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Nutraceutical value of vegetables: A review

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Abstract

Vegetables play a significant role in the human diet. Vegetables are high in carbohydrates, proteins, vitamins and minerals, hence are considered as protective foods. They also provide health security on account of the presence of biologically active nutraceuticals or secondary metabolites of therapeutic importance. "Nutraceuticals are any substance that is a food or a part of a food and provides medical or health benefits, including the prevention and treatment of diseases." Vitamins, minerals, dietary fiber, organosulfur compounds (Glucosinolates and thiosulfides), and flavonoids are the most important phytonutrients in vegetables with biological activity against chronic health conditions. Each vegetable offers a unique combination of phytonutrients, so a wide variety of vegetables should be consumed in order to take all the health advantages. Phytoestrogens, carotenoids, limonoids, phytosterols, glucosinolates, polyphenols, flavonoids, isoflavonoids, and anthocyanidins are all examples of phytochemicals. They have a significant effect on the healthcare system and can offer medical health benefits including prevention and/or treatment of disease and physiological disorders. Many traditional vegetables are being found to have functional properties and novel food items with extra nutraceutical constituents are being produced. Therefore, in order to develop cultivars with better nutritional qualities, it is necessary to accurately identify the plant compounds that are vital for human nutrition and should be proposed to breed cultivars with enhanced nutritional qualities.

Keywords: Vegetables, nutraceutical, phytochemicals, therapeutic, human nutrition

Introduction

Vegetables are essential components of a balanced diet and contribute significantly to fulfilling the dietary demands of minerals and vitamins. Nutraceuticals are among the important constituents of quality attributes in vegetable crops. They make available functionally dynamic secondary metabolites which have a protective role against various health diseases and disorders, particularly chronic diseases (Gupta *et al.*, 2013) [12]. The term "Nutraceutical" was invented by merging the terms "Nutrition" and "Pharmaceutical" in 1989 by Dr. Stephen De Felice (Kalra, 2003) [14]. "Nutraceuticals are any substance that is a food or a part of a food and provides medical or health benefits, including the prevention and treatment of diseases." Phytonutraceuticals are plant-derived chemical compounds with health-promoting characteristics. Most phytochemicals contain antioxidant activity and hence safeguard our cells from oxidative damage. Let food be thy medicine, and medicine be thy food, as Hippocrates recited over 2,500 years ago, is surely a belief that is receiving overwhelming interest today (Thakur and Sharma, 2018) [36].

Reasons behind the expansion of nutraceutical market

- 1. Current population:** Global population is increasing at an enormous rate. India has overcome China and becomes the most populated country. Although the emphasis is given to increased production, the quality of products is also very important.
- 2. Health Trends:** Modernization is no more a boon to the people. Consumption of fast foods, unhealthy food habits and inadequate consumption of dietary nutrition is the main reason for deteriorating people's health.

It is assessed that 250 million Pre-schoolers are thought to be vitamin A deficient globally. Every year, between 2,50,000 and 5,00,000 children are expected to lose their vision due to vitamin A deficiency and half of them pass away within a year of losing their sight.

Importance of nutraceuticals

Nutraceuticals play a beneficiary role for all four major groups of people as depicted below:

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- **Consumers:** People are becoming more health conscious; these nutraceuticals act as natural self-medication and are beneficial for the aging population (>65 years ago) who has a major share of pharmacy dollars spent in the world.
- **Health care professionals:** For promoting new discoveries in FF (forced feeding)- a technical term where nutrient-rich food is fed to patients against their will, promote healthy eating
- **Government:** For regulating the framework of the pharmaceutical industry and for balancing rising healthcare costs.
- **Retailer/Marketers:** for searching new growth opportunities.

Properties of nutraceuticals

As the name suggests nutraceuticals must have health-promoting and disease-prevention properties which on one side provide useful nutrients in adequate quantity and on the other side inhibit diseases. Both the properties of nutraceuticals are discussed below.

