VEGETABLES AS NUTRACEUTICALS

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Abstract

Nutraceutical is a functional food which has some health benefit. Due to modernisation, industrialisation and change in feeding habits leads to many chronic diseases in human beings. To overcome the diseases nutraceticals plays an important role. Nutraceticals are found in good quantity in Vegetables. Vegetables are powerpack of phytochemicals,vitamins , flavonoids, dietary fibers, minerals and carotenoids which has health benefits to human being. It is an attempt to elucidate the benefits of consuming vegetable in overcoming the disease and enhancing the immunity.

Introduction

A nutraceutical is a food with a medical-health benefit, including the prevention and treatment of disease. The term was coined in the late 1980s by Stephen DeFelice, M.D., founder and chairman of the Foundation for Innovation in Medicine.

Such foods also commonly are referred to as *functional foods*, signifying they and/or their components may provide a health benefit beyond basic nutrition. Examples include fruits and vegetables as well as fortified or enhanced foods. While all foods are functional in that they provide nutrients, nutraceuticals contain health-promoting ingredients or natural components that have a potential health benefit for the body. “Functional” attributes of many traditional foods are being discovered, while new food products are being developed with beneficial components.

Nutraceuticals on the market today consist of both traditional foods and non-traditional foods. Traditional nutraceuticals are simply natural, whole foods with new information about their potential health qualities. There has been no change to the actual foods, other than the way the consumer perceives them. Many - if not most — fruits, vegetables, grains, fish, dairy and meat products contain several natural components that deliver benefits beyond basic nutrition, such as lycopene in tomatoes, omega-3 fatty acids in salmon or saponins in soy.

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Non-traditional nutraceuticals, are foods resulting from agricultural breeding or added nutrients and/or ingredients. Agricultural scientists are able to boost the nutritional content of certain crops through the same breeding techniques that are used to bring out other beneficial traits in plants and animals — everything from beta-carotene-enriched rice to vitamin-enhanced broccoli and soybeans. Research currently is being conducted to improve the nutritional quality of many other crops.

Vegetables comes under traditional nutraceuticals.

Vegetable usually means an edible plant or part of a plant other than a sweet fruit or seed. This typically means the leaf, stem, or root of a plant. However, the word is not scientific, and its meaning is largely based on culinary and cultural tradition. Therefore, the application of the word is somewhat arbitrary and subjective. For example, some people consider mushrooms to be vegetables even though they are not plants, while others consider them a separate food category. Some vegetables can be consumed raw, some may be eaten cooked, and some *must* be cooked in order to be edible. Vegetables are most often cooked in savory or salty dishes. However, a few vegetables are often used in desserts and other sweet dishes, such as rhubarb pie and carrot cake.

Any plant whose fruit, seeds, roots, tubers, bulbs, stems, leaves, or flower parts are used as food

Ex-

- **Fruits- Tomato, Bean,**
- **Tubers-Beet, Potato etc**

- **Bulb-Onion, Garlic**
- **Leaves-Spinach, Lettue,Cabbage etc.**
- **Flower-Cauliflower.**

Fruits: Tomato,Beans

Tomato (*Solanum lycopersicon* L.)

It is cultivated in open field and green houses throughout the year for both fresh consumption and for industrial processing. in open field and under greenhouse conditions for both fresh consumption and industrial processing. It belongs to Solanaceae family . The nutraceutical properties of tomato are mainly related to the antioxidant potential of tomato, which in turn is due to the presence of a mix of antioxidant bio-molecules like lycopene, ascorbic acid, phenolics, flavonoids and vitamin E. Lycopene, a carotenoid found in tomato products, prevents oxidation of low density lipoprotein (LDL) cholesterol and reduces the risk of developing atherosclerosis and coronary heart disease according to a recent study published in the October 1998 issue of Lipids (Agarwal, and Rao ,1998). This study showed that daily consumption of tomato products providing at least 40 mg of lycopene was enough to substantially reduce low density lipoprotein (LDL) oxidation. High LDL oxidation is associated with increased risk of atherosclerosis and coronary heart disease. This lycopene level can be achieved by drinking just two glasses of tomato juice a day. Research shows that lycopene in tomatoes can be absorbed more efficiently by the body if processed into tomato juice, sauce, paste and ketchup. The bound chemical form of lycopene found in tomatoes is converted by the temperature changes involved in processing to make it more easily absorbed by the body. Ongoing research suggests that lycopene can reduce the risk of prostate cancer and cancers of the lung, bladder, cervix and skin.

