Vegetable Science (2021) 48 (1) : 1-21

Zero Hidden Hunger: Role of Vegetables

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Received: July 2021/ Accepted: August 2021

Abstract

According to the latest UN projections, world population will rise to 9.1 billion in 2050. Almost all this population growth will occur in the developing countries. Global demand for food, feed and fibre will nearly double. Crops may also be used for bioenergy and other industrial purposes. New and traditional demands for agricultural produces will put great pressure on already available agricultural resources. Agriculture will be forced to compete for land and water with sprawling urban settlements. Mitigation of climate change is another challenge for agriculture. They will need new technologies to grow more from less land, with a fewer resources. As per FAO, there is little scope for further expansionof agricultural land. Considerableamount of land potentially suitable for agriculture is covered by forestsor protected for environmentalreasons or used for urban settlements. The optimal use of land and water is the basis for intensive agriculture. Today, the world average per capita crop land has decreased to around 0.27 hectares. The demand for food is expected to grow as a result of population growth and rising incomes. Demand for cereals (for food and animal feed) is projected to reach some 3 billion tones by 2050. Annual cereal production will have to grow by almost one billion tones. Here comes the role of horticulture especially vegetables. Vegetables have tremendous potential in terms of natural resources. Further, their productivity is very high in vegetables when compared to cereals. In developing countries, the effort to ensure food security with staple food crops has neglected the need for nutritional security. Even though starchy staples provide calories and some protein, the important role of other dietary components vital for health largely available through consumption of vegetables and fruits are often ignored. World Health Organisation (WHO) has introduced a food based dietary guideline as a resource for achieving good health by public and as a resource for countries for developing their own guide lines. Increasing consumption of fruits and vegetables is included in the guidelines of most countries.

Key words: Nutrition security, Vegetables, High value crops, Phytochemicals, Flavanoids, Antinutrients, Lifestyle diseases, Bionutrients, Developing countries

Impact of low fruit and vegetable consumption on health

Generally, fruits and vegetables should be consumed at a level of 400 grams daily. Low fruit and vegetable consumption is related to ischemic heart disease, ischemic stroke, lung cancer, stomach cancer, Oesophagal cancer and colorectal cancer (Chavasit 2012). Risk of these diseases can be reduced by consumption of these foods (Table 1).

Role of vegetables in human nutrition

The major contribution of vegetables to human health is through higher amounts of vitamin C, vitamin A, folicacid and minerals. There are many non-nutrient phytochemicals in vegetables which protect the human body from cancers and cardiovascular diseases. So, vegetables are often termed as protective foods. They play a key role in neutralising the acids produced during digestion of proteins and fatty acids. They also provide roughage in the form of dietary fibre which helps in digestion and bowel movement. Dietary fibre has also attracted global attention due to their role in protection against certain types of cancer, regulation of transit, loweringof blood cholesterol, etc.

Recently phytochemicals in vegetables have attracted a great deal of attention in connection with diseases caused because of oxidative stress. Oxidative stress, which releases free oxygen radicles in the body, has been implicated in a number of disorders including cardiovascular malfunction, cataracts, cancers, rheumatism and many other autoimmune diseases besides ageing. These phytochemicals (*Viz*., carotenoids,

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Table 1: Relative risks associated with an increase in intake of fruits and vegetables[a] for selected health outcomes, by age group

Age group (Year)	Outcome[b]					
	IHD	IS	LC	GC	OC	CC
0-4	1.00	1.00	1.00	1.00	1.00	1.00
5-14	1.00	1.00	1.00	1.00	1.00	1.00
15-29	0.90	0.94	0.96	0.94	0.94	0.99
30-44	0.90	0.94	0.96	0.94	0.94	0.99
45-59	0.90	0.94	0.96	0.94	0.94	0.99
60-69	0.90	0.94	0.96	0.94	0.94	0.99
OC=70-79	0.93	0.95	0.97	0.95	0.95	0.99
80 and above	0.95	0.97	0.98	0.97	0.97	1.00

Source: Lock et al. (2005)

[a] Unit of change in risk=Change per increase of 80 g per day intake of fruits and vegetables

[b] Outcome: IHD= ischemic heart disease;IS= ischemic stroke;LC= lung cancer;OC=Oesophagal cancer;CC= colorectal cancer

tocopherol, ascorbic acid, flavonoids, *etc*.) act as antioxidant, scavenge free radicles and act as saviours of the cell. Carotenoids provide the colour pigments in vegetables like tomato, carrotand many leafy vegetables. Carotenoids seem to offer protection to colorectal, breast, uterine and prostrate cancers. They are also related to immune response and protection of skin against ultraviolet rays. They also give oxidative protection to the gluthionine phase II detoxification enzymes in the liver and thus support the elimination of pollutants and toxic materials from the body. Xanthophylls present in vegetables comprise compounds of positive biological effects canthaxanthin, crytoxanthin, zeaxanthine and astaxanthine. They provide anti oxidative protection of vitamin A, vitamin E and other carotenoids. Vegetables also provide plant secondary metabolites called phytochemicals which are responsible for induction of enzymes that detoxify carcinogens. Flavanoids comprise the largest group of secondary metabolites. Lettuce, onion, chilli and broad bean are rich in flavanoids like Quercetin, Kaempferol, Myricetine and Luteolin. Flavanoids can also prevent cytotoxicity of LDL to cell lines and can reduce atherosclerosis and coronary heart diseases.

Wide ranges of minerals and trace elements are present in vegetables. Leafy vegetables and crucifers are rich source of minerals and trace elements. Calcium, phosphorus and iron are important minerals that have major role in bone health and prevention of anemia. The important trace elements found in vegetables are Zn, Cu, Mn and Se. They play an important role in immune function and body defense against oxidative stress. Interest in selenium as a bioactive element has increased dramatically in the last three decades as a result of several studies that demonstrated that increased risk of cancer with low selenium intake. Broccoli and garlic grown on selenium rich soil are good sources of Se (Finley and Penland 1998). Chromium is another trace element which is effective in optimizing insulin metabolism and lowering plasma cholesterol levels.

Thiosulphides are organo-sulfur compounds mainly found in onion, garlic, shallot, chive, leek etc. Alliin, Methiin, are major thiosulphides in intact tissue of *Allium* species. Thiosulphides are highly unstable. When the tissues are cut, chewed, cytosolic allin is rapidly lysed by vascular enzyme alliinlyase or allinase into highly unstable diallylthiosulphinate (Allicin) which is again converted into alkyl alkane thiosulphinates. These compounds are related to reducing cancer mainly stomach cancer, cardiovuscual disease. Thiosulphides reduces cholesterol and other fatty acid synthesis, prevent lipid peroxidation of LDL, enhance fibrinolysis and improve fluidity of erythrocyte, increase antioxidant status and inhibit angiotension converting enzyme (Rahman and Lowe 2006). Thiosulphides have also been shown to stimulate the immune system, by activating T cell proliferation and reducing blood glucose level in diabetes by stimulating insulin secretion by the pancreas (Augusti and Sheela 1996). Cruciferous vegetables have been shown to protect lung and other chemical induced cancers. Alliums including garlic, chive and onion procts against stomach cancer. Tomatoes and peppers protect against esophagal and prostrate cancer. Spinach and chard have been shown to inhibit proliferation of human gastric adinocarcinoma cells.

Saponins found in vegetables are Cherantins which have hypoglycemic properties or other action of potential benefit against diabetes mellitus. Bitter gourd is the excellent source of cheratins. Other hypoglycemic compounds found in bitter gourd which have same property are Insulin like peptide and alkaloids. These compounds prevent glucose absorption from intestine, regenerate insulin producing cell and potentiate the effect of insulin and thus prevent diabetes.

Vegetables and their health benefits

Tomato: Tomato (*Solanum lycopersicum*) is the most important vegetable crop cultivated through out the world for its ripe fruits. It is a rich source of potassium, folate, and vitamin A, vitamin C and vitamin E. Tomatoes also contain valuable bioactive compounds like carotenoids and phenolic compounds. The major carotenoids present in tomatoes are lycopene, â-carotene, á-carotene, lutein, zeaxanthin and lycopene (Li et al. 2012). Lycopene reduces several cancer types and the risk of coronary heart disease (Rao et al. 2006). Serum lipid peroxidation and LDL (Low-Density Lipoproteins) oxidation were significantly decreased by lycopene. Lutein, another carotenoid present in tomato is associated with reducing the risk of age-related macular degeneration, cataracts and atherosclerosis (Bone et al. 2000). Phenolics including flavanoids are important hydrophilic phytochemicals presents in tomato. Recently phenolics received wide attention due to its strong biological activities. In tomato hydroxycinnamic acids and their derivatives are the most abundant family of the total phenolics. Within this family the major compounds were caffeoyl-hexose I, coumaric acid hexose I, chlorogenic acid and 5-caffeoylquinic acid. Other important group of phenolics present in tomato are phenylacetic acids and its derivatives, hydroxybenzoic acids and derivatives. Flavonoids are a diverse group of phenolic secondary metabolites. Many of the compounds belonging to this group are potent antioxidants *in vitro* and epidemiological studies suggest a direct correlation between high flavonoid intake and decreased risk of cardiovascular disease, cancer and other age related diseases.

