

Potential Health Benefits of Tropical Tuber Crops

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Tropical root and tuber crops are the second most important source of carbohydrates after cereals generally in tropical countries of the world. These tuber crops store edible starch material in modified underground stems and roots. They play a significant role in the world's food security due to its ability to grow and yield well in marginal and wastelands. Tuber crops are an important source of animal feed and raw materials for the processing industries like manufacturing sago, starch, snack foods, fermented foods, alcohol and beverages.

Presently with regard to environmental change, they are acquiring the status as the best source of adaptive food, nutrition and livelihood. These crops primarily include sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta* Crantz), taro (*Colocasia esculenta*), yams (*Dioscorea* sp.), elephant foot yam (*Amorphophallus paeoniifolius*) and other minor tuber crops. Apart from the major tropical tuber crops like sweet potato, cassava, aroids and yams, there are other minor tuber crops that are grown only in some pockets of the world. These crops are rich in nutrients and bioactive compounds and have medicinal properties. Among these, arrowroot (*Maranta arundinacea*) and Chinese potato (*Solenostemon rotundifolius*) are the most popular than the rest of the

crops like yam bean, curcuma species, queensland arrowroot (canna), costus, typhonium, tacca, vigna species etc. Some are very important due to their medicinal properties as well as industrial applications. Many of these crops have not spread farther due to lack of awareness and physiological constraints or lack of adaptability.

Non-communicable diseases (NCDs) like cardiovascular diseases, cancers, chronic respiratory diseases and diabetes are increasing globally in both developed and developing countries. NCDs are the leading cause of death in the world, representing 63% of all annual deaths (WHO, 2013). The oxidative stress or free radical toxicity would be caused by both endogenous and exogenous factors that contribute to the etiology of NCDs as well as the aging process. The positive correlation between plant food intake and increased health benefits by reducing NCDs has been the main focus of a number of scientific investigations in the recent past. Tropical root and tuber crops are important sources of a number of beneficial phytochemicals namely, phenolic compounds, carotenoids, anthocyanin, saponins, glycoalkaloids, phytic acids, vitamins, minerals etc. These phytochemicals play a role in several bioactivities as antimicrobial, antioxidant, anti-obesity, antidiabetic, immunomodulatory, hypocholesterolemic activities and others.

Sweet Potato (*Ipomoea batatas* L.)

The origin of sweet potato is Central and South America. But, it is widely cultivated in many tropical and subtropical countries of the world. This crop is the seventh largest food crop, cultivated in warm temperate, subtropical and tropical regions of the world. Under varied climatic conditions, sweet potato

can be cultivated all around the year and complete crop loss under adverse climatic conditions is rare. Hence, it is considered an "insurance crop or climate resilient crop." The crop is widely cultivated in Southeast Asia, Latin America and Oceania regions. China is the major producer of sweet potato and it grows about 90% of total world production. Sweet potato tubers are a rich source of carbohydrates, fibre as well as an array of minerals and vitamins including iron, selenium, calcium, and good sources of vitamin A, vitamin B complexes and vitamin C. Consumption of sweet potato helps to control non-communicable diseases, due to its high content of an antioxidant and bioactive compounds such as phenolic acids, anthocyanins, beta-carotene etc. Unique features and nutritional value of this vegetable, the National Aeronautics and Space Administration (NASA), USA, have selected sweet potatoes as a candidate crop to be incorporated into the menus for astronauts on space missions (Chandrasekara and Joseph Kumar, 2016). Recently, ICAR-Central Tuber Crops Research Institute, Thiruvananthapuram, Kerala, developed and released beta-carotene (14.0 mg/100g) and anthocyanin (90.0 mg/100g) rich varieties, namely Bhu Sona and Bhu Krishna respectively.