Health Promoting: Phytochemicals found in bioactive plants, such as those found in vegetables, may have positive effects on human health by maintaining the health of various tissues and organs. A change in dietary patterns, such as an increase in consumption of fruits and vegetables are effective way of maintaining good health and reducing the incidence of chronic diseases. Various health-promoting properties of nutraceuticals are discussed below.

Antioxidant activity: Scavenging of free radicals, decreases the oxidative stress produced by oxygen free radicals (Kelsey *et al.*, 2010) ^[16].

Gastrointestinal Health: Probiotics and phytobiotics enhance the activity of lactobacilli. They produce bacteriocins that modify the receptors used by pathogenic microbes and provide resistance against them. Thus, help to activate the intestinal immune system increasing resistance to diseases (Kredal *et al.*, 2014) ^[20].

Reproductive Health: Beta carotene helps in maintaining epithelial tissue functioning in reproductive organs (Sarin *et al.*, 2012) ^[31]

Renal and Excretory Health: Lycopene, Zeaxanthin, and Lutein support appropriate microbial flora in the bladder and urinary tract by balancing calcium and oxalate crystal formation. These compounds also maintain calcium accumulation and promote healthy urinary oxalate excretion (Sarin *et al.*, 2012) ^[31].

Prolonging Life Span: Caffeic acid has effect on epigenetic modification. Epigenetic modification is the main reason for declined cellular functions noticed during aging as epigenome is liable for the functional use and consistency of the genetic information. Modification of epigenome enhances the aging of both dividing and non-dividing cells (Eisenberg *et al.*, 2009) ^[8]

Disease prevention: Nutraceutical-rich vegetables have been recognized to have a role in various diseases. They not only have the capacity to stop the growth of disease but also can

cure many ailments and improve the immune system. Role of nutraceuticals in disease prevention is discussed below.

Cardiovascular diseases: Flavonoids, Flavones and Flavonones intensity the capillaries that carry oxygen to all cells and inhibit angiotensin converting enzyme (ACE) responsible for high blood pressure. Polyphenols alter cellular metabolism and signalling which reduces arterial diseases. (Wildman, 2007) ^[13].

Diabetes: Omega 3 Fatty Acid, Lipoic Acid and Catechins promote insulin sensitivity. It is its ability to make use of glucose for energy reducing insulin tolerance and bringing blood sugar levels normal (Stephen, 2012) ^[33].

Cancer: Beta Carotene and Sulphur Compounds are strong antioxidants that scavenge free radicals and thus oppose the enzymes that encourage tumour growth (Sabita and Trygve, 2012) ^[30].

Obesity: Capsaicin and Vitamin secrete lipin (a protein secreted by adipose tissue) which controls frequent appetite, increases energy expenditure and reduces low density cholesterol (Kasbia, 2005) ^[15].

Oral disease: Polyphenols, Flavonoids and Proanthocyanidins heals the mucosal wounds and help to prevent inflammation of gums called Gingivitis (Gaur and Agnihotri, 2014) ^[10].

Alzheimer's disease: Lutein, Lycopene, Beta Carotene, Folic Acid and Vit B12 have antioxidant property. They reduce neuronal damage by minimizing oxidative stress. Folic acid and B-12 also reduces homocysteine amino acid level which helps in the progress of disease. Thus, they help to delay the development of dementia. (Klatte *et al.*, 2003) ^[19].

Parkinson's disease: CNS disorder in which dopamine-releasing cells are damaged affecting movement. Polyphenols, Vitamin C, Vitamin D, Vitamin E and Unsaturated Fatty Acid nutraceuticals help in rejuvenation of brain cells, blood circulation, improving memory function and hormonal secretion (Mythri *et al.*, 2015) ^[24].

Eye disorders: Lutein, Carotenoids, Flavonoids, Vitamin E, Zeaxanthin and Ascorbic Acid improves eyesight. Carotenoids on consumption are converted to retinol which inhibits the growth of clumps. Also, it deposits in the retina and improve vision, in another sense reducing cataract formation (Khan *et al.*, 2014) ^[17].