- In addition, they are also good source of antioxidant vitamin-C (provide 21% of recommended daily levels per 100 g); consumption of foods rich in vitamin C helps body develop resistance against infectious agents and scavenge harmful free radicals.
- Fresh tomato is very rich in potassium. 100 g contain 237 mg of potassium and just 5 mg of sodium. Potassium is an important component of cell and body fluids that helps controlling heart rate and blood pressure caused by sodium.
- They contain moderate amounts of many vital B-complex vitamins such as folates, thiamin, niacin, riboflavin as well some essential minerals like iron, calcium, manganese and other trace elements.

- Zeaxanthin is another flavonoid compuond present abundantly in this vegetable. Zeaxanthin helps protect eyes from "age related macular disease" (ARMD) in the elderly persons by filtering harmful ultra-violet rays.
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Cluster Beans (*Cyamopsis tetragonolobus)*

It is commonly known as guar bean botanically called as *Cyamopsis tetragonolobus* is an annual legume. It is also known as gawaar in Hindi & Marathi, Goruchikkudu kaya or Gokarakaya in Telugu, Gorikayie in Kannada and Kotthavarai in Tamil. Cluster Beans are a type of green beans grown in India, especially in Andhra Pradesh and Maharashtra. They are a flatter, smaller cousin of the regular green (French or string) beans. 80% of the world production of cluster beans is in India and grows best during frequent rainfall and also tolerates arid conditions. Guar is also used to feed to cattle, or used as a green manure. It is good source of Guar gum. Guar gum, also called guaran, is a galactomannan. It is primarily the ground endosperm of guar beans. The guar seeds are dehusked, milled and screened to obtain the guar gum. It is typically produced as a free-flowing, pale, off-white-colored, coarse to fine ground powder. Partially hydrolysed guar gum (PHGG)is used as prebiotic in animal feed.

- Guar gum is a food additive shown to reduce serum cholesterol. It appears to have positive effects on blood glucose. Do not use guar gum to promote weight loss. Guar gum has been administered in amounts from 7.5 to 21 g daily in clinical trials for weight loss.
- The ability of guar to alter viscosity 15 and thus affect GI transit results in delayed absorption of glucose and may contribute to its hypoglycemic activity.
- Administration of feed supplemented with PHGG can prevent the colonization of *Salmonella enteritidis* in young and laying hens, which, in turn, could be related to improvement in the balance of intestinal microflora.(Ishihara etal.. 2000)

- Partial hydrolysis of dietary GG improve both feeding behaviour and food passage from the crop in growing chicks.(Furuse and Mabayo,1996)

Drum stick *Moringa oleifera*

Moringa oleifera is the most widely cultivated species of the genus *Moringa*, which is the only genus in the family Moringaceae. "Power house of minerals" is the most common tree in India. Its leaves,fruits, flowers, barks and seeds have medicinal values and are used in various manners in all dishes. Invaluable in preventing cardiac diseases; researchers have stated that the nutritional value of the leaves is equivalent to 7 times the Vitamin C in oranges plus 4 times the calcium in milk plus 3 times potassium in bananas plus 2 times the protein in milk plus 4 times the vitamin A in Carrot.

Leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration, and reportedly without loss of nutritional value. Moringa is especially promising as a food source in the tropics because the tree is in full leaf at the end of the dry season when other foods are typically scarce.

It has antibiotic, antitrypanosomal, hypotensive, antispasmodic, antiulcer, anti-inflammatory, hypo-cholesterolemic, and hypoglycemic activities, as well as having considerable efficacy in water purification by flocculation, sedimentation, antibiosis and even reduction of Schistosome cercariae titer

Juice of Drum stick when mixed in milk and offered to children greatly helps by strengthening their bones as it is said to be a great source of Calcium. Also drumstick is said to be a great blood purifier. Pregnant women should often eat drumsticks as it helps ease any kind of pre and post delivery complication. Drumstick soup helps ease any kind of chest congestions, coughs and sore throats. Inhaling steam of water in which drumsticks have been boiled helps ease asthma and other lung problem.

