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Nutritional and medicinal value of underutilized vegetable crops in India

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Abstract

Today, it has been a big challenge to provide safe, healthy and nutritious source of food for poor income group and undernourished population of the developing world. Due to scarcity, high cost and unreliable supply of healthy food in the developing and underdeveloped countries have resulted in the find out the cheap and alternative source of healthy and nutritious food. Indigenous vegetables of equal or better nutritional status could perform better under cultivation with relatively low input levels. Currently, however, supply from the wild meets local demand, although the market is still disorganized. This exploitation of wild resources is an important source of income and food, especially for the rural poor, who are also underemployed. These vegetables are cheaper than exotic imports and affordable.

Keywords: Underutilized, nutritional, medicinal, vegetables, food

Introduction

India is the second largest in vegetable production in the world after china. As per ICMR recommendation vegetable consumption is 280g/day, but it is only 135g/day. This gap is due to load on production of conventional foods. To overcome this it is essential to explore the available underutilized vegetables. These underutilized vegetables are far superior nutritionally and have medicinal properties along with high yield potential. Some of these crops are resistant to biotic and abiotic stresses. The name itself indicates that these crops are less utilized. The reason for this is these are generally region and season specific. India possesses a good genetic wealth of domesticated crops and out 20,000 angiosperm plants, 600 plant species constitute the diversity in vegetable crops, however, presently only one fourth are utilized as major vegetable crops and rest are named as minor, underutilized/neglected, rare vegetables, lesser known vegetables, wild edible vegetables, underutilized crops. The crops, which are neither grown commercially on large scale nor traded widely, may be termed as underutilized crops. These crops are cultivated, traded, and consumed locally. These crops have many advantages like easier to grow and hardy in nature, producing a crop even under adverse soil and climatic conditions. So, exploitation of underutilized vegetable crops can become a solution to the social problem of health and nutrition insecurity, poverty, and unemployment. The consumption of underutilized vegetable crops can provide nutrition to the poor and needy peoples by meeting the nutrient requirements of vulnerable groups. As underutilized fruits, and vegetables are a rich of source of carbohydrates, fats, proteins, energy, vitamins-A, B₁, B₂, B₃, B₆, B₉, B₁₂, C, folic acid, and minerals- Ca, P, Fe, and dietary fiber. Thus, they have the nutritional capacity to prevent and cure various diseases like kwashiorkor, marasmus, night blindness, anemia, diabetes, cancer, hypertension, and hidden hunger. It is also established fact that seasonal, locally available, and cheap fruits and vegetables can also keep the population healthy and nutritionally secure rather than costly off-season ones. Also, the underutilized crops have the potential to give economic security to poor by giving employment and by fetching good returns from their sale in raw form as well as value-added products.

Nutritional and medicinal value of underutilized vegetable

Drumstick (*Moringa oleifera*)

Moringa oleifera is an important multipurpose tropical tree under-recognized for its nutritional and medicinal properties. The Moringa plant has been consumed by humans throughout the century in diverse culinary ways (Iqbal *et al.*, 2006)^[20]. Almost all parts of the plant are used culturally for its nutritional value, purported medicinal properties and for taste and flavor as a

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vegetable and seed. The leaves of *Moringa oleifera* can be eaten fresh, cooked, or stored as a dried powder for many months reportedly without any major loss of its nutritional value (Arabshahi-D *et al.*, 2007; Fahey, 2005) [5, 16]. Epidemiological studies have indicated that *Moringa oleifera* leaves are a good source of nutrition and exhibit anti-inflammatory, anti-ulcer, anti-atherosclerotic and anti-convulsant activities (Chumark *et al.*, 2008; DanMalam *et al.*, 2001; Dahiru *et al.*, 2006) [11, 15, 13]. The investigation of the different parts of the plant is multidisciplinary, including but not limited to nutrition, ethnobotany, medicine, analytical chemistry, phytochemistry and anthropology (McBurney *et al.*, 2004) [31]. For centuries and in many cultures around the world, the medicinal usage of the Moringa has been used to treat problems such as skin infections, anaemia, anxiety, asthma, blackheads, blood impurities, bronchitis, catarrh, chest congestion, cholera and many other illnesses (Khawaja *et al.*, 2010; Singh *et al.*, 2012) [24, 34, 45]. *Moringa oleifera* also consists of anti-inflammatory, anti-spasmodic, anti-hypertensive, anti-tumour, anti-oxidant, anti-pyretic, anti-ulcer, anti-epileptic, diuretic, cholesterol lowering, renal, anti-diabetic, (Sharma *et al.*, 2012) [45, 44] and hepatoprotective activities (Lai *et al.*, 2010). It has also long been labeled for its great cosmetic value in which in recent years, the Moringa has commonly been found to be used in various health care products including body and hair moisturisers and conditioners. It was also discovered that Moringa oil was used in skin ointments ever since the Egyptian times. The Moringa was claimed to be 'the most nutrient-rich plant yet discovered' by Khawaja *et al.* (2010) [24].