Phytonutrients and Nutraceutical compound in vegetables: Based on their protective properties as well as their unique physical and chemical properties, phytonutrients can be categorized into various classes. It is crucial to keep in mind that all phytonutrient classes must be ingested for a sound and healthy body. Focusing on nutraceuticals increases the possibility of intriguing, fresh, and novel business prospects. The significant phytonutrients and their beneficial therapeutic properties are listed below.

1. Carotenoids

These are lipid-soluble, yellow-orange-red pigments.

Carotenes and xanthophylls are members of the carotenoid family. There are about 600 carotenoids found in nature. Carotenes are 40-carbon tetraterpenes that lack hydroxyl or

keto groups (beta carotene), whereas xanthophylls include carotenoid alcohols and keto carotenoids such as cryptoxanthin, canthaxanthin, zeaxanthin, and astaxanthin.

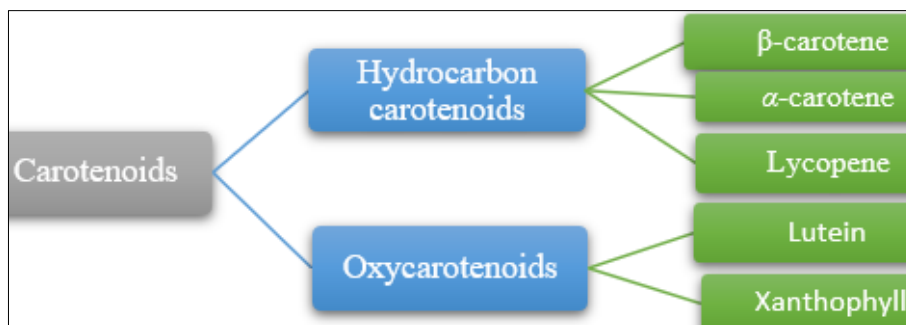


Fig 1: Classification of Carotenoids

1.1 β-carotene: It is the precursor of Vitamin A. β-carotene protect cells from lipid peroxidation (oxidative degeneration of lipids) & membrane damage. It also reduce the oxidative stress all this light puts on our eyes. It can sharpen your ability to see in the darkness a little. The carotenes also

augment immune response and can protect skin cells against UV radiation (Mahima *et al.*, 2014) ^[2]. Carrot major source of β-carotene providing 17% of the total vitamin A consumption (Arscott and Tanumihardjo, 2010) ^[2].

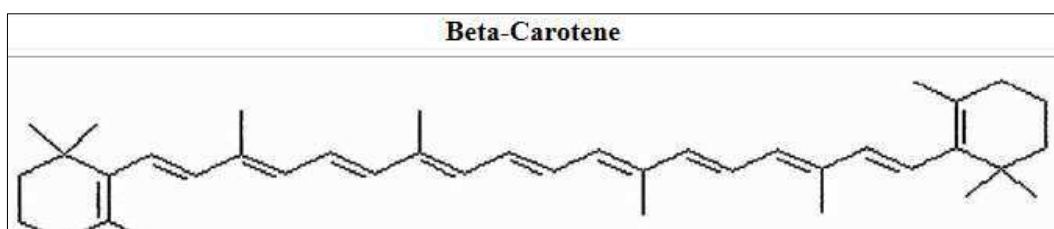


Fig 2: Chemical structure of Beta- Carotene

Table 1: β- Carotene content of foods

Food	Content(mg/100g)
Carrots, raw	18.3
Sweet potatoes, cooked	9.5
Pumpkin, canned	6.9
Carrots, cooked	8
Kale, cooked	6.2
Spinach, raw	5.6
Spinach, cooked	5.2

1.2 Lycopene-It acts as a precursor in the production of -

carotene. Lycopene is a particular inhibitor of cancer cell proliferation, which is controlled by the physiological process known as the cell cycle (Kim *et al.*, 2003) ^[18]. It also causes the Phase II enzyme to be activated, which aids in the removal of carcinogenic and toxic substances from human bodies. Lycopene is also a powerful antiproliferative, anticancer, anti-inflammatory, cognition-improving, and cholesterol-reducing drug (Gunasekera *et al.*, 2007) ^[11]. Tomatoes (3mg/100g), watermelon (4.9 mg/100g), and Asiatic carrot (0.65-0.78 mg/100g) are among the best-known sources of lycopene.