The leaves are rich in Vitamins A and C and are considered useful in catarrhal affections. The pods made into a soup are prescribed as a diet in sub-acute cases of enlarged liver and spleen, articular pains, tetanus, debility of nerves, paralysis, pustules, patches and leprosy. A curry made from unripe pods is effective for keeping intestinal worms at bay.

Tuber Crops-

Ex- Carrots , Beetroot ,Parsnips etc.

Tuber crops provides dietary fibers, Vitamins (Folate,VitaminsAand C),Potassium and other components like Carotenoids

Carrots (*Daucus carotta*)

Carrots are part of the *Umbelliferae* or *Apiaceae* family so named as a result of the umbrella-shaped flower clusters. The family includes a number of important culinary plants. Carrots are believed to have originated in the Middle East and were first cultivated around 5000 years ago. Ancient Egyptian and Roman paintings show early carrots to have been predominantly purple or white (with some red and yellow varieties) and to have been used for medicinal as well as culinary purposes. The modern carrot was developed by Dutch growers in the 17th Century by selective breeding of these ancient varieties as much to celebrate the Dutch royal family (House of Orange).

Cartenoid content of Carrotboth raw and boiled (µg/100g)

Food	Beta Carotene	Gamma Carotene	Beta Crytoxanthin	Lutein and zeaxanthin
Raw carrot	8285	3477	125	256
Carrot (Boiled)	8332	3776	202	687

The bio-availability of some of these dietary active components is strongly affected by processing. For example only 3% of the Beta-carotene in raw carrots is released during digestion but is increased to 39% by pulping and cooking18.

Carrots are particularly rich in carotenoids which are also responsible for the orange to yellow colour. Notable are alpha-carotene, beta-carotene, beta-cryptoxanthin, lutein, zeaxanthin and falcarinol. There is evidence of low levels of phenolics19, 20 in the orange and yellow varieties. These are greatly enhanced in the highly coloured varieties now becoming more available.

Carotenoids are lipid soluble and comprise a long chain hydrocarbon molecule with a series of conjugated double bonds. It is these conjugated (or alternating double) bonds that confer the orange yellow colour. The double bonds also have the capacity to quench singlet oxygen and peroxyl radicals. These radicals are linked to physiological stress in the host but are linked with chronic disease. Carotenoids are particularly linked with anti-oxidative protection in the skin and eye (especially the macula lutea).

Beetroot (Beta vulgaris)

Beetroot is a particularly good source of inorganic nitrate.

Nitrate is believed to be metabolised to nitric oxide and other bioactive nitrogen species and there is strong evidence that regular consumption has a major effect on cardio vascular health34 including lowering blood pressure, reducing hypertension, inhibition of platelet aggregation and other vasco-protective properties. A protective role against ischaemic (poor blood supply) stroke has also been observed in animal models. Recent data has confirmed that inorganic nitrate can also reduce oxygen load during exercise35 and beetroot is increasingly being seen as an important element in sports and performance nutrition.

Beetroot are almost unique amongst vegetables in containing a group of red pigments know as betalins. These compounds are visually similar to the familiar anthocyanins found in many fruits but are never found together. Betalins are powerful antioxidants and as a result beetroot have been classed in the top ten vegetables. There is evidence, at least in animal models, that as a result of this high antioxidant activity beetroot has an inhibitory effect on skin and lung cancer.

Parsnips (*Pasinaca sativa*)

Parsnips are closely related to carrots and both are members of the *Apiaceae* family. Prior to the introduction of potatoes into Europe in the 16th century parsnips had a greater role to play as a staple. Parsnips are amongst the sweetest vegetables and were used as to provide sweeteners prior to the commercial growing of sugar beet.

Parsnips provide a god source of insoluble fibre. In animal studies Demonstrated that parsnip derived fibres improved intestinal function, helped reduce serum cholesterol and modulated blood glucose levels in the same way as conventional sources of fibres. Parsnips are also a valuable source of folate, calcium iron and magnesium.

Leaves-

Spinach, Lettue,Cabbage etc.

Spinach (*Spinacia oleracea*)

Common spinach, *Spinacia oleracea*, was long considered to be in the Chenopodiaceae family, but in 2003 the Chenopodiaceae family was combined with the Amaranthaceae family under the family name 'Amaranthaceae' in the order Caryophyllales. Within the

Amaranthaceae family there are now a subfamily Amaranthoideae and a subfamily Chenopodioideae, for the amaranths and the chenopods,

It consist of following health benefit.

