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Nutritive values and importance of green leafy vegetables in human diet: A review

Shikha Markam**Abstract**

Greens are among the most productive plants in terms of nutritional value per unit area, because they grow rapidly and can have several crops in a season. They contribute sufficient amounts of vitamin A and C and several minerals even after losing some of the constituents while cooking. The need for green food is being greatly emphasized owing to the increase in knowledge of value of essential minerals and vitamins. They could be used as an important source of nutrients during the pre-cropping season, before traditional crops are available for human consumption. There are hundreds of edible green leafy vegetables grown and used in India. Most common green leafy vegetables grown in tropical areas of India are *Amaranthus* sp., *Alternanthera sessilis*, *Coriandrum sativum*, *Hibiscus sabdariffa*, *Ipomea aquatica*, *Mentha arvensis*, *Moringa oleifera*, *Murraya koenigii*, *Portulaca aquadrifida*, *Sauropus androgynous*, *Sesbania grandiflora*, *Solanum nigrum*, *Spinacia oleracea*, *Talinum traingulare*, *Trigonella foenum-graecum* used. The nutritional values and chemical constituents present in these green leafy vegetables are of great importance to human health. Consumption of these green leafy vegetables will improve the nutritional status and will reduce the risks of specific diseases like diabetes, cancer and hepatotoxicity. The present study is on reviewing edible green leafy vegetables available in tropical conditions of India and their pharmacological benefits, essential in this modern world to support the benefits of their consumption.

Keywords: Green leafy vegetables, moringa, spinach and nutritive value

Introduction

India, endowed with climatic conditions provides opportunities for growing an array of green leafy vegetable, which form second important category of vegetables. These green leafy vegetables are mostly rich in essential minerals, vitamins and dietary fibre and have therapeutic properties. With the wake of the novel coronavirus disease (COVID-19) pandemic, there is need to boost our immune systems to prevent from the rate of disease incidence (Padhee and Joanna Kane-Potaka, 2020). Consuming green leafy vegetables are the right and smart way to augment the meet out the nutritional requirements necessary for good health and wellbeing. Dieticians recommend a daily consumption of at least 125 g of green leafy vegetables for a balanced diet. There is a wide variation in consumption of green leafy vegetables in different parts of the world. Being short duration crop, these can be grown as intercrop or as mixed crop or in roof gardening.

As a food source, leafy vegetables are the best source of pro-vitamin A and C and also supplies good amounts of iron, folate and other essential minerals. They are also an excellent source of phytochemicals, which aids in fighting against heart disease and cancer. Majority of the green leafy vegetables belong to Amaranthaceae family. Green leafy vegetables like spinach, amaranthus and gogu are termed as "Poor man's diet" as they are abundantly available all-round the year at a very low price and less expensive as compared to other vegetables. A number of greens are cultivated in India throughout the year. Some are suitable for growing during winter eg. Palak, spinach, fenugreek and mustard and others such as amaranthus, portulaca and poi are suitable for growing during summer. The ten most popular green leafy vegetables are spinach, amaranthus, fenugreek, agathi, mustard, mint, gogu, alternanthera, drumstick leaves and coriander. Besides these, great variety of less familiar green leafy vegetables are also used locally in different parts of the country.

The spinach, amaranth and fenugreek leaves are generally consumed all over the country. Each green leafy vegetable has unique flavour, taste, aroma, depending upon the way it blends with other foodstuffs. Spinach can be used it salt, spicy and sweet food preparations.

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Some greens like fenugreek, mustard, radish, mint and curry leaves have strong flavour, while other like amaranthus has mild flavour. Gogu, on the other hand, is sour in taste. These leafy vegetables should be included as an essential component of our daily diet.

Nutritional and health benefits of green leafy vegetables

“Greens” refer to those vegetables grown for their leafy portions for use in both cooking and salads. As a group, they are recognized for their high mineral and vitamin contents; recently, they have gained new popularity from nutrition-conscious consumers. Micronutrient rich green leafy vegetables, the common man’s healthy foods, are rightly placed under the category of Protective foods. Dark green leafy vegetables are good sources of minerals like iron, calcium, potassium, and magnesium and vitamins including K, C, E, and many of the B vitamins. They also provide a variety of phytonutrients including beta-carotene, lutein, zeaxanthin, and Omega-3 fatty acid which protect cells from damage and age-related problems (Sreenivasa Rao, 2017). Greens have very little carbohydrate in them and the carbohydrate is packed in layers of fibre, which make them very slow to digest and have very little impact on blood glucose. Edelman and Colt (2016) [9] reported that protein content of green leafy vegetables such as spinach (*Spinacia oleracea*), broccoli (*Brassica oleracea* var. *Italica*) and duckweed (*Lemna perpusilla*) provide all the essential amino acids that meet the FAO nutrition standards. Indian Green leafy vegetables such as basella (*Basella rubra*), fenugreek (*Trigonella foenum graecum*), hibiscus (*Hibiscus cannabinus*), coriander (*Coriandrum sativum*), cabbage (*Brassica oleracea*) and spinach (*Spinacia oleracea*) are good sources of soluble dietary fiber content. Consumption of higher levels of vegetable fiber resulted in reduced risk of cardiovascular diseases and possibly, colon cancer (Jenkins, 2001) [15]. Most sources seem to agree on the excellent nutritional benefits of moringa (Folkard and Sutherland, 1996) [10]. The moringa leaves provide many vitamins and minerals and can be consumed in cooked or dried forms. The foliage is comparable to spinach in both its appearance and nutritional quality. Nearly 46 Antioxidants and 36 Anti Inflammatory compounds are available in the moringa plant. The more antioxidants in the body, the less is the aging and disease occurrence (Beulah, 2016) [4].