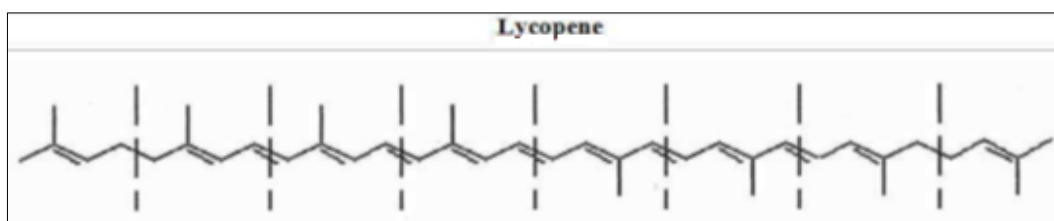


Fig 3: Chemical structure of Lycopene

1.3 Lutein -It is a very popular carotenoid. Lutein helps our eyes by providing nutritional support; it additionally safeguards the retina from ultraviolet radiation by fighting against free radicals that might injure the eyes. The most commercially fascinating source is marigold (*Tagetes erecta*),

where lutein is mostly found esterified with saturated fatty acids such as lauric, myristic, palmitic, and stearic acid (Singh and Devi, 2015). Green leafy vegetables, broccoli (2.4 mg/100g), spinach (12.9 mg/100g), kale (15.8 mg/100g), and lettuce are high in lutein.

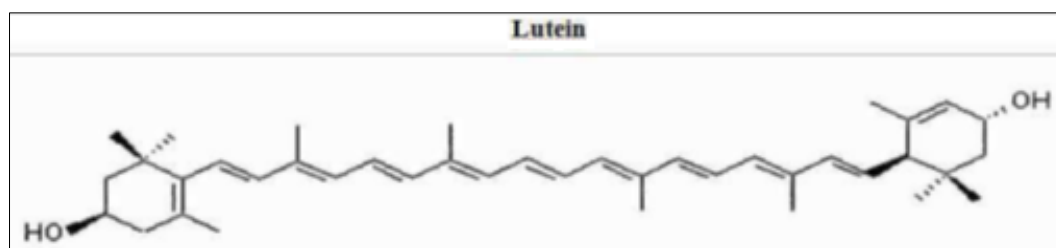


Fig 4: Chemical structure of Lutein

1.4 Xanthophyll: The xanthophyll group includes zeaxanthin, cryptoxanthin, and astaxanthin. Xanthophylls serve to protect vitamins A, E, and other carotenoids from oxidation. Xanthophyll especially canthaxanthin penetrates the skin and protects it from sunshine. Furthermore, it aids in the prevention of macular degeneration by preventing blue light from reaching the retina's structure and lowering the risk of light-induced oxidative damage, which is the major cause of vision impairment in persons over the age of 50. (Krinsky and colleagues, 2005). It has been demonstrated that cryptoxanthin protects female reproductive tissues, particularly uterine and cervical tissues. Zeaxanthin is found in abundant in spinach, pumpkin and winter squash.