- Very low in calories and fats (100 g of raw leaves provide just 23 cal). It contains good amount of soluble dietary fiber; no wonder greeny spinach is one of the vegetable source recommended in cholesterol controlling and weight reduction programs!
- Fresh 100 g of spinach contains about 25% of daily intake of iron; one of the richest among green leafy vegetables. Iron is an important trace element required by the body for red blood cell production and as a co-factor for oxidation-reduction enzymes *cytochrome-oxidases* during the cellular metabolism.
- Fresh leaves are rich source of several vital anti-oxidant vitamins like vitamin A, vitamin C; and flavonoid poly phenolic antioxidants such as lutein, zea-xanthin and beta-carotene. Together these compounds help act as protective scavengers against oxygen-derived free radicals and reactive oxygen species (ROS) that play a healing role in aging and various disease processes.
- Zea-xanthin, an important dietary carotenoid, is selectively absorbed into the retinal macula lutea in the eyes where it is thought to provide antioxidant and protective light-filtering functions; thus helps protect from "age related macular disease" (ARMD), especially in the elderly.
- Vitamin A is also required for maintaining healthy mucus membranes and skin and is essential for vision. Consumption of natural vegetables and fruits rich in vitamin A and flavonoids helps body protect from lung and oral cavity cancers.
- 100 g of Spinach provides 402% of daily vitamin-K requirements. Vitamin K plays vital role in strengthening bone mass by promoting osteotrophic (bone building) activity in the bone. It also has established role in patients with Alzheimer's disease by limiting neuronal damage in the brain.
- This greeny leafy vegetable also contain good amounts of many B-complex vitamins like vitamin- B6 (pyridoxine), thiamin (vitamin B-1), riboflavin, folates and niacin. Folates help prevent neural tube defects in the offspring.
- 100 g of farm fresh spinach has 47% of daily recommended levels of vitamin C. Vitamin C is a powerful antioxidant which helps body develop resistance against infectious agents and scavenge harmful oxygen free radicals.

- The leaves also contain good amount of minerals like potassium, manganese, magnesium, copper and zinc. Potassium in an important component of cell and body fluids that helps controlling heart rate and blood pressure. Manganese and copper are used by the body as a co-factor for the antioxidant enzyme *superoxide dismutase.* Copper is required in the production of red blood cells. Zinc is a co-factor in many enzymes that regulate growth and development, sperm generation, digestion and nucleic acid synthesis.
- It is also rich source of **omega-3 fatty acids**

Lettue *(Lactuca sativa)*

Botanically this marvelous, nutrition rich leafy green belongs to the daisy family of *Asteraceae.*

It consist of following health benefit.

- Vitamins in lettuce are plentiful. Fresh leaves are an excellent source of several Vitamin A and beta carotenes. Just 100 g of fresh, raw-lettuce provides 247% of daily vitamin A, and 4443 mcg of beta-carotene (Carotenes convert to vitamin A in the body; 2 mcg of carotene is considered equivalent to 1 IU of vitamin A). These compounds have antioxidant properties. Vitamin A is required for maintaining healthy mucus membranes and skin, and is also essential for vision. Consumption of natural fruits and vegetables rich in flavonoids helps to protect body from lung and oral cavity cancers.
- Zeaxanthin (1730 mcg per100) an important dietary carotenoid in lettuce is selectively absorbed into the retinal macula lutea where it is thought to provide antioxidant and protective light-filtering functions, thus it offers some protection against age related macular disease (ARMD) in the elderly.
- It is a rich source of vitamin K, Vitamin K has potential role in the increase of bone mass by promoting osteotrophic activity in the bone. It also has established role in Alzheimer's disease patients by limiting neuronal damage in the brain.
- Fresh leaves contain good amounts folates and vitamin C. Folates require for DNA synthesis and therefore, vital in prevention of neural tube defects in-utero fetus during pregnancy. Vitamin C is a powerful natural antioxidant; regular consumption of foods rich in vitamin C helps body develop resistance against infectious agents and scavenge harmful, pro-inflammatory free radicals.
- It also contain good amounts of minerals like iron, calcium, magnesium, and potassium which are very essential for body metabolism. Potassium in an important component of cell and body fluids that helps controlling heart rate and blood pressure. Manganese is

used by the body as a co-factor for the antioxidant enzyme *superoxide dismutase.* Copper is required in the production of red blood cells. Iron is essential for red blood cell formation.