Brinjal: Brinjal (*Solanum melongena* L) is another popular solanaceous vegetable crop grown throughout subtropics and tropics of the world. It is a perennial crop but grown commercially as an annual. The unripe fruit of eggplant is primarily used as a cooking vegetable for the various dishes all over the world. Traditionally brinjal is used for treatment of several diseases. Various parts of the plant are useful in the treatment of inflammatory conditions, cardiac debility, neuralgia, ulcers of nose, cholera, bronchitis and asthma, analgesic and hypolipidemic (Sudheesh et al. 1997). Studies have shown that brinjal extracts suppress the development of blood vessels required for tumor growth and metastasis (Matsubara et al. 2005) and inhibit inflammation that can lead to atherosclerosis (Han et al. 2003). Anthocyanin from brinjal could be potent natural pigment that prevents chemical induced mutation (Azevedo et al. 2007). Phenolic extract from brinjal had high alpha-glucosidase inhibitory activity and in specific cases moderate to high angiotensin I-converting enzyme inhibitory activity (Kwon et al. 2008). Brinjal contains ascorbic acid and phenolics, both of which are powerful antioxidants (Vinson et al. 1998). The main phenolic compound found in brinjal includes N-caffeoylputrescine, 5-caffeoylquinic acid, and 3-acetyl-5-caffeoylquinic acid. In addition, trace quantities of flavonols, namely, quercetin-3-glucoside, quercetin-3-rhamnoside, and myricetin-3-galactoside are also observed in its pulp (Singh et al. 2009). It is also a natural source of vitamin A. From the 120 vegetable species evaluated for antioxidant activity using four different assays (2, 2-azinobis-[3-ethylbenzthiazoline-6-sulphonic acid]), 2, 2-diphenyl-1-picrylhydrazyl radical, inhibition of lipid peroxidation, and Superoxide scavenging), it ranked among the top 10 species for superoxide scavenging activity (Yang 2006). Extracts from fruit peel have been demonstrated to possess high capacity in scavenging of superoxide free radicals and inhibition of hydroxyl radical generation by chelating ferrous iron (Noda et al. 2000). Nasunin, an anthocyanin isolated from the peel of purple fruit, is one phenolic compound implicated in both inhibition of hydroxyl radical generation and superoxide scaveging activity (Noda et al. 2000). Flavonoids isolated from its fruit showed potent antioxidant activity (Sadilova et al. 2006) against chromosomal aberrations induced by Doxorubicin. Nutritional component and functional activity of vegetable is function of genotype. Natural out crossing, mutation could lead to change in genotype resulting diversity in nutritional value as well as functional properties.

Chilli: It is an important spice cum vegetable crop grown throughout the world. The ripe fruits are especially rich in vitamin-C (Marin et al. 2004). The two chemical groups of greatest interest are the capsaicinoids and the carotenoids. The capsaicinoids are alkaloids that give hot chilli peppers, their characteristic pungency. The rich supply of carotenoids contributes to chilli peppers' nutritional value and colour (Hornero-Mendez et al. 2002; Perez-Galvez et al. 2003). The fruits of most *Capsicum* species contain significant amounts of vitamins B, C, E and provitamin A (carotene) when in a fresh state. The large type of *C. annuum* is among the richest known sources of vitamin C, which may be present up to 340 mg/100 g in some varieties. Fruits of *Capsicum*species have relatively low volatile oil content, ranging from about 0.1 to 2.6 percent in paprika. The characteristic aroma and flavour of the fresh fruit is imparted by the volatile oil. The composition of the volatile oil of fresh green bell peppers has been examined. Twenty-four components in this oil were positively identified by Buttery et al. (1969) using gas

chromatography. One of the major components, 2-methoxy-isobutyl pyrazine, was considered to possess an aroma characteristic of the fresh fruit and to dominate the organoleptic profile of paprika. The colour of the paprika powder is the principal criterion for assessing its quality. The pigment content of paprika powder can range from 0.1 to 0.8 percent. The major colouring pigments in paprika are capsanthin and capsorubin, comprising 60 percent of the total carotenoids. Other pigments are b-carotene, zeaxanthin, violaxanthin, neoxanthin and lutein (Anu and Peter 2000). In international trade the colour intensity of paprika pods is generally expressed as ASTA units unlike oleoresin which is described in colour value. Nearly 40 percent of paprika oleoresin is used to blend in chicken feed.

Capsicum: It is another solanaceous species grown throughout the world for vegetables and spice purpose. Among more than 30 species, five main domesticated species commercially cultivated are *Capsicum annuum* (hot paper, bell pepper, paprika) *C. frutescens* (tabasco pepper), *C. chinense* (naga), *C. pubescens* (South American rocoto peppers) and *C. baccatum* (wax pepper). Among the domesticated species *C. annuum* is the largest group of capsicum grown worldwide. Capsicum play an important role in human health as antioxidants and immune enhancers, helping in the prevention of cancers, cardiovascular diseases, age related macular degeneration, cataracts, diseases related to low immune function, and other degenerative diseases (Perera and Yen 2007). Strong functional properties of capsicum attributed to its various bioactive compounds. The major bioactive compounds present in Capsicum are capsaicin carotenoids, phenolicsand, vitamin E The main carotenoids present in Capsicum are b-carotene, a-carotene, b-cryptoxanthin, zeaxanthin, luteine, capsanthin, capsorubin, and cryptocapsin (Collera-Zuniga et al. 2005). Among them only â-carotene and â-cryptoxanthin have vitamin A activity (Minguez-Mosquera and Hornero-Mendez 1994). Spicy character of capsicum is attributed to its capsaicin, a phenolic compound closely related to vanillin, which gives the pungency to the capsicums and shows a significant antioxidative effect (Adegoke et al. 1976). However, other carotenoids are potent antioxidant and they potentially reduce the risk of age-related life style diseases. In addition, capsicum is rich in polyphenols, particularly the flavonoids, quercetin, myrcetin and luteolin (Lee et al. 1995). Quercetin was not detected in green chili. Bird chili contained the highest level of luteolin (1035.0 mg/kg) among all the samples tested. Therefore, consumption of bird chili may reduce risk of tumorigenesis because luteolin was shown to be a potent inhibitor to enzyme lipoxygenase and prostaglandin synthetase (Larson 1988).

Bitter gourd: *Momordica charantia* L. is a tropical and subtropical annual cucurbitaceous vegetable, widely grown in Asia, Africa, and the Caribbean for its edible fruit. Traditionally bitter gourd fruits are used as anthelmintic, antiemetic, carminative, purgative and for the treatment of anaemia, jaundice, malaria, cholera, etc. (Ross 1999). Fruits are reported to possess wide range of pharmacological activities such as gastroprotective and ulcer healing activities, hypoglycaemic, antidiabetic, antifungal, inhibition of p-glycoproteins, antihyperlipidemic, hepatoprotective activity (Kushawa et al. 2005). The roots are used in headand are used against urinary calculi and as an errhine in jaundice. The leaves are aphrodisiac, antihelmintic, fever, asthma, bronchitis, high coughand, piles. Studies on animals revealed that leaves of related species *Momordica dioica* have potent hepatoprotective action against carbon tetrachloride induced hepatic damage in rats (Jain et al. 2008). Fruit is routinely used as a vegetable and also for the treatment of diabetes mellitus by the local people.

Bitter gourd is rich source of phenolic phytochemicals. The predominant phenolic compounds aregallic acid, followed by caffeic acid and catechin (Kubola and Siriamornpun 2008). Beside phenolics, many cucurbitane type triterpenoids have been isolated from the fruits, seeds, leaves vines and stems (Tan et al. 2008). Worldwide, 347 million people have diabetes mellitus. More than 80% of diabetic deaths occur in low- and middle-income countries. WHO projects that diabetes wwill be the seventh leading cause of death in 2030. India has the highest number of diabetics, with 31.7 million in 2000 and a projected 79.4 million by 2030. The diabetes epidemic in sub-saharan Africa is one of the fastest growing in the world, increasing 2.6-fold in 30 years. Proper diet is one of the proper management strategies in diabetes control. In Malasia, bitter gourd is used as a complementary alternative medicine because of its hypogycemic properties. In Germany it has been termed as “insulin from the garden” (Krawinkel 2014). Bhaskarachari, 2014 studies the Glycemic Index in different bitter gourd types. He found that Glycemic Index was lowest in long slender variety (53.79) and highest in the wild variety (60.59). Bitter gourd is effective in type 1 and type 2 diabetes mellitus. It acts through different physiological and biochemical pathways. An insulin like protein, Momordicosides S and T, fatty acids, Momordicin trehalose, triterpenes and triterpenoids in bitter gourd have been proven in cell culture or animal studies to have antidiabetic effect. Bitter gourd is also found effective in decreasing intestinal glucose absorption, increased pancreatic insulin

secretion, and reduced or prevented insulin resistance of insulin dependent tissues (Habicht et al. 2014).

Pumpkin: Pumpkin (*Cucurbita moschata*) and its related species (*C. pepo; C. maxima*) are important vegetables in cucurbits cultivated for its fruits. It is rich sourceof vitamins and minerals. Besides it is a good source of various bioactive compounds. It is high in carotenoids, especially â-carotene and lutein, both of which are important antioxidants. Other carotenoids are á-Carotene and minor carotenoides æ-carotene, zeaxanthin, violaxanthin , â-carotene 5,6-epoxide, â-cryptoxanthin, taraxanthin, luteoxanthin, auroxanthin, phytofluene, neurosporene and neoxanthin (Toshiro et al. 1986; González et al. 2001; Rodriguez-Amaya et al. 2008). Besides, *Cucurbita sp* contain protein-bound polysaccharide with strong hypoglycemic effect (Li et al. 2005). Oil from un-germinated pumpkin seeds and proteins from germinated pumpkin seeds also possessed hypoglycemic activity (Li et al. 2001).

Ash gourd: *Benincasa hispida* is an important cucurbitaceous vegetable grown for its multiple health benefits. Fruit is rich a source of vitamins and minerals like ascorbic acid, riboflavin, thiamin, niacin, potassium, sodium, calcium, iron etc. It also contains essential amino acids, mono as well as polysaccharides and various volatile compounds. The fruit is traditionally used the for treatment of diabetes, urinary infection, chronic inflammatory disorder, epilepsy and other nervous disorders, peptic ulcer etc. It is used as an ingredient for preparation of medicine 'Kusmanda Lehyam' (Kumar and Vimalavathini 2004). Therapeutic properties of ash gourd are attributed to its bioactive compounds with strong functional properties. Fruits demonstrated strong antioxidant activity *in vitro* as well as *in vivo* condition (Huang et al. 2004; Roy et al. 2007). It also exhibited angiotension-converting enzyme (ACE) inhibitor property (Huang et al. 2004). A small fruited ash gourd is grown in Kerala which is the main ingredient of the famous ayurvedic preparation "Kooshmanda rasayanam'. Fruits are also used as an anthelmintic, antiperiodic, aphrodisiac, diuretic, laxative and against haemorrage, haemophysis and for lowering blood sugar. Fruit juice is used in treatment of insanity, epilepsy and urinary infection. It possesses anti ulcer activity and used as a tonic for heart. Seeds are used as a vermifuge. Young shoots, leaves and flowers are also used as food.100 g edible portion contains 96.30% moisture, 1.9 g carbohydrate, 0.4 g protein, 0.1 g fat, 0.8 g fibre, 1.0 mg vitamin C, 0.06 mg thiamine, 0.01 mg riboflavin, 0.4 mg niacin 0.3 g minerals, 30 mg calcium, 20 mg phosphorus and 0.8 mg iron

Bottle gourd: *Lagenaria siceraria* is a commonly used cucurbitaceous vegetable in India. Both fruits and leaves are used as vegetables throughout the world. The bottle gourd fruit contains 96.1 % moisture, 0.2% protein, 2.5% carbohydrates, 0.1 % fat, 0.6% fibre, 0.5% mineral matter, 0.044 mg thiamine, 0.023 mg riboflavin, 0.33 mg niacin and 12 mg ascorbic acid per 100g edible portion. The pulp is good for overcoming constipation, cough and night blindness and as antidote against certain poisons. A decoction made from the leaf is a very good medicine for curing jaundice.