2. Phenols: Phenols comprise a wide class of phytonutrients. They protect tissues from oxidative damage and inhibit the enzymes that induce inflammation in humans. Therefore, avoid the conversion of chemical compounds into carcinogens and prevent mutations Tangney and Rasmussen (2013) [35]. Also, the phenols prevent platelets from clumping by blocking certain enzymes that induce inflammation and, most likely, by modifying the prostaglandin pathways. Under the phenolic category, the major subclasses are flavonoids, anthocyanidins, and isoflavones. Eggplant (*Solanum melongena* L.) is the vegetable with the highest phenolic content and is regarded as a model vegetable crop for improving nutraceutical quality. Chlorogenic acid (CGA) is the primary phenolic component found in eggplant. Stommel and Whitaker (2013) [34] report that CGA exhibits anti-oxidant, anti-carcinogenic, anti-inflammatory, anti-obesity, cardioprotective, and neuroprotective effects.

2.1 Flavonoids: Flavonoids are the primary active nutraceutical compounds found in plants. They function as effective antioxidants and metal chelators. They have hepatoprotective, anticarcinogenic, and anti-inflammatory characteristics, thereby decreases the production of ROS (Reactive Oxygen Species) by inflammatory cells. The flavonoids inhibit the Angiotensin-Converting Enzyme (ACE), which raises blood pressure. Flavonoids protect the

vascular system by blocking numerous specific enzymes of the cardiovascular system. By inhibiting aldose-reductase enzyme activity, these may check the formation of cataracts in those with inborn abnormalities in sugar metabolism, such as diabetes, (Dam *et al.*, 2013) [7]. Onion and garlic contain bioflavonoid and quercetin, which provide protection against cancer and heart disease.

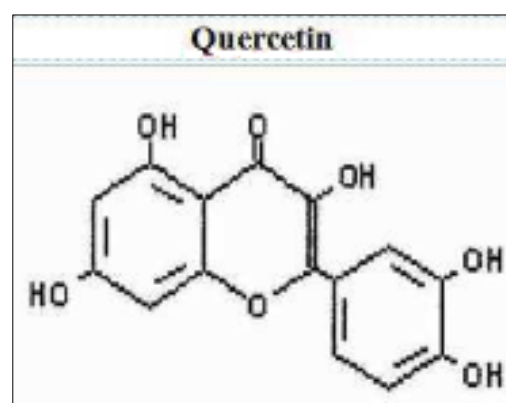


Fig 5: Chemical Structure of Quercetin

2.2 Anthocyanins

It gives flowers and fruits colours like blue, purple, red, and orange. The term is derived from two Greek words that signify "flower" and "dark blue" rather than the typical blue-green hue we normally associate with cyan. According to research by Jeong *et al.* (2013) [18], anthocyanins prevent the oxidative damage caused by free radicals and so offer a defence against cancer and cardiovascular disease. By consuming enough anthocyanins, the risk of coronary artery disease among humans is reduced (Cassidy *et al.*, 2013). Brinjal, red cabbage, sweet potatoes, red radish, purple cauliflower, broccoli, and black/purple carrots are significant vegetable sources (Bailon *et al.*, 2004) [9]. Nasunin, the main anthocyanin present in purple brinjal, has a significant level of antioxidant activity. (Noda *et al.*, 2000) [25]. Amount of anthocyanin in different vegetables is shown below in table.

Amount of anthocyanin in different vegetables

Crop	Anthocyanin (mg/100g)
Red Cabbage	322
Red Radish	100-154
Red Onion	23.3-48.5
Black carrot	520

2.3 Isoflavones

Mostly found in beans and other legumes. Broad bean is a good source of various phytonutrients such as isoflavone and plant sterols. The role of isoflavones is very similar to

flavonoids and has the ability to block the enzymes that promote growth of the tumors. People who take plenty of beans have a low risk of developing breast, uterine, and prostate cancer. (Arya *et al.*, 2019) [3].