- It is rich in B-complex group of vitamins like thiamin, vitamin B-6 (pyridoxine), riboflavins.

. Cabbage:

Cool season leafy vegetable belongs to the "brassica" family of vegetables,

It has following health benifit

- It is storehouse to many phyto-chemicals like *thiocyanates, indole-3-carbinol, lutein, zeaxanthin, sulforaphane* and *isothiocyanates*. These compounds are powerful anti-oxidants and known to help protect against breast, colon, and prostate cancers and help reduce LDL or "bad cholesterol" levels in the blood.
- Fresh cabbage is an excellent source of natural antioxidant, vitamin C. Provides about 61% of RDA, more than that of in the oranges. Regular consumption of foods rich in vitamin C helps body develop resistance against infectious agents and scavenge harmful, pro-inflammatory free radicals.
- It is also rich in many essential vitamins such as pantothenic acid (vitamin B5), pyridoxine (vitamin B-6) and thiamin (vitamin B-1). These vitamins are essential in the sense that our body requires them from external sources to replenish.
- It also contains good amount of minerals like potassium, manganese, iron, and magnesium. Potassium is an important component of cell and body fluids that helps controlling heart rate and blood pressure. Manganese is used by the body as a co-factor for the antioxidant enzyme, *superoxide dismutase.* Iron is required for the red blood cell formation.
- Cabbage is very good source of vitamin K, provides about 63% of RDA levels. Vitamin-K has potential role in bone metabolism by promoting osteotrophic activity in them. So enough vitamin K in the diet gives you healthy bones. In addition, vitamin-K also has established role in curing Alzheimer's disease patients by limiting neuronal damage in their brain.

Flower: Brocoli, Cauliflower

Broccoli

Botanically, the vegetable is the member of large *cruciferous* (*brassica)* family of vegetables.

It consist of following health benefit.

- Broccoli is very low in calories, provides just 34 cal per 100 g. However, it is rich in dietary fiber, minerals, vitamins, and anti-oxidants that have proven health benefits.
- Fresh Broccoli is a storehouse of many phyto-nutrients such as *thiocyanates, indoles, sulforaphae, isothiocyanates* and flavonoids like beta-carotene cryptoxanthin, lutein, and zeaxanthin. Studies have shown that these compounds by modifying positive signalling at molecular receptor levels help protect from prostate, colon, urinary bladder, pancreatic, and breast cancers.
- Fresh vegetable is exceptionally rich source of vitamin-C. Provides 89.2 mg or about 150% of RDA per 100 g. Vitamin-C is a powerful natural anti-oxidant and immune modulator, helps fight against flu causing viruses.
- It contains very good amounts of another anti-oxidant vitamin, vitamin-A. 100 g fresh head provides 623 IU or 21 % of recommended daily levels. Together with other pro-vitamins like beta-carotene, alpha-carotene, and zeaxanthin, vitamin A helps maintain integrity of skin and mucus membranes. Vitamin A is essential for vision and helps prevent from macular degeneration of retina in the elderly population.
- It is also a good source of minerals like calcium, manganese, iron, magnesium, selenium, zinc and phosphorus.
- Fresh broccoli heads are an excellent source of folates; contains about 63 mcg/100 g (Provides 16% of RDA). Studies have shown that consumption of fresh vegetables and fruits rich in folates during pre-conception and pregnancy helps prevent neural tube defects in the offspring.
- Broccoli leaves (green tops) are an excellent source of carotenoids and vitamin A; (provide 16000 IU of vitamin A per 100 g) contain these compounds several times more than in the roots.
- This flower vegetable is also rich source of other vitamin-K and B-complex group of vitamins like Niacin (vit B-3), pantothenic acid (vit.B-5), pyridoxine (vit.B-6) and riboflavin. The flower heads also have some amount omega-3 fatty acids.

Cauliflower

Botanically, it is a member of the cruciferous or brassicaceae family; has got similar nutritional and phyto-chemistry profile with broccoli and cabbage. Several cultivars exists other than common snow-white variety including green, orange, purple, and romanesco heads.