Muskmelon: *Cucumis melo* is an important desert vegtable grown throughout the World for its mature fruits are eaten raw as dessert. The plant extract has the blood sugar lowering principle, and roots have the emetic and purgative properties. Its ripe fruits are very much useful in human kidney disease. The seeds are diuretic, cooling, nutritive, and beneficial in the treatment for enlargement to prostate gland. The pulp is diuretic and beneficial to chronic or acute eczema. The ripe fruit is aphrodisiac and cures biliousness. It is rich in potassium andthus it can help controlining blood pressure and prevent the risk of strokes. Potassium in the fruit can also reduce the problem of developing kidney stones. The folic acid present in muskmelons helps to create healthy fetuses (in pregnant women) and can prevent cervical cancer and osteoporosis. It also serves as a mild antidepressant. Muskmelon is a good source of vitamin C, which is an anti-oxidant. This helps to prevent heart diseases and even cancer. In addition to health benefits, muskmelon takes care of skin also. It contains Vitamin A, which is useful in maintaining healthy skin. Regular consumption of muskmelon juice can help to treat lack of appetite, acidity, ulcer and urinary tract infections. It can reduce the heat in the body and can prevent heat related disorders.

Cucumber: *Cucumis sativus* is an important salad crop grown throughout the world. It is rich in vitamin B and C as well as minerals such as calcium, phosphorous, iron and potassium. Cucumbers prevent constipation, jaundice and indigestion. The typical flavour of cucumber is attributed to two compounds 2, 6 nonadienal and 2, 6 nonadienol. The pleasant aroma of cucumber is derived mainly from the 2, 6 nonadienal and 2 hexenal and, the astringent taste is contributed by 2 noenal. Some volatile compounds have also been identified in cucumber inonanol, trans-2-nonen-l-ol, cis-3-nones and C10-15 saturated straight chain aldehydes. Group of compounds found in cucumber called cucurbitacins. cucurbitacins A, B, C, D and E have all been identified within fresh cucumber. Cancer cell development and cancer cell survival can be blocked by activity of these cucurbitacins. Second group of

cucumber phytonutrient are lignans. The lignans pinoresinol, lariciresinol, and secoisolariciresinol have all been identified within cucumber. The role of these plant lignans in cancer protection involves the role of bacteria in our digestive tract. These reduce the risk of estrogen-related cancers, including cancers of the breast, ovary, uterus, and prostate. This has been associated with intake of dietary lignans from plant foods like cucumber.

Watermelon: *Citrullus lanatus* is an important vegetable gown for its sweet fruits. Its edible placenta is a rich source of minerals like potassium, iron and vitamins like vitamin A, thiamine and riboflavin. Besides, it is a good source of dietary antioxidants like phenolics, flavonoids, ascorbic acids, lycopene, â-Carotene etc. Watermelon contains moderate but significant quantities of phenolics (Perkins-Veazie et al. 2002; Brat et al. 2006). Watermelon fruits have been identified as a good source of vitamin C, mainly in the reduced form of ascorbic acid (Vanderslice et al. 1990). The lycopene content of watermelon is found to be higher than many other fruits and vegetables. Consumption of watermelon juice increase plasma concentrations of lycopene and â-carotene in humans. Watermelon is a rich source of citrulline, an amino acid that can be metabolized to arginine, a conditionally essential amino acid for human beings. Arginine is the nitrogenous substrate used in the synthesis of nitric oxide which plays an essential role in cardiovascular and immune functions. Consumption of watermelon juice increases plasma concentration of arginine in human adult (Collins et al. 2007). Dietary supplementation with watermelon pomace juice containing citrulline increase arginine availability, reduce serum concentrations of cardiovascular risk factors, improves glycaemic control, and ameliorate vascular dysfunction in obese animals with type-II diabetes (Wu et al. 2007).

Ridge gourd and smooth gourd: Tender fruits of *Luffa cylindrica* and *L. Acutangula are* used as vegetables. They are rich sources of minerals like calcium, magnesium, potassium, sodium and vitamins like thiamin, riboflavin, niacin and ascorbic acid (Bangash et al. 2011, Karmakar et al. 2013a & 2013b). It contains moderate amount of soluble as well as insoluble dietary fiber (Khanum et al. 2000). Fruits of *Luffa sp* showed potential free radical scavenging activity and antioxidant activity (Shekhawat et al. 2010; Raghu et al. 2011). Ethanolic extract of seed of *Luffa acutangula* showed potential antioxidants, anti-inflammatory and analgesic activity (Gill et al. 2011). In recent time research finding focused ridge gourd as potential antitumor food due to its significant antiproliferative and antiangiogenic activity (Reddy et al. 2009). Presence of ribosome inhibition protein viz. luffin a & luffin b in seed revealed the potentiality of luffa as anti-HIV agent. Ribosome inactivating proteins are group of protein that are able to inactivate eukaryotic protein synthesis by attacking the 28s ribosomal RNA. Scientific investigation revealed that luffin possesses strong anti-immunodeficiency virus deficiency activity (Au et al. 2000).

Snake gourd: *Trichosanthes anguina* is an underexploited cucurbit vegetable. It is a good source of calcium, potassium, iron, substantial amount of carotene, little thiamine, riboflavin andniacin. Juice of the fresh leaves are traditionally used to treat several heart related disorders, jaundice etc.The edible part of the immature fruit is 86 – 98% per 100g fresh fruit contains water (94g), protein (0.6g), fat (0.3g), carbohydrate (4g), fibre (0.8g), Ca (26mg), Fe (0.3mg), P (20mg), Vitamin B1 (0.02mg), Vitamin B2 0.03ng, Niacin 0.3mg, Vitamin C (12mg) and has, energy value of 70kJ . The moisture content of the snake gourd seed is 3.13% which is low when compared with values reported for melon seed (5.6%) and water melon (5.7 %) (Ige et al.1984).

Pointed gourd: *Trichosanthes dioica* Roxb. is one of the most nutritive cucurbit vegetables. Fruits are rich sources of mineral like phosphorus, calcium, magnesium, sodium and vitamins like ascorbic acid and vitamin A. Since time immemorial various parts of pointed gourd has been used as anthelmintic, antipyretic, antidiuretic, appetizing, digestives, expectorant (Sharma and Pant 1988). Fruits and leaves have blood pressure lowering properties in experimental animal and mild diabetic human subjects (Rai et al. 2008a; Rai et al. 2008b). Major bioactive compounds present in pointed gourd are phenolics and triperpenoids. Bioactive lectins isolated from its seeds have sugar binding capacity. The fruits are easily digestible and diuretic in nature. They are also known to have antiulcerous effects. It grows as a vegetable all over India and is prescribed to improve appetite and digestion. The decoction of pointed gland is useful as a valuable alternative tonic, and as a febrifuge, which is given for boils and other skin diseases. The juice of the leaf is applied to patches of alopecia areata. The root is used as a hydragogue cathartic tonic and febrifuge. The fruits are used as a remedy for spermatorrhoea, and the juice of unripe fruits and also tender shoots, are used for cooling and as a laxative. The fruits and seeds have some prospects in the control of some cancer-like conditions and haemagglutinating activities.

Ivy gourd: *Coccinia indica* is another underexploited cucurbit vegetable which is good for diabetic patients. It is a good source of several micronutrients, including

vitamins A and C. In traditional medicine; fruits have been used to treat leprosy, fever, asthma, bronchitis and jaundice. The leaves are a rich source of protein (3.3 - 4.9 g), minerals and vitamins, vitamin A (8000-18000 IU) (Boonkerd et al.1993). The plant possesses antioxidant property and administration of its leaf extract in streptozotocin diabetic rats caused a significant increase in plasma vitamin C and reduced glutothione (Venkateswaran and Pari 2003). The roots, fruits and leaves of ivy gourd have been used in Ayurvedic and folk medicines to treat the diabetes, mellitus, skin eruption, tongue sores and earche. The extract of the root shows a hypoglycemic effect in fasted albino rats. It is claimed that these products help to regulate blood sugar levels. There is some research to support that compounds in the plant inhibit the enzyme glucose-6-phosphatase. Glucose-6-phosphatase is one of the key liver enzymes involved in regulating sugar metabolism. Therefore, ivy gourd is recommended for diabetic patients. Although these claims have not been supported, there currently is a fair amount of research focused on the medicinal properties of this plant focusing on its use as an antioxidant, anti-hypoglycemic agent and immune system modulator.

Garden pea: *Pisum sativum* is mainly grown as winter crop for its green pods. It is a good source of protein (7.2g), minerals (0.8 g) and vitamins (Vitamin A 139 IU, Vitamin C 9 mg, thiamine 0.25 mg). Being low in calories, green peas are good for those who are trying to lose weight. They are rich in dietary fibre, making them good for those suffering from constipation (Choudhary 1967). Studies have indicated that green peas might prove beneficial for those suffering from the problem of high cholesterol. The high amount of iron and vitamin C in green peas has been found to help strengthen the immune system. The lutein present helps to reduce the risk of age-related muscular degeneration and cataracts. Green peas slow down the appearance of glucose in the blood and thus, help keep the energy levels steady (Duke 1981). The folic acid and vitamin B_6 in green peas are good for promoting the cardiovascular health of an individual. Anti-nutritional factors, although present in pea, are relatively minor and do not adversely affect crop use.