3. Glucosinolates

These are commonly found in Cruciferae plants and activate detoxifying enzymes in the liver and white blood cells, thus boosting in immunity. When vegetables containing glucosinolates are sliced, they are converted to isothiocyanates (which contain sulphur) and indoles (which have no sulphur). Isothiocyanates are (-N=C=S) chemicals that contribute to the pungency of horseradish, radish and mustard. Isothiocyanates, dithiolthiones, and sulforaphane are glucosinolates biotransformation products that have been associated in hindering enzymes that trigger cancer growth in the liver, lung, breast, and gastrointestinal tracts (Baskar *et al.*, 2012) [5]. Watercress has a harsh flavour due to phenethyl isothiocyanate. It suppresses carcinogenesis by polycyclic aromatic hydrocarbons and promotes apoptosis by activating caspase-8, which is especially effective against nitroamines found in tobacco smoke (Lanzotti, 2006) [22]. Sulforaphane, which is abundant in broccoli, promotes apoptosis as well as arresting of cell cycle in cancer cells. Additionally, It generates D-glucuronolactone, a powerful breast cancer inhibitor, and destroys *Helicobacter pylori* bacteria, which cause stomach ulcers and gastric cancer (Alrawaiq and Abdullah, 2014) [1]. The human papillomavirus (HPV), which can cause uterine cancer, is inhibited by indole-3-carbinol. I-3-C also inhibits estrogen receptors in breast cancer cells thus reducing CDK6 (Cyclin-dependent kinase - 6) and increasing p21 and p27 in prostate cancer cells. (Weng *et al.*, 2008) [38].

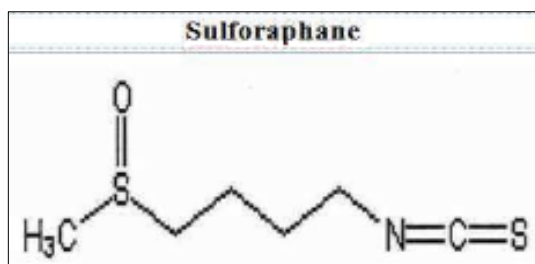


Fig 6: Chemical structure of Sulforaphane

Table 3: Types of glucosinolates along with major sources

Types of Glucosinolate	Major sources
Isothiocyanate	Cauliflower, Cabbage and Knolkhol
Sulforaphane	Broccoli-Most important in preventing cancer
Glucobrassicin	Cabbage and Broccoli
Gluconasturtiin	Cabbage
Sinigrin	Brussels sprout and Broccoli
Indole-3- carbinol	Cabbage

3. Antioxidant Vitamins

Antioxidant vitamins include vitamins such as vitamin C and vitamin E. These vitamins work both alone and collaboratively to prevent oxidative processes that contribute to a variety of degenerative diseases such as cancer, cardiovascular disease, cataracts, and others. Ascorbic acid, often known as vitamin C, provides hydrogen atoms to lipid radicals thus inhibits singlet oxygen radicals and eliminates molecular oxygen. (Pehlivan, 2017) [27]. Major source of Vitamin -C are sweet pepper, tomato, broccoli, cabbage, cauliflower, brussel sprouts etc. Vitamin E acts as an antioxidant at the cellular level, prevents peroxidation of

easily oxidisable vitamins and polyunsaturated fatty acids and preserves unsaturated fatty acids (Rizvi *et al.*, 2014) [29]. Vitamin E and selenium work together to prevent lipid peroxidation. Major sources of Vitamin-E are green leafy vegetables, peas, beans, turnip green, pumpkin and red sweet pepper.

4. Thiosulfonates

It is made up of organosulfur compounds found in onions, garlic, and cruciferous vegetables (cabbage, turnips, and mustard family members). Mercaptocysteines and allylic sulphides are examples of thiols. Allylic sulphides are released when the plant is chopped or squashed, and they are responsible for the strong aroma of garlic and onion. Garlic's antimicrobial properties were discovered by Louis Pasteur in 1858. Later, in 1932, Albert Schweitzer used garlic to treat amoebic dysentery in Africa. It also has antimutagenic, anticarcinogenic, immune boosting and cardiovascular protecting characteristics (Vazquezand Miatello, 2010) [37]. Propanethial-S-oxide, which is emitted from chopped onions, is transformed to sulfuric acid, causing an intense sensation of burning in the eyes. The enzyme alliinase found in onions is destroyed after cooking thus, inhibiting the synthesis of beneficial sulphur compounds. (Lanzotti, 2006) [22]