Green leafy vegetables are abundant sources for β -carotene. In leaves, vitamin A is present in the form of provitamin A carotenoids such as β -carotene (ca. 25-30%), α -carotene, γ -carotene, β -cryptoxanthin and non-provitamin A carotenoids lutein (ca. 45%), violaxanthin (ca. 15%) and neoxanthin (ca. 15%) (Britton, 1996) [5].

Medicinal importance of green leafy vegetables

Leafy vegetables are ideal for weight management as they are typically low in calories. They are useful in reducing the risk of cancer and heart disease since they are low in fat, high in dietary fibre, and rich in folic acid, vitamin C, potassium and magnesium, as well as containing a host of phytochemicals, such as lutein, beta-cryptoxanthin, zeaxanthin, and beta-carotene. Most studies have established that intakes of green leafy vegetables reduce cardiovascular diseases (Wang *et al.*, 2016). In Spain, Stephen Daniells (2008) suggested that an increased intake of green leafy vegetables, but not fruit, may reduce the risk of lung cancer by 50 per cent. Because of their high magnesium content and low glycemic index, green leafy vegetables are also valuable for persons with type 2 diabetes.

An increase of one serving/day of green leafy vegetables were associated with a nine per cent lower risk of diabetes. The high level of vitamin K in greens makes them important for the production of osteocalcin, a protein essential for bone health. The risk of hip fracture in middle-aged women was decreased 45 per cent for one or more servings / day of green leafy vegetables compared to fewer servings (Diane Feskanich *et al*, 1995) [8]. Lutein and zeaxanthin, carotenoids found in dark-green leafy vegetables, are concentrated in the eye lens and macular region of the retina, and play a protective role in the eye.

They protect against both cataract and age related macular degeneration, the major cause of blindness in the elderly. Millions of children around the world have an increased risk of blindness, and other illnesses because of inadequate dietary vitamin A from green leafy vegetables. Green leafy vegetables contain a variety of carotenoids, flavonoids and other powerful antioxidants that have cancer-protective properties. In a study, it was reported that eating 3 or more servings a week of green leafy vegetables significantly reduced the risk of stomach cancer, the fourth most frequent cancer in the world. Cabbage, cauliflower, brussels sprouts, and broccoli are rich in indoles and isothiocyanates, which provide protection against colon and other cancers. Broccoli sprouts have been reported to contain 10 or more times as much sulforaphane, a cancer protective substance, than mature broccoli. A higher consumption of green leafy vegetables has been shown to significantly decrease the risk of breast and skin cancer.

Commercially important green leafy vegetables Amaranthus

Amaranth is one of the ancient groups of plants having great potential for combating under- and mal-nutrition in dietary. It is also called “poor man’s spinach”, and is the most common leafy vegetable grown in India during summer and rainy season. Being a very fast growing short duration crop with high yield potential of edible matter per unit area, it fits well in a crop rotation. About 60 species of amaranthus is widely distributed throughout the world in tropical, subtropical and temperate regions. Among them, *Amaranthus tricolor*, *A. blitum* and *A. tristis* are cultivated in India. Leafy type amaranth is usually grown in kitchen and market gardens and the grain types as mixed crops along with cereals, pulses and vegetables.

The fresh tender leaves and its stem are delicious when cooked like other fresh leafy vegetables. The tiny seeds of grain amaranthus are popped or parched and milled for flour or gruel. Compared to spinach, *Amaranthus* contains three times more vitamin C, calcium and niacin. Compared to lettuce, grain *Amaranthus* contains 18 times more vitamin A, 13 times more vitamin C, 20 times more calcium and 7 times more iron (Guillet, 2004) [12]. A study by Allemann *et al.* (1996) [2] showed that amaranth has the potential to be a valuable source of nutrition in areas in Africa with hot, dry climates. The crop can grow on marginal lands and when it gets well established it can withstand acute drought conditions.