Sweet potato tuber is a good source of carbohydrates and other nutrients, while its leaves and tender stems (tops) contain additional nutritional components in much higher concentrations than the other popular leafy vegetables. In many parts of the world, sweet potato leaves are consumed as a vegetable. They are very rich in vitamins and minerals like vitamin B complexes, vitamin C, vitamin E, vitamin K, beta-carotene, iron, calcium, zinc and protein.

Leaves are also an excellent source of bioactive compounds. It contains at least 15 biologically active anthocyanins and polyphenols that have significant medicinal value for certain human diseases and may also be used as natural food colorants. These compounds showed various kinds of physiological functions like, free radical scavenging (Antioxidative), anti-mutagenic, anticancer, anti-hypertension, antidiabetes, anti-inflammation and antibacterial, which can be beneficial for maintaining and boosting human health (Islam, 2006).

Cassava (*Manihot esculenta*)

Cassava is the most widely grown tuber crop in the tropics; its cultivation is limited to the tropical and subtropical regions of the world. It is a perennial shrub belonging to the family Euphorbiaceae. Cassava originated in South America and subsequently, its cultivation was spread to tropical and subtropical regions of the world, mainly in Africa and Asia. Due to high content carbohydrates, cassava is used as a staple food for more than 500 million people in the world. A number of bioactive compounds are reported in cassava tubers, like non-cyanogenic glucosides, cyanogenic glucosides such as linamarin and lotaustralin, hydroxycoumarins such as terpenoids, scopoletin, and flavonoids (Blagbrough et al. 2010).

Yams (*Dioscorea* sp.):

Yams (*Dioscorea* spp.) are herbaceous, climbing, twining, perennial vines, members of the monocotyledonous family Dioscoreaceae and are the staple food in West Africa, Caribbean regions, and Southeast Asia. Yam is consumed as raw, cooked or boiled and as powder or flour in food preparations and industrial uses. Yam tubers have a high content of carbohydrate and

moderate nutrient density with appreciable content of potassium, manganese, carotenoids, tocopherols, vitamin B6, thiamin, vitamin C and dietary fibre. It has several bioactive components like, diosgenin, mucin, polyphenols, dioscorin, dioscin, choline and allantoin. Mucilage of yam tuber contains soluble glycoprotein and dietary fibre. Several studies have shown anti-mutagenic, hypoglycemic, immunomodulatory, antimicrobial and antioxidant activities of yam extracts (Chandrasekara and Josheph Kumar, 2016). The most important component reported in yam is diosgenin, a sapogenin used in the synthesis of steroidal drugs and oral contraceptives.

Aroids

Aroids are the tuber bearing monocotyledon plants belonging to the family Araceae. There are several edible tuber producing members of this group grown in several tropical and sub-tropical countries, such as elephant foot yam (*Amorphophallus paeoniifolius*), taro (*Colocasia esculenta*), tannia or yautia (*Xanthosoma sagittifolium*), giant taro (*Alocasia macrorrhizos*), and swamp taro (*Cyrtosperma merkusii*). Taro or colocasia (arvi) is originated in India and Southeast Asia, whereas the origin of the tannia is South America and the Caribbean regions. It is a staple food in many places such as Papua New Guinea, Tonga and Western Samoa. Moreover, taro is the most widely cultivated and consumed crop in Asia, Africa, and Pacific as well as Caribbean Islands.

Carbohydrate content of the taro is more than double the content of potato. Its corm has been reported 70–80% (dry weight basis) of starch granules with small, 1–4µm in diameter (Jane et al., 1992) hence; is highly digestible for the preparation of infant foods. Taro contains about

11% of protein on a dry weight basis, is more than sweet potato, cassava and yam. The protein fraction is rich in essential amino acids like arginine, tryptophan, phenylalanine, leucine and valine. The corms are also rich in vitamins, like beta-carotene, thiamin, niacin, riboflavin; minerals including iron, calcium, zinc, phosphorus, copper, magnesium, sodium and an excellent source of potassium. The taro leaf is a popular leafy vegetable. It has been reported to be rich in minerals such as iron, calcium, phosphorus, vitamins like niacin, thiamine, riboflavin and vitamin C, and essential amino acids like lysine, cystine, methionine, leucine and phenylalanine are relatively abundant in the leaf than the corm.