Elephant foot yam (*Amorphophallus campanulatus*)

Amorphophallus campanulatus commonly known as "Jimikand", "Elephant foot yam" is one of the underutilized aroid of araceae family. It is tuberous, stout indigenous herbs used in ayurvedic medicine system for treating various human ailments. In recent years the popularity of complementary medicine has increased. The corms are dry, acrid, pungent; increases both appetite and taste; digestive, anthelmintic and aphrodisiac; useful in vitiated conditions of vata and kapha, elephantiasis, inflammations, haemorrhoids, haemorrhages, dysentery, splenopathy, amenorrhoea, seminal weakness, fatigue, anaemia and general debility (jain *et al.*, 2009, Ramalingam *et al.*, 2010) [21, 41]. The fresh corms are applied externally as an irritant to treat acute rheumatism. The corm is a hot carminative in the form of a pickle. It contains betulinic acid, β - sitosterol, stigmaterol, triacotane, lupeol, and β -sitosterol palmitate (Ramalingam *et al.*, 2010) [41]. Besides these, glucose, galactose, sharp crystal of calcium oxalate, rhamnose and xylose are also present (basu *et al.*, 2013) [7]. The corms are reported to possess antibacterial, antifungal and cytotoxic activities due to presence of a diterpenoid namely salviasperanol and amblyone, a triterpenoids (Anonymous 1985, Khan, 2008) [4, 22]. The ethanol and aqueous extract of corms showed antioxidant and hepatoprotective activity (CC14 induced hepatic damage). The tuberous roots of the plant possess blood purifier properties and have been used traditionally for the treatment of piles, abdominal disorders, tumours, enlargement of spleen, asthma and rheumatism (Kirtikar and Basu, 1989) [25].

Yams (*Dioscorea spp.*)

Yams (*Dioscorea*) belong to Dioscoreaceae family. They are herbaceous plants with twine there are some 600 species (Amani *et al.*, 2004) [3] of yam, but only six are mostly grown

as staple foods. These are *Dioscorea rotundata* (white yam), *D. alata* (water yam), *D. cayenensis* (yellow yam), *D. esculenta* (Chinese yam), *D. bulbifera* (aerial yam) and *D. dumetorum* (trifoliate yam) (Otegbayo *et al.*, 2001) [36]. Approximately 600 *Dioscorea* species are eaten in various parts of the world. Yams, the edible starchy tubers, are of cultural economic and nutritional importance in the tropical and subtropical regions of the world (Mishra *et al.*, 2011). Yam has been suggested to have nutritional superiority when compared with other tropical root crops. They are reported as good sources of essential dietary nutrients. Yams are a good source of vitamin C – 27% of the daily value for fighting infections such as colds and flu and quick wound healing, anti-aging, strong bones, and healthy immune function. It also provides good amounts of fiber, potassium, manganese, and metabolic B vitamins.

Amaranth (*Amaranthus spp.*)

