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Underutilized Aquatic Vegetables and Their Nutritional Values

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FIGURE 1. Vegetable growing water
(Image Courtesy: plantingyourfuture.com , 2021)

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SUMMARY

In India, lakes, rivers and other freshwaters support a large diversity of biota representing almost all taxonomic groups. From an ecological point of view, the diversity of species present in the wetlands is an indication of the relative importance of the aquatic biodiversity issue as a whole. The total numbers of aquatic plant species exceed 1200 and aquatic vegetation is a valuable source of food. In the winter, migratory waterfowl search the sediment for nutritious seeds, roots and tubers. Resident waterfowl may feed on different species of aquatic vegetation year-round. Aquatic vegetables are "environmentally friendly": they suffer from few diseases and pests and can be grown without chemical fertilizers. Concerted efforts are being made to unravel the genes that lie behind some of these attractive traits, such as resistance to pests.

INTRODUCTION

India is considered one of the suitable niches and most of the boundaries have got the unique gift of nature of unprecedented high rainfall and unique topography to harvest and preserve nature's drop, resulting in round-the-year availability of green lustrous aquatic edible greens, carbohydrate-rich rhizomes and nutritionally packed flowers and fruits suitable for various vegetable uses. Communities dominated in the wetland areas of India not only get their requirements of vegetables from such sources, but it also has been an indispensable part of their life. Lotus and water chestnut are some of the few examples which have been in use on various religious occasions since time immemorial. Aquatic species such as *Trapa bispinosa*, *Ipomoea aquatica* and *Nelumbo nucifera* are among the most commonly consumed vegetables. These are eaten in mean daily quantities exceeding 50g and contain high Ca, Fe and – carotene concentrations. Water chestnut (*Trapa bispinosa*), lotus (*Nelumbo nucifera*) and water spinach (*Ipomoea aquatic)* is grown as aquatic vegetable. Present food habits indicate that most consumers are fond of rhizomes of lotus. Starch and fat-laden horned fruits of *Trapa bispinosa* form a staple food. Young leaves, stems and roots of *Ipomoea aquatic* are eaten, as common vegetables. The utilization of aquatic vegetables as food could alleviate protein shortages in the local population. Concerted efforts are needed to assess the food value of the native aquatic flora for their exploitation at a commercial scale.

India, with its annual rainfall of over 110 cm, varied topography and climatic regimes support and sustain diverse and unique wetland habitats. Natural wetlands in India consist of the high altitude Himalayan lakes, followed by wetlands situated in the flood plains of the major river systems, saline and temporary wetlands of the arid and semi-arid regions, coastal wetlands such as lagoons, backwaters and estuaries; mangrove swamps; coral reefs and marine wetlands, and soon. In addition to the various types of natural wetlands, a large number of man-made wetlands also contribute to faunal and floral diversity. These man-made wetlands, which have resulted from the needs of irrigation, water supply, electricity, fisheries and flood control, are substantial in number. The various reservoirs, shallow ponds and numerous tanks support wetland biodiversity and add to the country's wetland wealth. It is estimated that freshwater wetlands support 25 per cent of India's known range of biodiversity. Wetlands in India occupy about 60 million hectares, including areas under wet paddy cultivation. The majority of the inland wetlands are directly or indirectly dependent on major rivers like Ganga, Bhramaputra, Narmada, Godavari, Krishna, Kaveri and Tapti. Regional wetlands are integral parts of larger landscapes, their functions and values to the people in these landscapes; depend on their extent and location.

Role of aquatic vegetables in phyto-remediation

Metal content Cd (non-essential), Zn and Fe (essential) in plant parts of these selected species indicate their ability to bio-concentrate in their tissues. The concentration of these metals was invariably high in leaf tissue. Thus, it is possible to use these species to restore the biosolid and sewage sludge-contaminated sites, while exercising caution on human consumption. Leafy aquatic vegetables are used for the removal of lead and mercury from polluted waters. It is also possible to supplement the dietary requirement of human food with Zn and Fe as these are essential nutrients and the plant species are edible. However, there is a need to monitor the metal transfer factor through the food chain. Glutathione and organic acids metabolism play a key role in metal tolerance in plants. Glutathione is a ubiquitous component in cells from bacteria to plants and animals. Glutathione metabolism is also connected with cysteine and sulphur metabolism in plants. Cysteine concentration limits glutathione biosynthesis. Low-molecular thiol peptides phytochelatins (PCs) often called class III metallothioneins are synthesized in plants from glutathione induced by heavy metal ions. Organic acids play a major role in metal tolerance by forming complexes with metals, a process of metal detoxification. Chelation of metals with excluded organic

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Feature Article

acids in the rhizosphere and rhizospheric processes indeed forms an important aspect of investigation for remediation. These metabolic pathways underscore the physiological, biochemical and molecular basis for heavy metal tolerance.