Yardlong bean: Yardlong bean [*Vigna unguiculata L. (Walp.)* subsp. *sesquipedalis*] is an important leguminous vegetable mostly cultivated in China, Southeast Asia, the Caribbean, Centraland West Africa for its immature pods. The pods are rich in calcium, phosphorus, sodium, and potassium and fair amounts of vitamin A, thiamine and ascorbic acid (Piluek 1994). It is also very popular in south India especially Kerala. It is a rich source offolic acid, which is essential for prevention of neural tube defect in new born baby (Devi et al. 2008). Immature pods showed potential free radical scavenging activity and antioxidant activity measured by various methods (Yang et al. 2005; Wen et al. 2010). Antioxidant potential of yard long bean is attributed to the presence of natural antioxidants like ascorbic acid, beta carotene and phenolics (Wen et al. 2010). Due to proven potential physiological health benefit of anthocyanin, purple podded variety of yard long bean is now in focal point of nutraceutical research. Purple poded variety from Kerala Agricultural University is very popular in Kerala. Ha et al. (2010) identified five anthocyanins viz. delphinidin-3-O-glucoside, cyanidin-3-O-sambubioside, cyanidin-3-O-glucoside, pelargonidin-3-O-glucoside, and peonidin-3-O-glucoside from immature purple pod of yard-long beans. A potent antimicrobial peptide, 'sesquin' with a molecular mass around 7 kDa and an N-terminal sequence highly homologous to defensin was isolated from yard long beans. This peptide exerted antimicrobial activity against fungus and bacteria and antiproliferative activity toward breast cancer (MCF-7) cells and leukemia M1 cells. It also exhibited some inhibitory activity toward human immunodeficiency virus-type 1 reverse transcriptase (Wong and Ng 2005).

French bean: French bean (*Phaseolus vulgaris*) is another important leguminous vegetable grown for its immature green pod. Dried seeds are used as pulse popularly known as *rajma*. Immature green pods are good source of calcium, phosphorus, thiamin, riboflavin, folic acid, ascorbic acid and relatively low amount of á-tocopherol. It contains moderate amount of dietary fibre (Kaur and Kapoor 2002; Isabale et al. 2010; Wen et al. 2010). Antioxidant property is attributed to its water soluble and lipid soluble antioxidant nutraceuticals. Major water-soluble antioxidants in French bean are ascorbic acid and phenolics including flavonoids. Miean and Mohamed (2001) identified three flavonoids i.e. quercetin (114.5 mg/kg dw), myrecetin (45 mg/kg dw) and luteolin (11 mg/kg dw) in French bean. Hempel and Böhm (1996) identified another flavonoid kaempferol (5.6 to 14.8 ìg/g fw) in both yellow and green coloured varieties. Currently, kaempferol is in interest because of its antioxidant (Vinson et al. 1995), antitumor, anti-inflammatory, and antiulcer activity (Goet et al. 1988), and its inhibitory activity of HIV protease (Brinkworth et al. 1992). Major lipid soluble antioxidants including carotenoids (Neoxanthin, Violaxanthin, Lutein, Zeaxanthin, â-carotene) and tocopherol are identified by Isabale et al. (2010). A dimeric 64-kDa hemagglutinin was isolated from the seeds of French bean which have antifungal and anti-HIV-1 reverse transcriptase activities.

It also inhibited proliferation of hepatoma HepG2 cells and breast cancer MCF-7 cells (Lam and Ng 2010).

Winged Bean: Winged bean *(Psophocarpus tetragonalobus* L.D.C.) is an important legume vegetable grown for its immature pods, seeds, flowers, shoots, leaves and roots which are edible. The average protein content is 2.4 g per 100 g of edible portion. It is also rich in minerals and vitamins. Seeds are rich in protein content (30-42 per cent) and possess favourable amino acid composition. The amino acid composition is similar to that of soybean seeds. The winged bean is relatively deficient in sulphur containing amino acids (Cerny and Addy 1973) and is fairly rich in available lysine and it may be supplemented cereal diets which are deficient in lysine content. The leaves are relatively low inlysine butrich in tryptophan. About 15 percent protein could be recovered from the leaves of the winged bean cultivars (NAP 1981). The vitamin-A content in fresh and tender leaves is measured around 20,000 IU. Roots are rich in protein content (8-20% on dry weight basis) compared to 1-5% in potato (Srikantha et al. 1978).

Cowpea: Cowpea (*Vigna unguiculata*) is grown is an important leguminous vegetable crop gown for its edible pod. It is a good source of protein, complex carbohydrates and fibre (Phillips et al. 2003; Amjad et al. 2006; Olivera-Castillo et al. 2007). It also provides vitamins such as folate, thiamine and riboflavin (Phillips et al. 2003) and minerals potassium, magnesium, phosphorus, calcium, copper, iron and zinc (Amjad et al. 2006). Tannins and phenolic acids Viz., protocatechuic, p-hydroxybenzoic, caffeic, p-coumaric, ferulic, 2,4-dimethoxybenzoic, cinnamic, gallic, vanillic, p-hydroxybenzoic and protocatechuic acid have been identified in cowpea (Cai et al. 2003; Duenas et al. 2005; Siddhuraju and Becker 2007). Regular consumption of cowpeas tones the spleen, thereby enhancing the production of cells that improve immune responses of our body. Consuming these legumes can induce the process of urination and also provide relief from leucorrhea. Cowpeas are also good for the stomach and the pancreas.

Dolichos bean: Dolichos bean (*Lablab purpureus*) or hyacinth bean is a popular vegetable crop in India. Its immature green pods are used as vegetables and dry seeds as pulse. Like other legumes, hyacinth beans are a good source of protein (3.8 g), minerals and vitamins. Amino acid composition of hyacinth beans is comparable to other legume proteins. Methionine is the most limiting amino acid in hyacinth beans. Like other legumes, hyacinth bean seeds contain trypsin inhibitor, lectin, phytic acid and polyphenol. The toxicity of lectin can be eliminated by autoclaving (heating) the meal. Apart from their nutritional value the plant is also used in traditional systems of medicine. In China the boiled ripe seeds are thought to be a tonic, and good to get rid of flatulence. The beans are also used as an aphrodisiac, for fevers, stomach problems, and as an antispasmodic. When the beans are used regularly in a diet, they prevent the build-up of cholesterol, (Vadde et al. 2007).

Cabbage: Cabbage (*Brassica oleracia* var. *capitata*) is an important cole crop cultivated in India and rich in various minerals and vitamins (Singh et al. 2009, 2010, 2013). Sauerkraut is a fermented cabbage product rich in ascorbic acid recommended for people suffering from scurvy. Many bioactive compounds have been identified like glucosinolates, phenolics, and carotenoids. Nielsen et al. (1993) showed that cabbage contains a mixture of more than 20 compounds of which seven have been identified as 3-O-sophoroside-7-O-glucosidesof kaempferol and quercetin with and without further acylation with hydroxycinnamic acids. In addition, unmodified kaempferol tetraglucosides or their derivatives acylated with either sinapic, ferulic or caffeic acid were found in cabbage leaves (Nielsen et al. 1998). Red cabbage another type of cabbage presently received wide attention due to its health potential and commercial application. Red pigmentation of red cabbage is caused by anthocyanins, which belong to flavonoids. Red cabbage contains more than 15 different anthocyanins which are acylglycosides of cyanidin (Dyrby et al. 2001). Total anthocyanins content in red cabbage in 25 mg/100 g (Wang et al. 1997) or 44.4–51.2 mg/100 g for anthocyanidins released after acidhydrolysis (Franke et al. 2004). In Japan red cabbage is a source of red food colorants and the preparation of these pigments is described in several patents (Bridle & Timberlake 1997).

Cauliflower: Cauliflower (*Brassica oleracia* var *botrytis*) is another important cole crop. Prefloral fleshy apical-meristem known as 'curd' is commonly used as vegetables. Coloured curds are good source of vitamins, minerals and dietary fibre. The major carotenoids present in cauliflower are lutein, neoxanthin, viola-xanthin and â-carotene. It is also good source of tocopherols (Isabelle et al. 2010). Other important bioactive compounds present in cauliflower are glucosinolate, ascorbic acid and phenolics including flavonoids. Major glucosinolates present in cauliflower are glucoalyssin, glucoiberverin, glucobrassicin, neoglucobrassicin, 4-hydroxy glucobrassicin, 4-methoxyglucobrassicin etc. (Gratacós-Cubarsí et al. 2010). Cabello-Hurtado et al. (2012) assessed *in vitro* antioxidant activity of cauliflower glucosinolates and their derivatives. Glucosinolates showed significant antioxidant activity measured by oxygen radical

absorbance capacity assay and superoxide radical scavenging activity assays. In cauliflower, predominant hydroxycinnamic acid conjugates have been identified as 1,2-disinapoyl diglucoside, 1-sinapoyl-2-feruloyl-diglucoside, 1,2,2'-trisinapoyl diglucoside and 1,2'-disinapoyl-feruloyl-diglucoside. The major flavonol glycosides present in cauliflower are Quercetin-3-diglucoside-7-glucoside, Kaempferol-3-diglucoside-7-glucoside and Kaempferol -3-diglucoside-7-diglucoside (Gratacós-Cubarsí et al. 2010). Anthocyanins an important group of flavonoids also have been identified in some varieties of violet pigmented cauliflowers. Violet cauliflower extracts show significant antioxidant properties, which have the scavenging activity of the very reactive hydroxyl radical (Pizzocaro et al. 2000). The predominant anthocyanins present in purple cauliflower are *p*-coumaryl and feruloyl esterified forms of cyanidin-3-sophoroside-5-glucoside (Lo Scalzo et al. 2008).