It consist of following health benefit.

- Very low in calories. 100 g of fresh cauliflower has only 26 calories. However, it is very low in fat and contains no cholesterol.
- Its florets contain about 2 g of dietary fiber per 100 g; providing about 5% of recommended value.
- Cauliflower contains several anti cancer phyto-chemicals like sulforaphane and plant sterols such as indole-3-carbinol which appears to function as an anti-estrogen agent. Together these compounds have proven benefits against prostate, breast, cervical, colon, ovarian cancers by virtue of their cancer cell growth inhibition, cytotoxic effects on cancer cells.
- Also, Di-indolyl-methane (DIM), a lipid soluble compound present abundantly in brassica group of vegetables has found effective as immune modulator, anti-bacterial and anti-viral compound by potentiating Interferon-Gamma receptors and its production. DIM has currently been found application in the treatment of recurring respiratory papillomatosis caused by the Human Papilloma Virus (HPV) and is in Phase III clinical trials for cervical dysplasia.
- Fresh cauliflower is excellent source of vitamin C; 100 g provides about 48.2 mg or 80% of daily recommended value. Vitamin-C is a proven antioxidant helps fight against harmful free radicals, boosts immunity and prevent from infections and cancers.
- It contains good amounts of many essential B-complex group of vitamins such as folates, pantothenic acid (vitamin B5), pyridoxine (vitamin B6) and thiamin (vitamin B1), niacin (B3) as well as vitamin K. These vitamins are essential in the sense that body requires them from external sources to replenish and required for fat, protein and carbohydrates metabolism.
- It is also good source of minerals such as manganese, copper, iron, calcium and potassium. Manganese is used in the body as a co-factor for the antioxidant enzyme

superoxide dismutase. Potassium is an important intracellular electrolyte helps counter the hypertension effects of sodium.

Bulbs: Onion,Garlic

Onion: ***Allium cepa*.**

Botanically, the vegetable belongs to the *Alliaceae* family .

It consist of following health benefit.

- Onions are very low in calories (just 40 cal per 100 g) and fats; but rich in soluble dietary fiber.
- Onion phyto-chemical compounds *allium* and *Allyl disulphide* convert to allicin by enzymatic reaction when the bulb disturbed (crushing, cutting etc). Studies have shown that these compounds have anti-mutagenic (protects from cancers) and anti-diabetic properties (helps lower blood sugar levels in diabetics).
- Laboratory studies show that *allicin* reduces cholesterol production by inhibiting *HMG-CoA reductase* enzyme in the liver cells. Further, it also found to have anti-bacterial, anti-viral, and anti-fungal activities.
- *Allicin* also decreases blood vessel stiffness by release of nitric oxide (NO); thereby bring reduction in the total blood pressure. It also blocks platelet clot formation and has fibrinolytic action in the blood vessels which, helps decrease overall risk of coronary artery disease (CAD), peripheral vascular diseases (PVD), and stroke.
- They are rich source of chromium, the trace mineral that helps tissue cells respond appropriately to insulin levels in the blood; thus helps facilitate insulin action and control sugar levels in diabetes.
- They are also good source of antioxidant flavonoid *quercetin*, which is found to have anti-carcinogenic, anti-inflammatory, and anti-diabetic functions.
- They are also good in anti-oxidant vitamin, vitamin-C and mineral manganese which is required as co-factor for anti-oxidant enzyme *superoxide dismutase*. In addition, *isothiocyanate* anti-oxidants in them help provide relief from cold and flu by exerting anti-inflammatory actions.
- Onions are also good in B-complex group of vitamins like pantothenic acid, pyridoxine, folates and thiamin. Pyridoxine or vitamin B-6 helps keep up GABA levels in the brain, which works against neurotic conditions.

Garlic (*Allium sativum)*

This root herb plant belongs to the family of *Alliaceae* .

It consist of following health benefit. Strong flavored, garlic cloves contain many noteworthy minerals, vitamins, anti-oxidants, and phyto-nutrients that have proven health benefits.

