesterol, glucoside, enhydrin, and other nutrients are found in the plant. The leaves are slightly bitter and are useful for treating inflammation, skin illnesses, laxatives, bronchitis, nervous affliction, leucoderma, biliousness, and small pox. It has been stated that the plant has antioxidant, hepatoprotective, CNS depressant, analgesic, and antidiarrheal properties. Enhydra fluctuans leaf extract is efficient against Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, and Micrococcus luteus. Ali and colleagues. The leaves are also utilized to treat ring worm by the locals [18].

Houttuynia cordata (fish mint/chameleon plant/heart leaf): Houttuynia cordata, commonly known as "Mosundary" in Assamese, prefers damp, shady environments. A piperaceae herbaceous perennial plant with leaves that are alternating and generally heart-shaped, and flowers that are greenish yellow and borne on a terminal spike. It usually blooms during the summer. It's often grown as a leaf vegetable and used as a fresh herbal garnish. It is often used in salads or cooked with other vegetables in northeastern India, as well as with fish in fish curry and as a garnish over side dishes. The soft roots can also be used with dry meat or fish, chiles and tamarind to make chutneys. *H.* cordata is an aromatic medicinal and edible herb that has long been used in Asia to treat pneumonia, hypertension,

constipation, and hyperglycemia through detoxification, heat reduction, and diuretic activity. There is mounting evidence that H. cordata has anti-cancer, anaphylaxis inhibitory, anti-mutagenic, anti-inflammatory, anti-allergic, anti-oxidative, anti-viral, antibacterial, anti-obesity and anti-diabetic properties. Furthermore, metformin, a well-known biguanide anti-diabetic medication that has been used for more than 60 years, has a variety of effects, including suppression of hepatic gluconeogenesis, increased insulin sensitivity, and increased peripheral glucose absorption. Despite its therapeutic advantages, metformin causes a considerable range of adverse effects, including diarrhoea, nausea, cramping, vomiting, bloating, lactic acidosis and stomach pain. It is utilized as a diarrhea and dysentery cure in Asia, and it contains major active components such as flavonoids, volatile oils and alkaloids. Rutin, quercetin, quercitrin, isoquercitrin and hyperin are the most abundant flavonoids found in H. cordata. Flavonoids have antiviral, antibacterial, antioxidant, anti-inflammatory, antileukemic, anticancer and immunomodulatory properties.

Ipomea aquatica (water spinach): *Ipomoea aquatica* is a semi-aquatic, fast-growing tropical plant used for its tender shoots and leaves as a vegetable. It is a member of the Convolvulaceae family. It is distributed throughout the world's tropical and subtropical climates. Water spinach, river spinach, water morning glory, and water convolvulus are all names for this plant. In Kokborok, it is known as "Twi ni lot." It grows naturally in streams and requires minimal maintenance. Greens are high in vitamins, minerals, proteins, fiber, carotene, and flavonoids, and provide numerous health benefits. The leaves are also high in energy (300.945.31 kcal/100 g).

Enhydra fluctuans (Helencha): It is a tropical herb known locally as "Alencha" that belongs to the Asteraceae family and is gaining popularity due to its therapeutic properties. This is a semi-aquatic herbaceous vegetable plant with serrated leaves that is edible. The stems and leaves are cooked in the same way as vegetables. The plant contains nutrients such as carotene, saponins, cholesterol, glucosides, and enhydrin. The leaves are mildly bitter and have been claimed to be effective in treating inflammation, skin illnesses, laxative, bronchitis, neurological affliction, leucoderma, biliousness, and small pox. It also has antioxidant, hepatoprotective, CNS depressant, analgesic and antidiarrheal properties.

Chekurmanis (Sauropus androgynus): Chekurmanis (Sauropus androgynus), a perennial shrub in the Euphorbiaceae family, is widely planted in Southeast Asia. Chekurmanis is a good source of vitamins, minerals, and protein. Chekurmanis leaves are a good source of protein, vitamin E, beta-carotene, vitamin C, riboflavin, thiamine, calcium, iron, and zinc. Thus, chekurmanis is a unique green leafy vegetable that is high in nutrients and a good source of vitamins, minerals and protein. Chekurmanis leaves have been claimed to have excellent antioxidant capabilities, most likely due to vitamin C and E concentration. Chekurmanis contains 11.6 g of carbohydrates, 6.8 g of protein, 0.48 mg of riboflavin, and 0.48 mg of thiamine. It also contains 247 mg of ascorbic acid and 570 mg of calcium per 100 g edible portion on a fresh weight basis. In terms of iron content, Chekurmanis ranks 1 among all annual green vegetables. It contains up to 28 mg 100 g⁻¹ of iron, whereas

annual leafy vegetables such as amaranthus, palak, spinach, and radish leaves contain up to 22.9, 16.2, 10.9 and 18 mg 100 g⁻¹ of iron, respectively [19,20].

Discussion

Bioactive compounds of ethnic vegetable and legumes

Ethnic vegetables and legumes are high in phytochemicals. These are generally classified into polysaccharides or carbohydrates which include monosaccharides, disaccharides, oligosaccharides and sugar alcohols; organic acids and lipids; nitrogen containing compounds including amines, cyanogenic glycosides, glucosinolates, purines, and miscellaneous nitrogen compounds; alkaloids including pyridine alkaloids, betalain alkaloids, indolealkaloids, indolizidine alkaloids, pyrrolidine alkaloids, quinoline alkaloids, steroidal alkaloids, and tropane alkaloids; phenolics such as flavonoids (anthocyanins, flavanols, flavonols, dihydroflavonols, flavones, isoflavonoids, flavanones, dihydrochalcones), phenolic acids (hydroxybenzoic acids, hydroxycinnamic acids), lignans, coumarins (coumestans, furanocoumarins), phenols (alkylphenols, methoxyphenols), phenylpropanoids (benzodioxoles, cucuminoids, hydroxyphenyl propenes), quinones (benzoguinones, naphthoquinones, anthraguinones), stilbenoids and xanthones; and terpenoids including monoterpenoids (phenolic terpenes), sesquiterpenoids, diterpenoids, triterpenoids (phenolic terpenes, saponins, phytosterols), and tetraterpenoids (carotenoids). The majority of these phytochemicals have been extracted and evaluated from ethnic vegetables.

Conclusion

Ethnic vegetables may benefit growers, consumers, and environmentalists if they are properly controlled. These vegetables have significant nutritional potentials as well as the ability to withstand unfavorable climatic circumstances. Ethnic vegetable crops need special attention and need to be made more famous in order to utilize their potential to treat lifestylerelated diseases. In terms of nutritional value, it is very important to do research on how to domesticate and use wild plants. To maintain future food and nutritional security, it is necessary to start a program on genetic resource inquiry, management, usage, and enhancement of ethnic/underutilized vegetable crops. The increased area and output of these vegetable crops will not only make sure that people have enough food to eat and save money on food imports, but it will also make it possible to export fresh vegetable crops and seeds, which is expected to help the economy of the region. Despite their recognized value, ethnic vegetables are sometimes not used to their full potential due to a shortage of planting materials, a lack of knowledge about their nutritional and therapeutic benefits, or a lack of information on the methods used to grow them. Ethnic vegetable crops also offer numerous employment possibilities in agro-based industries, packaging, storage, preservation, canning, and transportation. These vegetables comprising all of the nutritional benefits can play a

significant role in reducing the per capita consumption gap of the poor, which helps to a large extent to combat the nutrition deficiency problem.

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