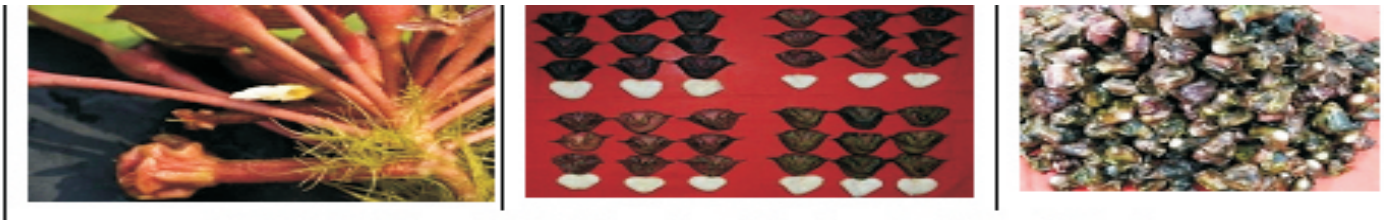

FIGURE 2. Flowering, fruiting and variation in nuts of Water chestnut

FIGURE 3. Lotus has grown in pond

FIGURE 4. Water spinach

Water chestnut

Water chestnut is one of the most important minor crops grown in India and grown in the tropical and subtropical regions, as a submersed plant. It thrives in soft nutrient-rich water in lakes, ponds and streams with a neutral to slightly alkaline pH. Kernel of water chestnut contains protein (up to 20.0 %), starch (52.0 %), tannins (9.4 %), fat (up to 1.0 %) and sugar (3.0 %) and also a good source of fibre, vitamin B along with Ca, K, Fe and Zn.

(a) Propagation of water chestnut

Propagation of water chestnut is commercially done through seeds. The fully mature nuts are placed in containers with little water to germinate the seeds. The sprouted seeds are sorted out and broadcast in the nursery tanks. At the beginning of the monsoon, the seedlings are lifted from the nursery tanks and planted in the pond, at a spacing of 1-2 meters. Tops may be trimmed if they are too tall at transplanting. The soil should be kept flooded with 100 -300 mm of water throughout the growing period.

(b) Cultivars

A standard variety of water chestnut is not yet released. Nuts with different husk colour like green, red or purple and a blending of red and green colours are recognized. Jaunpuri, Kanpuri, Desi large and Desi small are referred to as the growers in West Bengal and other parts of Eastern India.

Lotus

Lotus is also known as sacred lotus, Indian lotus, East Indian lotus, Oriental lotus, Lily of Nile, Bean of India and Sacred water lily. American lotus (*Nelumbo lutea*) is native to a region stretching from the southeastern part of North America to the northern part of South America. It is smaller than the sacred lotus; bears scented, pale yellow flowers. Young leaves, petioles and flowers are eaten as vegetables. Rhizome (Kamal-Kakadi, blen) is edible and sold as a vegetable. Fresh rhizomes are eaten after boiling and fried slices are used in curry or fried as chips. Fresh rhizomes can be preserved in frozen conditions and used as pre-cooked food. Generally, two types of rhizomes, white and red are available. Rhizomes varied 60-120 cm in length and 6-9 cm in diameter, are white to buff orange in colour and possess a few large cavities in cross-section. The leaves are used as a flavouring agent and to wrap sweet and spicy mixtures (rice, meat, fruit etc.) for steaming.

Water Spinach (Kalmi Saag)

Water spinach originated in tropical Asia, possibly in India and is a member of the morning glory family. Water convolvulus, Kang Kong and Swamp cabbage are some alternative names in English. It is known in Mandarin as Kong xin cai (empty heart/stem vegetable); ong tsoi and weng cai (pitcher vegetable) in Cantonese; Kang Kong in Filipino and Malaysian; and in Japanese as Asagaona. It is commonly used as a food plant and acts as an antihyperglycemic. The leaves are a good source of minerals and vitamins and are also considered a possible food protein source. The plant serves as highly nutritive green fodder, fish food and feed for broilers. It has long, jointed, hollow stems, allowing the vines to float on water or creep across the muddy ground. Adventitious roots are formed at nodes which are in contact with water or moist soil. They exude a milky juice, and their leaves are white or green, depending on the variety. Water spinach has no relationship with common spinach, but is closely related to sweet potato. Narrow leaves are 1-2.5 cm wide and 20-30 cm long. Broad leaves are up to 5 cm wide and 15-25 cm long. Based on stem colour and other morphological attributes, the cultivars may be classified into three main groups.

(a) Light green

Plants of this group have a light green stem. The shoots are tender, soft and glabrous with ovate, oblong and lanceolate leaves and spread densely in shallow water.

(b) Red-green

The stems of this group of plants are green and red. Shoots are tender, soft and glabrous with thick leaves, mostly hastate. The plants spread and produce several meter-long trailing branches. It is the most common type.

(c) Red stem

The stem of this plant group possesses a dark red colour and they are soft and glabrous with a diameter thinner than of the other varieties.

(d) Propagation through cuttings

Water spinach can also be raised from stem cuttings, 30-40 cm long, taken from the young growth just below a node, and planted about 5 cm deep. For aquatic culture, cuttings from the broad-leaved cultivars are transplanted in puddled soil.

CONCLUSION

The aquatic vegetables, in addition, harnessing their multifaceted benefits in terms of maintaining urban bodies in flood control, amenity uses, wildlife and broader environmental benefits may be considered in a very holistic manner. The various parts of the country with swamp lands and shallow ponds have been adjudged to be entirely unsuitable for fish culture or agriculture and the present policy for such areas is to "drain and develop" them for uses not in accord with their nature. This requires searching for innovative techniques that would allow using wetlands sustainably and the cultivation of aquatic vegetables is one of the possible ways. However, popularization and proper augmentation of these aquatic vegetables on a large scale could make a significant contribution towards nutritional security and economic upliftment of society. In addition to food and nutritional security, this is also likely to generate on-farm and off-farm (transportation, storage, processing, marketing *etc*.) employment. Owing to their potential under wetland conditions, there is an argument to promote them to sustainably address challenges such as increasing water-logged conditions in high rainfall areas, food and nutrition insecurity, environmental degradation, and employment creation under climate change. With research, development and policy to support them, aquatic vegetable crops could play an important role in climate change adaptation

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