Broccoli: Broccoli (*Brassica oleracia* var *italica*) is the most important cole crop that recently received wide attention due to its multiple health beneficial property. It is a good source of vitamins, minerals and dietary fibre. It accumulates selenium, an antioxidant trace element when grown in selenium enriched soil (Banuelos and Meek 1989). It ranked among the highest source of folic acid, contributing about 70-90 µg/100g (Scott et al. 2000). Antioxidant properties of broccoli are attributed to the presence of wide ranges of water soluble and lipid soluble antioxidants. Lutein, â-carotene and á-tocopherol are the important lipid soluble antioxidants present in broccoli. Among water soluble antioxidants, ascorbic acid and polyphenols including flavonoids are important. The predominant hydroxycinnamoyl acids were identified as 1-sinapoyl-2-feruloylgentiobiose, 1,2-diferuloylgentiobiose, 1,2,20-trisinapoylgentiobiose, and neochlorogenic acid (Vallejo et al. 2003). In addition, 1,20-disinapoyl-2-feruloylgentiobiose and 1,2-disinapoylgentiobiose,1-sinapoyl-2,2-diferuloyl gentiobiose, isomeric form of 1,2,20-trisinapoylgentiobiose, and chlorogenic acids are found in broccoli (Price et al. 1997; Vallejo et al. 2003). Total amounts of eruloylsinapoyl esters of gentiobiose and caffeic acid derivatives in 14 cultivars of broccoli varied from 0 to 8.25 mg/100 g and from 0 to 3.82 mg/100 g, respectively.The two main flavonol glycosides present in broccoli florets are 3-*O*-sophoroside-7-*O*glucoside of quercetin and kaempferol and the other minor glucosidesand isoquercitrin, kaempferol 3-*O*-glucoside and kaempferol 3-*O*-diglucoside (Price et al. 1997; Vallejo et al. 2004). Another important bioactive compound present in broccoli is glucosinolates. With the presence of mirosinase enzyme, these glucosinolates break into various bioactive isothiocianates. Main glucosinolates break down products are sulphoraphane, indole-3-carbinol, benzyl isothiocyanate and phentylisothiocyanate. These may be responsible for disease prevention properties of broccoli especially aganist different types of cancer. In vitro and in vivo studies have reported that isothiocyanates affect many steps of cancer development, including modulation of phases I and II of detoxification enzymes. They function as a direct antioxidant or as an indirect antioxidant by phase II enzyme induction, modulating cell signalling, induction of apoptosis, control of the cell cycle, and reduction of *Helicobacter* infections (Sarkar et al. 2003; Visanji et al. 2004).

Knol-khol: Knol-khol or kohlrabi (*Brassica oleracea* var. *gongylodes*) is a cool season, stout, round shaped (knob) vegetable of the Brassicaceae family which is grown for its knob, the tuberous modified stem, as well for its turnip-flavored succulent leaves (top greens). The succulent kohlrabi knobs are rich in mineral content (Ca, K, Mn, Fe, P and Cu), carotenoids, antioxidants, vitamins and dietary fiber; a it has low calorie and fat and almost zero in cholesterol content (Chakrabarti 2003; Kala and Jamuna 2006 and Ahmed and Beigh 2009). Potassium (K) is an important component of cell and body fluids that helps controlling heart rate and blood pressure by countering effects of Sodium (Na). It is rich source of ascorbic acid (60-75 mg/ 100 g); a water-soluble vitamin possesses antioxidant properties. It helps the body maintain healthy connective tissue, teeth and gum, additionally antioxidant property helps the human body protect from diseases and cancers by scavenging harmful free radicals from the body. Like other Brassica vegetables, knoll-khol also contains health-promoting phytochemicals such aisothiocyanates, sulforaphane and indole-3-carbinol that are supposed to protect against prostate and colon cancers (Fan et al. 2009). It also contains good amounts of many B-complex vitamins, namely niacin, pyridoxine, thiamin and pantothenic acid that act as co-factors to enzymes during various metabolisms inside the body. The top greens are also very nutritious and abundant in carotenes, vitamin A, vitamin K, minerals and vitamin B-complex.

Brussels sprouts: Brussels (*Brassica oleracea* var*, gemmifera)* sprouts are one of the many variations of cabbage, instead of single head at the top of the stem, a large bud or miniature head is borne in the axil of each leaf. Brussels sprouts are rich in protein (4.4%). vitamin-A (520 I.U.) and ascorbic acid (72mg.) and contain appreciable amounts of riboflavin, niacin, calcium and iron. Brussels sprouts are also rich source of

glucosinolates. This vegetable is rich in vitamin K that is used by body for blood clotting so some heart patients taking anticoagulants may have to avoid its excess intake. In short, all cruciferous vegetables contain glucosinolates and have great health benefits for this reason. The cancer protection we get from Brussels sprouts is largely related to four specific glucsinolates found in this cruciferous vegetable: glucoraphanin, glucobrassicin, sinigrin, and gluconasturtiian.

Kale: Among the leafy vegetable crops, kale (*Brassica oleracea* L. var. *virdis* L.; formerly *B. oleracea* L. var. *acephala* DC.) is very versatile and nutritious possessing high levels of vitamin A (equal to carrot), omega-3 fatty acids, lutein and zeaxanthin, vitamin C (nearly four times to the oranges/limes), and is a good source of vitamin B complex and minerals also. Kale has a higher bio-availability of Ca than milk. It is especially known for health benefiting antioxidants, low content of fat and oxalic acid, and no cholesterol. Like other Brassica vegetables, kale contains health-promoting glucosinolates (glucobrassicin, glucoraphanin, gluconasturtiian, glucopaeolin, sinigrin) and derived isothiocynates/metabolites (indole-3-carbinol, sulforaphane, phenethyl-isothiocyanate, benzyl-isothiocyanate, allyl-isothiocyanate) which protect against prostate and colon cancers, Di-indolyl-methane which acts as effective immune modulator, antibacterial and antiviral agent, and carotenoids (carotene, lutein, zeaxanthin, lycopene) which are responsible for enhancing the immune response and possess anti-degenerative, anti-aging and anti-cancerous properties. Endowed with excellent source of phyto-nutrients, kale provides a comprehensive support for the body's detoxification system (Singh et al. 2017).

Carrot: Carrot (*Daucus carota*) is an important root vegetable that can play an important role in human nutrition. Its tender roots are consumed either in salad, cooked or processed forms. The coloured carrots are very good sources of vitamins, pigments, anthocyanins, antioxidants, minerals and dietary fibers (Singh et al. 2018). Besides it is rich sources of both hydrophilic as well as lipophilic antioxidants. The major lipophilic antioxidants are beta carotene, alpha carotene, lutein and lycopene. Yellow carrot accumulates xanthophylllutein, an essential bioactive pigment that protect eye from age related macular degeneration and cataract; red carrot contains abundant lycopene in addition to beta carotene and alpha carotene; orange carrot possess abundant amounts of beta carotene and alpha carotene; and purple/ black carrot is very good source of anthocyanins, a potential antioxidants (Singh 2016). Lycopene is functional ingredient which prevents prostate cancer and scavenges free radicals from body. Major hydrophilic antioxidants are phenolics including flavonoids and anthocyanin. The major flavonoids identified in carrot are quercetin, luteolin and kaempferol (Miean and Mohamed 2001). Recently, among various bioactive compounds anthocyanin received wide attention due to their multiple health benefits.

Beet: Beet (*Beta vulgaris*) is an important vegetable belongingto chenopodiaceae family. Its roots are good sources of calcium, phosphorus, iron, thiamin, riboflavin, folic acid and ascorbic acid. The main pigments in beet are betalains. Betalains are water-soluble nitrogenous pigments. They can be divided into two major structural groups, the red to red-violet betacyanins and the yellow betaxanthins. Betacyanins can be further classified by their chemical structures into four kinds: betanin-type, amaranthusin-type, gomphrenin-type and bougainvillein-type (Strack et al. 1993). Common beets usually contain both red betacyanins (consisting of 75–95% betanin) and yellow betaxanthins (w95% vul-gaxanthin I), in various ratios depending on cultivar (Francis 1999; Piattelli 1981). Betalains are stable between pH 3.5 to 7.0 which covers nearly all foods with maximum colour stability at pH 5.5. Betanin is susceptible to light and temperature damage which limits the use to fresh foods, foods packed under modified atmospheric condition or food that do not undergo heat treatment. It is mainly used in frozen products (ice cream and yoghurt). Dried betanin is more stable and used as colour additives in instant food and powdered soft drink. Beside vegetable use it is also cultivated for sugar production and thus used in jelly, candy, and fillings. Root powder is a very popular colouring agent for soap and cosmetics. However, colour properties of, betalains from beet roots possess high antiradical effect and antioxidant activity, representing a new class of dietary cationized antioxidant (Pedreno and Escribano 2000; Kanner et al. 2001). Besides betalains it also contains phenolics including flavonoids which are potential antioxidants (Jiratanan and Liu 2004). It also contains soluble fibre which helps in reducing blood cholesterol level.

Radish: Radish **(***Raphanus sutivus***)** is a good source of vitamin-C containing 15.40 mg per 100g of edible portion and supplies a variety of minerals. It has 0.6% protein. 0.3% fat, 0.6% minerals, 0.6% fibre and 6.8 % other carbohydrates. Pink-skinned radish is generally richer in ascorbic acid than the white-skinned one (Singh et al. 2020). Fertilizers also influenced vitamin-C content of radish roots. Coloured radishes possess higher anti-oxidant properties due to presence of anthocyanins (Singh et al. 2016, Singh et al 2017, Koley et al. 2020,

Singh et al. 2020). Radish is used in liver and gall bladder troubles. In homeopathy, they are used for neuralgic headaches, sleeplessness and chronic diarrhoea. Roots, leaves, flowers and pods are active against gram-positive bacteria. The roots arc said to be useful in urinary complaints, piles and in gastrodynia.

Turnip: Turnip (*Brassica rapa*var. *rapa*), one of the cool season vegetables is grown for swollen tap root and green leaves (turnip top). Although its bulbous root is widely popular, yet the turnip top is more nutritious, several times richer in vitamins, minerals and antioxidants content (Persson et al. 2001; Fernadese et al. 2007; Saeed et al. 2012). The antioxidants help the body scavenge harmful free radicals, prevents from cancers, inflammation, and help boost immunity. The root is high only in vitamin C content; while green leaves are a good source of dietary fiber, vitamin A, folic acid, niacin, riboflavin, pyridoxine, pantothenic acid, thiamin, vitamin C, vitamin K, iron, manganese and calcium. Turnip greens are high in carotenoid, xanthin and lutein. It is very low-calorie root vegetable, contains only 25-30 calories/ 100 g. Turnip is characterized by a particular bitter and pungent taste, which has been related to the content of some glucosinolate degradation products (Carlson et al. 1987). It controls and reduce the risk of cancers of the lung, bladder, pancreas and the stomach. It also decreases the chances of diabetes, hypertension and obesity. Turnip greens are good for rheumatoid arthritis patients. Beta-carotene helps in the formation of vitamin A in the body, which is important for the proper working of the immune system. Studies have shown that the vitamin E present is also good for colon function and can reduce colon tumors. Vitamin E is also good for colon health and studies have shown that it can prevent colon cancer.