Water spinach

Water spinach (*Ipomoea aquatica*), also known as kangkong, water glorybind, water convolvulus, and swamp cabbage is an important green leafy vegetable in Southeast Asia belongs to the family Convolvulaceae. It is speculated to have originated in India but is now widely grown throughout the tropics. All

parts of the young plants are eaten (Candish *et al.*, 1987) [6]. The crop is fragile and requires rapid and careful handling to minimize damage and wilting. It is taken like cooked spinach and canned product is often available in ethnic markets (Rao and Tuhina, 2002).

Curry leaf

Curry leaf botanically *Murraya koenigii*, belongs to the family Rutaceae is highly valued for seasoning in South Indian and Sri Lankan cooking, much like bay leaves especially in curries with fish or coconut milk. In their fresh form, they have a short shelf life though they may be stored in a freezer for quite some time, though they lose much of flavor. They are also available dried, though the aroma is much inferior. The leaves are also used as an herb in ayurvedic medicine. Their properties include antidiabetic, antioxidant, antimicrobial, anti-inflammatory, hepatoprotective, anti-hypercholesterolemic etc. Aromatic bioactive constituents in the leaves of *M.koenigii* retain their flavor and other qualities, even after drying (Yankuzo, *et al.* 2011). *M. koenigii* leaves are slightly bitter in taste, pungent in smell, and weakly acidic. They are used as antihelminthics, analgesics, digestives, and appetizers in Indian cookery (Bhandari, 2012) [3].

Spinach

Spinach (*Spinacia oleracea*) is known as a rich source of iron and calcium. According to the United States Department of Agriculture, a 180 gram serving of boiled spinach contains 6.43 mg of iron, whereas one 6.oz. (170g) around hamburger patty contains at most 4.42 mg. Thus spinach does contain a relatively high level of iron, compared to other vegetable and meat sources. The iron in spinach is poorly absorbed by the body unless eaten with calcium. The spinach contains high levels of oxalate. Oxalates bind to iron to form ferrous oxalate, thus making the iron in spinach unavailable, plus high amounts of oxalates remove iron from the body. Therefore, a diet high in oxalate (or phosphate or phytate) leads to a decrease in iron absorption. As a result around 90 per cent of the iron content in spinach will be released in urine, and not absorbed in the body. Spinach is regarded as the most esteemed green leafy vegetables among all. Its cooling and nutritive content helps in eliminating cough, asthma and other toxic elements. Spinach contains iron, folic acid, vitamin A and essential amino acids in major quantities along with potassium, sulphur, silicon, magnesium and sodium in minor quantities. Spinach helps in reducing acidity problems in people, bestowing improved health. Spinach juice is diuretic, allaying bile disorders.

Intake of spinach provides satisfactory result in case of anaemia. It is highly effective in curing generic ailments. Spinach also has a high calcium content. However, the oxalate content in spinach binds with calcium decreasing its absorption. By way of comparison, the body can absorb about half of the calcium present in broccoli, yet only around 5% of the calcium in spinach. Spinach has a large nutritional value, especially when fresh, steamed, or quickly boiled. It is a rich source of vitamin A, vitamin C, vitamin E, vitamin K, magnesium and several vital antioxidants. Recently, opioid peptides called rubiscolins have also been found in spinach. It is a source of folic acid (vitamin B9) and this vitamin was first purified from spinach. To benefit from the folate in spinach, it is better to steam it than to boil it. Boiling spinach for four minutes can halve the level of folate. When cooked, the volume of spinach is decreased by three quarters. Spinach

is an excellent source of vitamin K, vitamin A, manganese, folate, magnesium, iron, vitamin C, vitamin B2, calcium, potassium and vitamin B6. It is a very good source of dietary fibre, copper, protein, phosphorus, zinc and vitamin E. In Addition, it is a good source of omega -3 fatty acids, niacin and selenium.

Future thrust

The major nutrition-related public health problems include a) chronic energy deficiency and under-nutrition, b) micro-nutrient deficiencies like anaemia due to iron and folic acid deficiency, vitamin A deficiency and iodine deficiency disorders and c) chronic energy excess and obesity. The National Nutrition Policy adopted in 1993 advocates a comprehensive intersect oral strategy for alleviating the multifaceted problem of malnutrition and achieving an optimal state of nutrition for all sections of the society. Even then the target could not be achieved. To solve the problem of malnutrition the following measures can be taken up. The research results revealed that dark-green leafy vegetables made a significant contribution towards total nutrient intake of two-to five year-old children for several of the micronutrients.

This contribution can potentially be increased and these vegetables be consumed more frequently and by a larger proportion of the children. This can be achieved through appropriate promotion and nutrition education programmes, e.g. promote as nutritionally rich traditional green leafy vegetables. Promotion of kitchen garden / nutrition garden for more intake of greens India is the richest source for vegetables and greens. A survey can be taken up to identify the non-traditional green leaves and their nutrient contents. The crops which are rich in nutrients can be commercially exploited. Breeding programme can be initiated in green leafy vegetables to increase the nutrient contents and reduce the anti-nutritional factors.

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