Amaranthus, collectively known as amaranth, is an annual or short lived perennial plant distributed worldwide in warm, humid regions. Amaranths are botanically distinguished by their small chaffy flowers, arranged in dense, green or red, monoecious or dioecious inflorescences, with zero to five perianth segments and two or three styles and stigmata, and by their dry membranous, indehiscent, one-seeded fruit. *Amaranthus* uses the C₄-cycle photosynthetic pathway which enables it to be uniquely efficient in utilizing sunlight and nutrients at high temperatures. Plants that use the C₄ carbon fixation pathway tend to require less water than the more common C₃ carbon-fixation pathway plants. *Amaranth* has often been referred to as drought tolerant, this is probably due to the ability of the genus to grow under a wide range of climatic conditions coupled with its. *Amaranthus* leaves have been reported to contain 17.5 – 38.3 % protein (dry-weight basis) of which 5 % is lysine, an essential amino acid that is lacking in most diets based on cereals and tubers. Leaf-protein levels (dry-weight basis) have been reported as 27% for *Amaranthus blitum*, 28% for *Amaranthus hybridus*, 30% for *Amaranthus caudatus*, and 33 % for *Amaranthus tricolor*. The cooked leaves (not mixed with other foods) have been reported to contain about 8% protein, 4% carbohydrates. The protein quality of the amaranth leaf-nutrient concentrate (determined by amino acid composition, digestibility, and nutritional effectiveness is excellent. It serves as an inexpensive rich source of protein and dietary fiber (Shukla *et al.*, 2010). The protein has a high content of sulphur-containing amino acids (methionine, cysteine), which makes it a good combination with cereals. Vegetable amaranth is also an important source of vitamins, especially pro vitamin A, the lack of which results in a most serious nutritional deficiency in the tropics and leads to blindness in thousands of children each year (Singh *et al.*, 2001). The leaves are also a good source of vitamin C, K and folate. When compared to spinach, *Amaranthus spp* contains 3 times more vitamin C, calcium, iron and niacin. It contains 18 times more vitamin A, 20 times more calcium and 7 times more iron when compared to lettuce. *Amaranthus* leaves have high levels of carotene and micronutrients such as sodium, copper, manganese, chloride. Phytochemical content in addition to being a significant source of vitamins and minerals, amaranth also contributes to the intakes of other phytochemicals such as phenolic compounds and isothiocyanates (group of glucosinolates), which possess strong antioxidant properties, and have been reported to help in the prevention and suppression of diseases such as cancer, arteriosclerosis and

aging. Earlier studies have established the abundance of antioxidants in *Amaranthus* leaves (Ali & Oba, 2010) and that there was a general trend towards increased antioxidant activity with increased total phenolic content in *Amaranthus tricolor* L. As antioxidants, phenolic compounds act as free radical scavengers and act to prevent diseases which follow free radical mechanism in humans. Among the group of flavonoids, quercetin has been reported to be a strong antioxidant (Hertog *et al.*, 1992). It has been found to chelate metals, scavenge oxygen free radical and prevent oxidation of low density lipoprotein in *in vitro* studies. Vegetable amaranths are recommended as a good source of fibre for patients with constipation.

Karchikai (*M. cymbalaria*)

Momordica belongs to the family Cucurbitaceae and is commonly known as melons, gourds or cucurbits and includes crops like cucumbers, squashes, pumpkins, luffas, melons. The family is predominantly distributed around the tropics, where those with edible fruits were amongst the earliest cultivated plants in both the old and new world. *Momordica* is one among the different genera of cucurbitaceae which includes 47 species. This is one of the most genetically diverse groups of food plants in the plant kingdom. The plants belonging to this family are frost-sensitive, drought tolerant, and intolerant to wet and poorly drained soils. These are used as vegetables and also having high nutraceutical values (Kulkarni *et al.*, 1992) [26]. Production of cucurbits seems to have increased over the time due to high demand and consumer awareness on the health benefits of cucurbit fruits. The plant is a perennial climber available only during the Kharif & Rabi season and is found in the south Indian states of Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, and Tamil Nadu. The crop is not cultivated by the farmer as a regular crop, even though it comes very well during Kharif and Rabi season mainly in the black soils where sorghum, Bengal gram and onion can be cultivated. Initially it was considered as a weed, but the tubers were used for medicinal purpose, from ancient times. Recently because of the nutritional value of the fruits, it is used as vegetable. It is reported as medicinal plant in India and various parts of plant are useful for treating the common ailments. Not only the fruits even leaves can also be used as a leafy vegetable (Kirtikar & Bashu 1993). Because of lack of awareness about the nutritional aspects, it is not commercially cultivated. Hence it is considered as an underutilized vegetable crop. It is not commercially cultivated because of lack of planting materials. It is a rich source of Vitamin C, Fibre & Beta carotene and also rich in Iron & Calcium content. It is having medicinal properties such as Antidiarrhoeal, Hepatoprotective, Antidiabetic, Nephroprotective, Antiallergic, Antimicrobial etc. Not only are the fruits, all parts of plant having medicinal properties. The nutrient contents of Fruits of the two vegetables *M.cymbalaria* (Karchikai) and *Momordica charantia* (Bittergourd) are compared. The calcium content of Karchikai is three times higher than that of the Bitter gourd. The higher concentration of this nutrient in Karchikai may be exploited and used. The ascorbic acid (Vitamin C) content of Karchikai is two times higher than that of Bitter gourd. It is used to meet the shortage of vitamin C consumption. The content of potassium in Karchikai is also two times higher than in bitter gourd. (Gopalan *et al* 1994.) Not only the fruits, the tubers and leaves of this crop are also used for therapeutic uses as these contain flavonoids, steroids, Tri terpenes, Saponins (Kumar *et al.*, 2010). Tubers have been reported to