Amaranths: Amaranth (*Amaranthus* spp.) is a nutritive leaf vegetable grown for its leaves throughout the tropics. *A. tricolor* (*A tristis, A gangeticus*), *A dubius*, *A hypochondriacus (A flavus), A cruentus (A. paniculatus*) and *A caudatus* (*A edulis*) are the important cultivated species. *A. spinosus* and *A. viridis* are two weed species whose leaves are also consumed by local people. *A blitum (A. lividus*) includes both weedy and cultivated species. In amaranth, both red and green varieties are available. In India, it is grown during summer and rainy seasons. Because of high productivity and low cost of cultivation, it is the cheapest of all leaf vegetables. Being a C_4 plant, it is highly efficient in biomass production. The harvest index is almost one in this crop. Amaranth leaf protein contains more lysine than the best high lysine corn and more methionine than soyabean. *A tricolor* has 5.2 g protein, 6.1 g carbohydrate, 1 g fibre, 5520 µg ß-carotene, 99 mg vitamin C, 0.03 mg thiamine, 0.03 mg riboflavin, 1.2 mg niacin, 2.7 g minerals, 397 mg Calcium, 3.49 mg Iron, 122 mg Magnesium, 230 mg Sodium and 341 mg potassium per 100 g edible portion. Presence of antinutrient factors like oxalate and nitrate is a limiting factor in the large-scale consumption of amaranthus. It is reported that about 40% of oxalates found in amaranth is in free state and affect the calcium metabolism. Another anti nutrient factor present in amaranth is free nitrates. Oxalate content ranged from 0.77% to 4.3% and nitrate content varied from 0.20% to 2.70% in different species (Sadhan Kumar and Nirmaladevi 2009).

Grain amaranth was selected as one of the four crops by National Academy of Sciences, USA Select Panel as an underexploited tropical plant with promising economic values. It is a multipurpose crop where both leaves and grains are utilized. The three principal species considered for grain production include: *A. hypochondriacus*, *A. cruentus* and *A. caudatus*. It is a C_4 plant. Grain contains 15g Protein, 7 g fat, 63 g total carbohydrate, 2.9 g fibre, 477 mg phosphorus, 0.32 mg riboflavin, 1.0 mg niacin, 3.0 mg ascorbic acid, 0.14 mg thiamine and 490 mg calcium per 100 g edible portion. Leaves contain 3.5 g protein, 0.5 g fat, 6.5 g total carbohydrate, 1.3 g fibre, 67 mg phosphorus, 3.9 mg iron, 411 mg potassium, 6100 IU vitamin A, 0.16 mg riboflavin, 1.4 mg niacin, 80 mg ascorbic acid, 0.08 mg thiamine and 267 mg calcium per 100 g.

Spinach: Spinach is a cool season vegetable grown for its edible leaves. It belongs to family Chenopodiaceae, genus *Spinacia* and species o*leracea*. It has 2 n = 2 x = 12 (Ryder, 1979). 100 g edible portion contains 2.9 g carbohydrate, 2 g protein, 0.7 g fat, 0.6 g fibre, 7045 IU vitamin A, 28 mg vitamin C, 0.03 mg thiamine, 0.26 mg riboflavin, 0.05 mg niacin, 132 mg folic acid, 107 mg calcium, 57 mg phosphorus, 2.7 mg iron, 92 mg magnesium, 110 mg sodium and 605 mg potassium.

Fenugreek: Fenugreek (*Trigonella foenumgraecum*) commonly known as *methi* is cultivated throughout India and other parts of the world as a leafy vegetable, condiment and medicinal purposes. Traditionally seeds are used as antidiabetic agent and the leaves are rich in minerals, protein, vitamin-A and C. The leaves are very rich in protein containing' about 18.6 to 40.9 per cent at different stages of growth, on dry weight basis and 100 g of fresh methi leaves contains 3900 I.U. of vitamin A and 140 mg of vitamin C. The *in vitro* available iron in fenugreek leaves is only about 4.6% of the total iron. Vitamin B, (0.8 mg/100g), vitamin K (240 ppm), á and â tocopherols (0.87 and 0.37 mg/g dry weight respectively) are also reported to be present. Flavonoids

identified in the leaves of fenugreek are Kaempferol and 3' 4' – dio Me-Quercetin. The fenugreek leaves lose 7.4 to 10.8 per cent of vitamin-C after boiling in water, steaming and frying. It also has high medicinal and industrial importance. It prevents constipation, removes indigestion, stimulates spleen & liver, and is appetizing and diuretic. The soluble dietary fibre viz., gum, pectin and other mucilaginous substances present in fenugreek seeds are reported to reduce post- parandial levels of glucose in blood.

Bathua: Bathua or leafy chenopod (*Chenopodium album* L.) The succulent soft leaves of bathua contain appreciable amount of dietary fibre; protein; minerals such as Ca, Fe, P, K, Mg, Zn, Mn, Se and Na; vitamins i.e. vitamin-C, â-carotene, niacin, folic acid and riboflavin; antioxidatns; omega-6-fatty acid; etc (Kole et al. 2016, Singh and Singh 2017, Singh et al. 2018). The effect of feeding chenopodium cultivar on blood lipid profile of rats confirmed the hypochloesterolemic effect by lowering total blood cholesterol, LDL, VLDL and triglycerides, and increasing HDL content (Sood 2011).

Asparagus: Asparagus (*Asparagus officinalis*) is a delicate, nutritious and appetizing vegetable grown in temperate as well as tropical regions. Asparagus is a good source of vitamin-A. Green asparagus (100 g edible portion) contains 93 g of water, 2.2g of protein, 21 mg of calcium, 700 IU of vitamin A, 30 mg of ascorbic acid, 0.2 mg of thiamine, 0.16 mg of riboflavin and 1.0 mg niacin. It is a good source of vitamin B_6, calcium, magnesium and zinc, and a very good source of dietary fiber, protein, vitamin A, vitamin C, vitamin E, vitamin K, thiamin, riboflavin, rutin, niacin, folic acid, iron, phosphorus, potassium, copper, manganese and selenium as well as chromium, a trace mineral that enhances the ability of insulin to transport glucose from the bloodstream into cells. The amino acid asparagine gets its name from asparagus, as the asparagus plant is relatively rich in this compound. Asparagus root possesses aphrodisiac, demulcent, general tonic, diuretic, anti-inflammatory, antiseptic, anti-oxidant and antispasmodic properties. Regular use of asparagus root treats infertility, impotence, leucorrhea, menopause syndromes, hyperacidity, and certain infectious diseases such as herpes and syphilis. It is also useful in the treatment of epilepsy, kidney disorders, chronic fevers, excessive heat, stomach ulcers and liver cancer, increases milk secretion in nursing mothers and regulates sexual behaviors. *Asparagus racemosus* cleanses, nourishes, and strengthens the female reproductive organs and so, it is traditionally used for PMS, amenorrhea, dysmenorrhea, menopause and pelvic inflammatory disease (PID) like endometriosis. *Asparagus racemosus* is considered as the most potent female health tonic.

Lettuce: Lettuce (*Lactuca sativa*) occupies the largest area of the salad crop world wide. It is a pleasure food with low nutrient density. It has a crisp texture, a large surface to volume ratio and serves as source of bulk for diet conscious consumres. It is one of the few vegetable crops used extensively as a fresh raw product. Lettuce is generally not canned, dried or frozen and rarely cooked. The loose lettuce and romaine types are more nutritious than the head type lettuce, manilybecause of its high vitamin A and Vitamin C values. It is also a good source of calcium and phosphorus. Lettuce is also known to be sedative, diuretic and expectorant. Lettuce extracts are sometimes used in skin creams and lotions for treating sunburn and rough skin. It was once thought to be useful in relieving liver issues. Some American settlers claimed that smallpox could be prevented through the ingestion of lettuce, Watts (2007), and an Iranian belief suggested consumption of the seeds for the relief of typhoid . Duke et al. (2007) folk medicine has claimed it as a treatment for pain, rheumatism, tension and nervousness, coughs and insanity.

Curry leaf: Curry leaf (*Murraya koenigii* Linn.Sprengal) is a spicy leaf vegetable belonging to family Rutaceae and chromosomer number is 2n=18. It is used in culinary preparation to enhance flavour and taste of food and is a very rich source of iron and Vit.A. The leaves are slightly pungent, bitter and feebly acidic in taste. Curry leaf loses flavour when cooked. To retain fresh flavour, the leves should not be removed from branches until ready for use. 100 g curry leaf contains 6.1 g protein, 1.0 g fat, 18.7 g carbohydrate, 83 mg calcium, 57 mg phosphorus, 0.93 mg iron, 7.56 microgram carotene and 4 mg vitamin C.

Drumstick: Drumstick or Moringa (*Moringa oleifera*) is a devine gift to mankind to fight malnutrition which can be grown even in marginal lands. Its fruits, leaves and flowers are used by mankind. Seeds are used for water clarification. Fruits contain 3.7 % carbohydrate, 2.5 % protein, 0.1 % fat, 2 % minerals and 4.8 % fibre. It also contains 0.11 mg carotene, 423 mg choline, 0.05 mg thiamine, 0.07 mg riboflavin,0.2 mg niacin and 120 mg vitamin C. Leaves contain 13.4 % carbohydrate, 6.7 % protein, 1.7 % fat, 2.3 % minerals and 0.9% fibre. Leaves are a rich source of carotene (6.8 g/100 g), choline (423 mg/100 g), thiamin (0.06 mg/100g), riboflavin (0.05 mg/100 g), niacin (0.8 mg/100g) and vitamin C (220 mg/100 g).

Along with pods and leaves, all parts of the tree are considered medicinal and are used in the treatment of ascites, snakebites and as a cardiac stimulant. Roots

are used as an ointment of scurvy, catarrh, wounds and as an emetic, seed oil as edible oil; for lightening and in cosmetics, and the stem gum exudates in calico printing and medicines. The wood has suitable characteristics for pulp, paper and cellophane and textile production (Nautiyal and Venkataraman 1987). In Guatemala, drumstick is used to treat many disorders, in particular infectious diseases of the skin, digestive system and respiratory tracts. The antimicrobial activities of the leaves, roots, bark and seeds have been investigated *in vitro* against bacteria, yeast, dermophytes and helminthes pathogenic to man. Vitamin C content of pods and leaves of 11 clones of *Moringa oleifera* and 2 clones of *M. concanensis* was in the range of 55-143 mg/100 g (Verma et al. 1976). Leaves have high protein value as well as low fibre content which has made it suitable for the extraction of leaf protein for use as low-cost source of proteins (Awasthi and Tandon 1988). Its tender green leaves are good source of neutral detergent fibre (NDF) and acid detergent fibre (ADF).