Elephant foot yam (*Amorphophallus paeoniifolius*, synonym *A. campanulatus*) is a perennial herbaceous diploid tropical tuber crop belongs to family Araceae. This is a native crop of South Asia and is widely distributed in India, Malaysia, Philippines, Bangladesh, Indonesia and Southeast Asia. India and China are the major elephant foot yam producing countries. Elephant foot yam corms have been used as food, traditional medicine and animal feed. It is a cheap source of carbohydrates, vitamins, minerals, dietary fibre and glucomannan. Tuber is rich in minerals like calcium, phosphorus, iron, magnesium and different vitamins such as thiamine, niacin, riboflavin and vitamin A. The main biochemical constituents of elephant foot yam are glucomannan and starch; therefore, acts as an important source of dietary fibre as well as energy. The glucomannan have several health benefits, it plays role in reducing cholesterol, improving blood sugar levels, normalizing triglyceride content, immune function and promoting intestinal

activity in human beings (Sudhanshu, 2017). Elephant foot yam is also used as a medicine to cure bronchitis, asthma, abdominal pain, emesis, dysentery etc.

Arrowroot

Arrowroot, *Maranta arundinacea* L. (also called West Indian arrowroot) is belongs to family Marantaceae and believed to have originated in the North western parts of South America. It is a perennial herbaceous plant with cylindrical rhizomes having high starch content (17.2–18.9 %). It is cultivated for its edible rhizomes, for fresh consumption and to extraction of superior starch. It has been widely cultivated throughout the tropical countries like the West Indies, India, Sri Lanka, Indonesia, Philippines and Australia. Arrowroot starch has got greater potential for use in food industry, particularly baby food production, due to its easy digestibility. It is also used for making biscuits and in certain food preparations as stabilizer, thickener, applied for therapeutic use (Lajvardi, 1993).

Canna

The perennial herbaceous plant, canna (*Canna edulis*) is widely distributed throughout the tropical and subtropical regions, and belongs to the monocotyledon family Cannaceae. Canna produces shallow underground rhizomes, which is rich in starch. The edible types of *Canna edulis* is believed to be originated in the Andean region or Peruvian coast of South America. It is commercially cultivated for the production of starch. Various categories of resistant starch have been reported in canna. Its starches have large granules and high amylose content. Resistant starches got much attention due to its potential functional properties and health benefits. This starch influences positively in the functioning of the digestive tract, control of

blood cholesterol levels and helps in the control of diabetes due to low glycemic index.

Chinese Potato

Chinese potato, *Solenostemon rotundifolius* (Syn. *Plectranthus rotundifolius*, *Coleus parviflorus*) also called as Frafra potato, Hausa potato, is a member of the family Labiatae. It is a tuber producing, small herbaceous bushy annual with succulent stems and aromatic leaves. The crop believed to have originated in Kenya or Ethiopia from where it spread to other parts of Africa and South-east Asia. The tubers are rich in several minerals, vitamins and other nutrients, which help in the maintenance of health. Tubers are rich in carbohydrate mainly starch, amino acids viz. glutamic acid, arginine, aspartic acid and minerals like calcium and iron. The tubers are very good source of flavonoids and other compounds which act as potential antioxidant. The flavonoids which are reported in chinese potato have been found to reduce blood cholesterol as well as have high antioxidant activity. It is reported that, tuber is used for the treatment of dysentery, sore throat, eye disorders and hematuria in several African and Asian countries (Mukherjee et al., 2015).

Conclusion

Tropical roots and tubers are important diet components for humans after cereals and varieties of delicious preparations can be cooked by using tuber and leaves of these crops. Most of tropical tuber crops have higher biological efficiency as food producers with high dry matter production per unit area per unit time with minimum crop management on marginal

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