contain sterols, Triterpenes, Cardiac glycosides, and Saponins. This crop can act as a weapon against malnutrition & hunger.

Winged bean (*Psophocarpus tetragonolobus*)

Psophocarpus tetragonolobus (L.) popularly known as Winged bean or Goa bean is a tropical legume found growing abundantly in hot, humid equatorial countries, like India, Burma, Sri Lanka, Thailand and Philippines. It is also called a wonder legume as it has the high protein content in the seeds and therefore considered as a versatile legume (Peyachoknagul, 1989) [39]. The winged bean is an underutilised species but has the potential to become a major multi-use food crop. The entire winged bean plant is edible. The leaves, flowers, roots, and bean pods can be eaten raw or cooked; the pods are edible even when raw and unripe. The seeds are edible after cooking. Each of these parts contains vitamin A, vitamin C, calcium, and iron, among other nutrients. The tender pods, which are the most widely eaten part of the plant, are best when eaten before they exceed 2.5 centimetres (1.0 in) in length. They are ready for harvest within three months of planting. The flowers are used to colour rice and pastry. The young leaves can be picked and prepared as a leaf vegetable, similar to spinach. The nutrient-rich, tuberous roots have a nutty flavour. They are about 20% protein; winged bean roots have more protein than many other root vegetables. The leaves and flowers are also high in protein (10–15%). The seeds are about 35% protein and 18% fat. The great content of niacin present in the constitution of Winged beans helps in reducing the formation of blood clots by reducing platelet aggregation. This means it will reduce the risks of cardiovascular disorders arising out of the condition by keeping the levels of lipoprotein, apolipoprotein under control.

Pointed gourd (*Trichosanthes dioica*)

Pointed gourd (*Trichosanthes dioica*) is an important crop grown extensively in river beds in the states of Bihar, Uttar Pradesh, West Bengal and Assam in India (Chadha, 2000) [10]. It is known as “King of gourds” because of its higher nutrient content and medicinal value. Pointed gourd (*Trichosanthes dioica*) is known by a common name of parwal and is cultivated mainly as a vegetable. Juice of leaves of *T. dioica* is used as tonic, febrifuge, in edema, alopecia, and in subacute cases of enlargement of liver (Nadkarni *et al.*, 1996) [33]. In Charaka Samhita, leaves and fruits find mention for treating alcoholism and jaundice. A lot of pharmacological work has been scientifically carried out on various parts of *T. dioica*, but some other traditionally important therapeutical uses are also remaining to proof till now scientifically. According to Ayurveda, leaves of the plant are used as antipyretic, diuretic, cardiotoxic, laxative, antiulcer, etc. The various chemical constituents present in *T. dioica* are vitamin A, vitamin C, tannins, saponins, alkaloids, mixture of noval peptides, proteins tetra and pentacyclic triterpenes, etc. (Nitin kumar *et al.*, 2012) [34].

Basella (*Basella alba*, *B. rubra*)

Basella or vine spinach is a popular tropical leafy-green vegetable, commonly grown as backyard herb in the home gardens. Vine-spinach belongs to the *Basellaceae* family (Rathee *et al.*, 2010) [42]. and has two chief cultivars, *Basella alba*, which features green- stems and deep-green leaves, and *Basella rubra* with purplish stems and dark green leaves with pink veins (Cook, 2010) [12]. It is native to South Asia,