- Its bulbs contain organic thio-sulfinites such as *diallyl disulfide*, *diallyl trisulfide* and *allyl propyl disulfide* that can form allicin by enzymatic reaction, which is activated by disruption of bulb (like crushing, cutting etc).
- Laboratory studies show that allicin reduces cholesterol production by inhibiting *HMG-CoA reductase* enzyme in the liver cells.
- Allicin also decreases blood vessel stiffness by release of nitric oxide (NO); thereby bring reduction in the total blood pressure. It also blocks platelet clot formation and has fibrinolytic action in the blood vessels, which helps decrease the overall risk of coronary artery disease (CAD), peripheral vascular diseases (PVD) and stroke.
- Research studies also found that consumption of garlic is associated with possible decrease in the incidence of stomach cancer.
- *Allicin* and other essential volatile compounds in the garlic also found to have anti-bacterial, anti-viral, and anti-fungal activities.
- Garlic is an excellent source of minerals and vitamins that are essential for optimum health. The bulbs are one of the richest sources of potassium, iron, calcium, magnesium, manganese, zinc, and selenium. Selenium is a heart-healthy mineral, and is an important cofactor for anti-oxidant enzymes in the body. Manganese is used by the body as a co-factor for the antioxidant enzyme, *superoxide dismutase*. Iron is required for red blood cell formation.
- It contains many flavonoid anti-oxidants like carotene beta, zea-xanthin, and vitamins like vitamin-C. Vitamin C helps body develop resistance against infectious agents and scavenge harmful, pro-inflammatory free radicals.

Extract collected from *Allium sativium* for inhibition of *Aeromonas hydrophilia* and *Pseudomonas fluroscens at concentration 0.6mg/ml* (Muniruzzaaman.and Chowdhury,2004)

Hence the vegetables are the rich source of phyto chemicals,dietary fibers minerals and vitamins and their sigficance of the chemicals are given below

Dietary Fibre:

Dietary Fibre is a single term for a group of complex and generally difficult or impossible to digest carbohydrates. It is important for effective gut function. It is a rich source of nutrient for the many hundreds of different beneficial bacteria that colonise the large intestine and that have a variety of functions beyond digesting the food we consume. Dietary fibre contributes to the improved motility and health of the gut, reducing constipation and in some cases moderating more severe conditions such as IBD. Fibre plays an important role in reducing blood cholesterol and contributes to good heart health. As a slowly released form of energy some types create a feeling of fullness (satiety) and are useful in regulating insulin and glucose levels.

Folate:

Folate (or Folic Acid) assists with formation of red blood cells. It is particularly important in fetal development and foods high in folate taken before and during pregnancy can help reduce the risk of neural tube defects, spina bifida and anencephaly. It plays an important role in controlling homocysteine levels. Elevated homocysteine levels are associated with increased cardio vascular risk.

Potassium;

Potassium is an essential nutrient that helps regulate the osmotic pressure between cells in the body, the fluid that surrounds them and the circulation system. Diets rich in potassium can help maintain healthy blood pressure and contribute to heart health.

Vitamin A:

vitamin A is a naturally occurring compound which is particularly associated with good skin and eye health. It is also believed to contribute to good immune health.

Vitamin C:

vitamin C has health impacts linked to its redox properties that contribute to the body's antioxidant defence system. It is important in supporting healthy connective tissue, in particular gum and teeth. More generally it promotes healing and immune function. There is evidence that Vitamin C is essential in the absorption of iron and is involved in nerve signalling and hormone signalling

Other components

Carotenoids:

Carotenoids are a group of naturally compounds which are largely associated with yellow and orange fruits and vegetables. Of these perhaps the most important is beta Carotene which can be converted in the body to Vitamin A. It is commonly referred to as pro-vitamin A. Carotenoids are also powerful antioxidants. Oxidative stress has been linked with a number of degenerative diseases such as Alzheimer's and cancer. Carotenoids are also believed to contribute to immune health and like Vitamin A to skin and eye health.

Vegetable phyto chemicals as Nutraceuticals

- Feeding Cabbage and broccoli were effective in inhibiting DMBA-induced mammary tumor in rats. (**Wattenberg,1992)**
- Isothiocynic esters inhibited the growth of Ehrlich ascites carcinoma cells inoculated into mice. **(Daehnfeldt,1968)**
- Wattenberg and colleagues have found that isothiocynates and related compounds are effective inhibition of experimentally induced tumors and mammary gland, fore stomach.
- A number of thiocynate or isocyanides also appears to be effective inhibitor of carcinogenic binding to DNA in target tissue. **(Sousa and Marletta,1985)**

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