The widespread combination of diuretic along with lipid and blood pressure lowering constituents make this plant highly useful in cardiovascular disorders. Moringa leaf juice is known to have a stabilizing effect on blood pressure. "Thiocarbamate glycosides" have been isolated from moringa leaves, which are found to be responsible for the blood pressure lowering effect (Faizi et al. 1994; 1995). Most of these compounds, bearing thiocarbamate, carbamate or nitrile groups, are fully cetylated glycosides, which are very rare in nature (Faizi et al. 1995). Bioassay guided fractionation of the active ethanol extract of moringa leaves led to the isolation off our pure compounds, niazinin A, niazinin B, niazimicin and niazinin, which showed a blood pressure lowering effect. Another study on the ethanol and aqueous extracts of whole moringa pods and its parts ie., coat, pulp and seed revealed that the blood pressure lowering effect of seed was more pronounced with comparable results in both ethanol and water extracts indicating that the activity is widely distributed (Faizi et al. 1998). Activity-directed fractionation of the ethanol extract of pods of *M. oleifera* has led to the isolation of thiocarbamate and isothiocyanate glycosides, which are known to be the hypotensive principles (Faizi et al. 1995). Methyl phydroxybenzoate and ~ sitosterol investigated in the pods of M oleifera have also shown promising hypotensive activity (Faizi et al. 1998).

Moringa roots, leaves, flowers, gum and the aqueous infusion of seeds have been found to possess diuretic activity (Morton 1991; Caceres et al.1992) and such diuretic components are likely to play a complementary role in the overall blood pressure lowering effect of this plant. The crude extract of moringa leaves has a significant cholesterol lowering action in the serum of high fat diet, which might be attributed to the presence of a bioactive phytoconstituent, sitosterol (Ghasi et al. 2000). *M. oleifera* roots have been reported to possess anti-spasmodic activity (Caceres et al. 1992). Moringa leaves have been extensively studied pharmacologically and it has been found that the ethanol extract and its constituents exhibit anti-spasmodic effects (Dangi et al. 2002). The anti-spasmodic activity of the ethanol extract of *M. oleifera* leaves has been attributed to the presence of 4-(L-rhamnosyloxy) benzyl]- o-methyl thiocarbamate, which forms the basis for its traditional use in diarrhoea. Moringa roots have also been reported to possess hepatoprotective activity (Ruckmani et al.1998). This may be due to the presence of quercetin, a well-known flavonoid with hepatoprotective activity. The bark extract has been shown to possess antifungal activity (Bhatnagar et al. 1961).Aqueous leaf extracts regulate thyroid hormone and can be used to treat hyperthyroidism and exhibit an antioxidant effect (Pal et al. 1995; Tahiliani and Kar 2000). Moringa leaves are effective for the regulation of thyroid hormone status (Tahiliani and Kar 2000). Extract of *M oleifera* leaves conferred significant radiation protection to the bone marrow chromosomes in mice (Rao et al. 2001).

Chekkurmanis: Chekkurmanis (*Sauropus androgynous* Merr.) is a perennial leaf vegetable. It also called as multi-vitamin green or multi-mineral packed vegetable. It has a unique position in the list of leafy vegetables because of its high nutritive value and multifarious uses. Its leaves are very rich in protein, minerals and vitamins A, B and C. The crop is being grown in Southern India, Indonesia and Singapore. The leaves can be cooked like other greens. Chekkurmanis contains 6.8 g protein, 11.6 g carbohydrate, 3.2 g fat, 1.4 g fibre, 5706 µg carotene, 247 mg vitamin C, 0.48 mg thiamine, 0.32 mg riboflavin, 2.6 mg niacin, 3.4 g minerals, 570 mg Ca, 200 mg P and 28 mg Fe per 100 g edible portion.

Palak: Palak **(***Beta vulgaris* var. *bengalensis***)** is an important leaf vegetable grown in tropical and sub-tropical regions. It belongs to family Chenopodiaceae. Leaves and stem are used after cooking. Leaves and tender stem are used for making pakoda. It possesses medicinal properties also. It is mildly laxative, diuretic, used in case of fever and inflammations of lung and bowels.100 g edible portion contains 6.5 g carbohydrate, 3.4 g protein, 0.8 g fat, 0.7 g fibre, 9770 IU vitamin A, 70 mg vitamin C, 0.26 mg thiamine, 0.56 mg riboflavin, 3.3 mg niacin, 380 mg calcium,30 mg phosphorus, 16.2 mg iron, 65 mg magnesium, 58.5 mg sodium and 206 mg potassium.

Agathi: Agathi (*Sesbania grandiflora* Pers) is a perennial tropical, quick growing and soft wooded tree belonging to family Fabaceae. The flowers are also eaten as vegetable. The bark yields good fibre and a gum, and the juice of flowers improves the sight, when squeezed into the eyes. Leaves and flowers of agathi have nutritional and medicinal properties. Leaves are rich in protein (8.4 g), vitamin A (9000 IU), vitamin C (169 mg) fibre (2.2 g) and minerals like calcium (1.13 g), phosphorus (80 mg), iron (3.9 mg) per 100 g edible part.

Onion: Onions (*Allium cepa*) are rich source of amino acid and glutamyl peptide, anthocyanins, f1avonols and phenolics. Non-structural carbohydrates consisting of free sugers, trisaccharides and fructans contribute the major portion the dry weight of onions. High dry matter onion cultivars have reduced glucose and fructose contents and much higher fructan levels than varieties with low dry- matter contents. Onion is rich in sulfur containing compounds. The enzyme aliinase hydrolyses s- alkenyl eystein sulfoxides produce pyruvate, ammonia and many volatile sulfur compounds are associated with flavour and odour of onion. Onions contain primarily the s-(l-propenul), propyl and to a lesser degree, methyl alliins. The typical flavour of onion is due to the presence of propyl and l-propenyl containing allicins and di-and tri- sulfides. Onion contains an acrid volatile oil (0.05%) with a pungent smell. The oil is rich in sulfer and contains a variety of aliphatic disulfide including allyl or propenyl propyl disulfide, dipropyl disulfide, methyl propyl disulfide and their trisulfides. However, the chief component is propenyl propyl disulfide, an isomer of allyl propyl disulfide. The precursors of onion oil are the cysteine sulfoxide derivative of amino acids known as alliins. Onion contains an enzyme called alliinase, which converts alliins to disulfide oxides. These oxides are allicin type compounds. The lipid lowering effects of onion extracts has also been reported. The hypolipidemic effects of onion have also been attributed to their sulphur containing compounds. Onions are known to contain anthocyanins and the flavonoids quercetin and kaempferol. Quercetin is the major flavonoid of interest in onions. Mechanisms of action include free radical scavenging, chelation of transition metal ions, and inhibition of oxidases such as lipoxygenase. The homogenate fresh onion and hot water extract of fresh aerial parts of *Allium cepa* exhibit significant inhibition of lipid peroxidation. The antioxidative effects of consumption of onions have been associated with a reduced risk of neurodegenerative disorders, many forms of cancer, cataract formation, ulcer development and prevention of cardiovascular diseases by inhibition of lipid peroxidation and lowering of low-density lipoprotein (LDL) cholesterol levels. Another antioxidant effect of onions and their extracts includes the reduction of rancidity in cooked meat.

Garlic: (*Allium sativum* L.) It is mostly used for culinary purposes and is considered one of the most popular and widely used flavourings. People all over the world use it as a condiment for different food items. In India and other countries, it is used in several food preparations like chutneys, pickles, curry powders, curried vegetables, meat preparations, tomato ketchup. *etc*. The garlic powder has also earned significant popularity in the recent times. Garlic cloves contain an enzyme alliinase, which is released when they are crushed. Allinase acts on SACS and produce allicin, ammonia, and pyruvic acid and is a powerful antibiotic and antifungal compound (phytoncide). However, it is of limited use for oral consumption due to poor bioavailability. It also contains alliin, ajoene, enzymes, vitamin B, minerals, and flavonoids. Garlic contains about 62.8% water, 6.3% protein, 0.1 % fat, 29%carbohydrate including 3. 9% sucrose, traces of Ca, Fe, Zn and phosphate salts, and small amounts of vitamins like thiamin, riboflavin, niacin and ascorbic acid. Garlic can yield 0.06 to 0.1 % essential oil which is made up of mainly diallyl disulfide and small amounts of allylpropyl disulfide. This oil is formed from the decomposition product of on alliin called S-allyl cysteine sulfoxide (SACS). Garlic is used in making remedies for various ailments and physiological disorders and is considered one of the oldest medicines in the world. In Ayurveda, garlic is considered as one of the most effective antimicrobial herbs, as it has anti-bacterial, anti-fungal, anti-viral, anthelmintic and antiseptic properties. It has healing capacity and effectiveness against cholera, as well. It has useful anti-bacterial action against *Eberthella tvphosa, Escherichiacoli,* acid fast *Bacilli, Aerobacter aerogenes, Staphylococcus aureus etc.* According to Ayurveda, Garlic is also useful for increasing sexual energy and in combating impotence. It can help kill parasites like bookworms and pinworms. Several benefits of garlic have been described inUnani medicine. According to Unani medicine, garlic is used as carminative and can also act as a gastric stimulant. It can aid in digestion and absorption of food and is also given in flatulence. In modern allopathic treatment, garlic is used in a number of patented medicines and other preparations. The residue of garlic, obtained by alcoholic extraction and distillation, is believed to contain a bacteriostatic and bactericidal substance identified as 'allyl disulfide oxide'.It has been used traditionally for ages to treat a wide array of diseases, namely, respiratory infections, ulcers, diarrhea and skin infections (Fenwick and Hanley 1985). Garlic is used as an antidote to snake

and scorpion bites and is also very good medicine for running cold and saliva formation. As herbal medicine, it is also used to treat diseases like chronic bronchitis, respiratory catarrh, whooping cough, bronchitic asthma, influenza and other health problems. It can also fight infection, reduce cholesterol, protect against heart diseases and stroke, control diabetes and prevent cancer. It can prevent blood clots and destroy plaque preventing atherosclerosis and can reduce the chances of stroke and heart attacks. Its extract is also used in homeopathy medicines. The inhalation of garlic oil or garlic juice is commonly recommended in case of pulmonary tuberculosis, rheumatism and impotence. The Garlic juice is extensively used for treating various ailments of stomach and is also used as a rubefacient in skin diseases. It is used as eardrop in ear aches, as well. The garlic juice can also be used against duodenal ulcers, after diluting with water. Garlic is used for killing bacteria that cause tuberculosis and it reduces blood sugar level. It can help to improve the immune functions, fight against chronic diarrhea etc. and it also heals open pores, activates and stimulates blood circulation, and improves hair growth. The bioactive substances like alliin, allicin, gamma-glutamylcysteine, thiosulfinates etc. present in garlic can help in fighting against bacterial, parasitic and fungal infections. Garlic can be effective in treatment for congestion in the respiratory system, if taken along with honey.