probably originated in the monsoon fed tropical regions of Malabar Coast of India and Sri Lanka. *Basella alba* is an underutilized plant with great potential (Olgort, 2006) [35]. The plant is often grown as an ornamental. The medicinal importance of *Basella alba* had earlier reviewed by Adhikari *et al.*, (2012) [1], Kumar *et al.*, (2013) [27]. *Basella alba* is good source of vitamin A, vitamin C, vitamin B₉ (folic acid), calcium, magnesium, iron and several vital anti oxidants in the plant. (Duke and Ayenshu, 1985; Palada and Crossman, 1999); also has proteins, fats, carbohydrates, fiber, ash, calcium, vitamins, thiamine, riboflavin and niacin. According to Khare (2007) [23] the plant consists the essential amino acids such as arginine, isoleucine, leucine, lysine, threonine and tryptophan alongwith several vitamins, minerals and a low percentage of soluble oxalates. Sheela *et al.*, (2004) [46]. *Basella alba* contains basellasaponins and peptide, phenolic compounds (Maisuthisakul *et al.*, 2008) [30]. Plant is rich in vitamin A and vitamin C along with flavonoids, saponins, carotenoids, many amino acids and organic acids. Various *in vivo* and *in vitro* studies revealed that the plants is enriched with active substances/principles having medicinal potential. Major biological activities exhibited by *Basella alba* is androgenic, antidiabetic, anti-inflammatory, antimicrobial, antioxidant, antiulcer, antiviral, CNS depressant, hepatoprotective and wound healing, properties due to presence of β sitosterol and lupeol in the plant Gupta *et al.*, (2008) and Saleem *et al.*, (2001) [43]. Besides these all the plant possess a valuable ethnomedicinal importance and are used to cure digestive, skin diseases, bleeding piles, pimples, urticaria, irritation, anemia, whooping cough, leprosy, aphthae, insomnia, cancer, gonorrhoea, burns, headache, ulcers, diarrhea, liver disorders, bilious vomiting, sexual asthenia.

Bathua (*Chenopodium album*)

Chenopodium album is one of the most widely distributed species of weeds in the world. Commonly found in Australia, India, South Africa, and the Americas. *Chenopodium album* is primarily a weed of agronomic and horticultural crops, nurseries, and occasionally pastures.

In India, the plant is popularly called Bathua and found abundantly in the winter season. The leaves and young shoots may be eaten as a leaf vegetable. *Chenopodium album* have some gentle medicinal properties and is a very nutritious and healthy addition to the diet. *Chenopodium album* has some medicinal properties like anthelmintic, antiphlogistic, antirheumatic, contraceptive, laxative, odontalgic etc. *Chenopodium album* used in the treatment of rheumatism, bug bites, sunstroke, urinary problems, skin problems etc. *Chenopodium album* or bathua is very rich in various nutrients like proteins, vitamins like vitamin A, vitamin C and also minerals like iron, potassium, phosphorus and calcium. Due to its high nutritive value and medicinal properties, *Chenopodium album* or bathua is used in the preparation of many traditional medicines. It is also rich in substances called saponins and flavonoids which control diabetes, prevent cancer, reduce obesity and also protect our heart. They are rich in vitamin A, vitamin C, vitamin B-complex like Niacin, Riboflavin or vitamin B₂, Thiamine or vitamin B₁. They also contain minerals like calcium, phosphorus, iron, etc. It is also rich in omega 3 and omega 6 fatty acids. The leaves of *C. album* are being used in traditional medicines. It has been found to have antipruritic and antinociceptive (Dai *et al.*, 2002) [14], sperm immobilizing agent (kumar *et al.*, 2006) [28], cryptomeridiol and 8-alpha-acetoxycryptomeridiol as growth

promoting activity. It has been found to have flavonoid as phenolic amide, hypotensive activity (Horio *et al.*, 1993) [19] cinnamic acid amide, alkaloid chinoalbicin, apocortinoid, xyloside, phenols and lignans *C. album* extract was found to exhibit excellent antioxidant and free radical scavenging activity, when compared with ascorbic acid during *in vitro* studies. A study by Laghari *et al.* 2011, revealed that the methanolic extracts of *C. album* from fruits and leaves have great potential as a source for natural health products. *Chenopodium album* has significant antifungal potential against phyto-pathogenic fungus *Ascochyta rabiei*.

Conclusion

Underutilized vegetable crops require special attention and must be popularized in order to utilize their potential to treat many lifestyle related diseases. Research in the direction of domestication and utilization is of profound importance as far as nutritive value is concerned. The increase in area and production of these vegetable crops will not only provide nutritional security and save money on import but also export of fresh vegetable crops and seed in further expected to boost region economy. Underutilized vegetable crops also provide many fold employment opportunities in agro-based industries, packaging, storage, preservation, canning and transportation.

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