Okra: Okra or lady's finger (*Abelmoschus esculantus*) is a popular vegetable. Its tender fruit contains vitamins A, B and C (13 mg). It is rich in iodine, calcium, potassium and other mineral matters. It has 1.9 % protein. 6.4% carbohydrate, 0.2% fat and 1.2% fibre. Sucrose is present in the developing and dry seeds of okra at all stages of development. The raffinose family of oligosaccharides is present in mature and dry seeds, while free glucose and fructose were detected at most stages. Dry seeds contained raffinose, and stachyose sugars of oligosaccharides family. Mucilage present in okra fruits is acidic polysaccharidcs. Hydrolysis of the mucilage gave polysaccharide composed of galaciuronic and glucuronic acids and minor contents of galactose, rhamnose, glucose and arabinose. The maximum protein content was 2.08% in pods and 2.09% in seeds. Mature dry okra seeds contain 20.58% protein. Okra seeds contain 14-19% oil having good proportion of linoleic acid. Okra fruit contains high amount of calcium, phosphorous, sodium, sulphur and nitrogen contents were analyzed in the developing seeds, embryo, seed coat and fruit wall. Embryo was consistently rich in phosphorus and sulfur.

Antinutritional compounds in vegetables

A major factor, which is restricting the utilization of vegetables in nutrition, is the presence of a diverse array of toxic substances and anti-nutritional compounds viz. alkenyl benzenes, s-alk (en) yl cysteine sulphoxides, biogenic amines, cinnamic acids, cyanogenic glycosides, cucurbitacins, flavonoids, glycoalkaloids, glucosinolates, lectins, hydrazines, isoflavones, lathyrogens, lignans, raffinose family of oligosaccharides, oxalate, pyrrolizidine alkaloids, furanocoumarins, quinolizidine alkaloids, sesquiterpene lactones, saponins, trypsin inhibitors, xanthine alkaloids, mineral toxins, resinoids, tannins, phenols, non-amino organic acids, alcohols and terpenoids (Table 2). These anti-nutritional compounds are capable of inducing adverse effects ranging from neurological disorders, kidney stones,

Table 2: Anti-nutritional compounds/ toxicants of vegetables

Vegetables	Toxic compounds	Adverse effects
Carrot	Carota-toxin (Polyacetylenic alcohol)	Neurotoxic symptoms
Lettuce	Nitrates, Alkaloids	Methemoglobinaemia
Brassica (Cruciferous vegetables)	Glucosinolates, Choline-esterase inhibitor, S-methyl cysteine sulfoxides	Goiler, Digestive disorders
Beets, Spinach	Oxalates, Nitrates, Phytate, Tannis, Saponins, Nitrosamine	Methemoglobinaemia reduces bio-availability of certain minerals such as calcium, iron, and zinc. Careinogenic
Sweet potato	Ipomeamarone	Enzyme inhibitors
Watermelon	Serotonin	Elevates blood pressure
Pumpkin and squashes	Choline-esterase inhibitor	Neurotoxic
Legumes (Vegetables)	Lectins, Cyanogenic glucosides, Haemagglutinins, Trypsin, Amylase, Glucose-6-P-dehydrogenase inhibitor, Compounds havinganti-vitamin properties (Vitamin A, E and D)	Allergens
Asparagus	Saponins, Choline-esterase inhibotor	Neurotoxic
Solanaceous vegetables	Alkaloids	Birth defect, protease inhibitor
Potato	Solanine and chaconine	Invertase inhibitor
Tomato	Tomatine	Gastric discomfort
Pungent pepper (chillies)	Capaicin	Skin irritation, gastric disorders
Parsley, Celery	Psoralens, Terpenoids, Alkaloids, Choline-esterase inhibitor	Dermatitis

elevated blood pressure, gastric disorders and even death. Significant advances have been made in recent years to establish the nature of these compounds and to assess their toxic effects in animals and human beings. It is upto the breeders to develop/breed varieties with lesser amounts of these antinutrient factors.

Conclusions

Vegetables have always been considered to play a significant and important role in human nutrition providing not only essential nutrients but also other compounds for health promotion which prevent diseases. Further, their yield potential is very high when compared to food crops. So, vegetables can definitely play an important role in food and nutritional security of the world. Many vegetables can be grown in marginal lands where food crops cannot be grown. Vegetables like drumstick can play an important role here in dealing with the undernutrition which is prevalent in many parts of the world. Under- nutrition is a serious problem in under developing and developing countries. Micronutrient deficiencies, referred to as hidden hungerinclude iodine deficiency disorder, iron deficiency anemia, and vitamin A deficiency. Around forty percent of the world's malnourished children and 35 % of the developing world's low birth weight infants live in the India. Here majority of the people subsist on cereal based starchy staple-diets lacking in diversity, which contribute to micronutrient deficiency and result in severe diseases, especially in young, pregnant women and children. Moreover, these micronutrient deficiencies often go unnoticed despite their insidious effects on the immune system and growth cognitive development. The most popular and cheap approaches to address malnutrition are supplementation and food-based strategies. Vegetables, the cheapest source of vitamins and minerals, are high value food sources for the poorest families and can be incorporated in home gardens. The health effects of nutrients and bioactive substances depend both on their intake and bioavailability. To establish evidence for the effects of nutrients and bioactive substances consumption on human health and to better identify which nutrients provide the greatest effectiveness in disease prevention, it is first of all essential to determine the nature and the distribution of these nutrients in our diet. It is a challenge to the vegetable breeders to develop varieties with lesser amounts of antinutrient factors.

The policy paper No.7 of National Academy of Agricultural Sciences calls for nutrition education to be made a part of regular curricula in schools. Programmes like homestead gardening, urban gardening, household preservation and enrichment of food etc must be actively supported-NAAS, New Delhi-12.

lkjka'k

संयुक्त राष्ट्र के वर्तमान आंकड़े के अनुसार वर्ष 2050 तक विश्व की कुल आबादी बढ़कर 9.1 बिलियन होगी। लगभग सम्पूर्ण आबादी की वृद्धि विकासशील देशों में ज्यादा होगी। विश्व स्तर पर खाद्य, चारा एवं रेशा की आवश्यकता दुगुनी हो जायेगी। फसलों का उपयोग जैव ऊर्जा तथा अन्य औद्योगिक उद्देश्यों के लिये किया जायेगा। कृषि उपज का आधुनिकतम व पारम्परिक मांग पहले से उपलब्ध कृषि संसाधनों पर ज्यादा बल देने लगेगा। शहरों की ओर दौड़ लगाती आबादी हेतु जमीन तथा जल की प्रतिस्पर्धा कृषि को बाध्य करेगा। जलवायु परिवर्तन की गम्भीरता को कम करना एक दूसरी बड़ी चुनौती है। इसकी पूर्ति के लिये नवीनतम तकनीकों के माध्यम से कम जमीन व अन्य संसाधनों से उपज की वृद्धि करनी पड़ेगी। खाद्य एवं कृषि संगठन के अनुसार कृषि जमीन का विस्तार करना कम सम्भव है। कृषि के लिये कुछ स्तर पर उपयुक्त जमीन, जंगलों के द्वारा सुरक्षित है जो वातावरणीय कारणों से किया गया है अथवा ग्रामीणों के विकास के लिये रखा गया है। सधन कृषि का आधार जमीन व जल का इष्टतम उपयोग है। वर्तमान में विश्व की औसत प्रति व्यक्ति फसल जमीन की उपलब्धता घटकर लगभग 0.27 हेक्टेयर रह गया है। आबादी की वृद्धि व लोगों की बढ़ती आय से खाद्य की माँग बढ़ने का अनुमान है। खाद्यान्न (खाद्य एवं पशु चारा) की मांग अनुमानत वर्ष 2050 तक 3 बिलियन टन होगी। प्रति वर्ष खाद्यान्न फसलों का उत्पादन लगभग एक बिलियन टन बढ़ाना होगा। ऐसी स्थिति में औद्यानिक फसलों विशेषतः सब्जी फसलों की भूमिका ज्यादा उपयोगी होगी। प्राकृतिक संसाधनों में सब्जी फसलों की अद्भूत विरासत उपलब्ध है। सब्जी फसलों की उत्पादकता खाद्यान्न फसलों की तुलना में ज्यादा है। विकासशील देशों में खाद्य सुरक्षा सुनिश्चित करने से पोषकीय सुरक्षा को नजरअंदाज किया गया है। आज भी झाड़दार फसलों से ऊर्जा व कुछ प्रोटीन प्राप्त की जा रही है जबकि सब्जियों तथा फलों से अन्य महत्वपूर्ण पोषकीय घटक मिलते हैं जिसे नजरअंदाज किया जा रहा है। विश्व स्वास्थ्य संघटन ने भोजन आधारित खाद्य दिशा–निर्देश लोगों की अच्छी स्वास्थ हेतु प्रतिपादित किया है और प्रत्येक देश को अपनी परिस्थिति के अनुसार दिशा–निर्देश विकसित करने को कहा है। चारावासीट (2012) के अनुसार प्रत्येक देश अपने भोज्य सम्बन्धित दिशा–निर्देश में फलों तथा सब्जियों के उपयोग की अनुशंसा की है।

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