5. Lipoic Acid and ubiquinone

These antioxidants effectively neutralise hydroxyl radicals. They are useful in the liver's detoxification processes because they can protect catalase and glutathione. Additionally, lipoic acid can work in both the lipid and aqueous aqueous forms and can protect vitamins E and C. (Arya *et al.*, 2019) [3].

6. Phytosterols: Green and yellow veggies as well as their seeds contain phytosterols. These make the removal of cholesterol from the body easy by effectively competing with dietary cholesterol absorption from the intestines. Thus, these are beneficial in minimizing the risk of cardiovascular ailments (Awaisheh *et al.*, 2013) [4]. Additionally, they contribute to prevent the growth of cancer in a variety of organs, particularly the colon, breast, and prostate glands.

7. Isoprenoids: Isoprenoids neutralize free radicals by grabbing them as they try to attach to lipid membranes and passing them on to other antioxidants.

8. Prebiotics: Prebiotics are dietary substances that have a favourable effect on the host by modifying the composition or metabolism of the gut microbiota (Singh and Devi, 2015). These are short-chain polysaccharides with distinctive chemical structures that humans cannot digest; specifically, fructose-based oligosaccharides that occur naturally in food or are added to food. Fructo-oligosaccharides are abundant in vegetables such as chicory roots, tomatoes, and alliums.

9. Indoles: It contains phytonutrients that interact with vitamin C and bind with chemical carcinogens in complexes. These also contribute in the activation of detoxification enzymes. The acid in the stomach helps in the synthesis of indole biotransformation products such as ascorbigen (Arya *et al.*, 2019) [3].

Table 3: Phytochemical from vegetables used as Nutraceuticals (Rai *et al.*, 2012) [28]

Sr. No.	Chemical compounds	Plant source	Properties
	Allicin (organosulfur compound)	Garlic, onion, parsnip	Antifungal, antimicrobial and antioxidant; used, to treat arteriosclerosis.
	Apigenin	Cabbage, celery, lettuce	4',5,7-trihydroxyflavone is a flavone that is the aglycone of several glycosides.
	Beta carotene	Carrots, pumpkins, sweet potatoes, winter squash, broccoli, spinach and kale	Anti-aging; anti-cancerous; improve lung function and reduce diabetes and associated problems.
	Betainin	Beets, chard	Natural colouring agent used in ice cream
	Capsaicin or trans-8-methyl-N-vanillyl-5 nonenamide	Red chilli	Topically used for pain treatment and as a digestive aid when taken internally; antioxidant and antiallergic.
	Carnitine or L-Carnitine	Shatavari	It is liable for transporting long-chain fatty acid groups into the mitochondria.
	Caffeic acids	Carrot	Lipoxygenase inhibitor that prevents the formation of leukotrienes from arachidonic acid.
	Tocopherol	Broccoli, carrot, celery, onion	It is a fat-soluble antioxidant that prevents the formation of reactive oxygen species when fat is oxidised.
	Curcumin	Turmeric	Anticancerous; antioxidative
	Plant Glucosamine	Lettuce, peas, cabbage	Chondroitin and glucosamine are components of natural cartilage that serve as a cushion between the joints.
	Glutathione (GSH)	Cruciferous vegetables	A tripeptide that has antioxidant capabilities by shielding cells from free radical damage.
	Hesperetin	Green vegetables	Anti-inflammatory
	Saponin	Soybeans, beans, other legumes	Reduces blood cholesterol
	Quercetin	Onion, broccoli, cabbage, lettuce, tomato	Beneficial for the treatment of progressive Alzheimer's disease; used in cancer and other diseases such as cardiovascular disease.
	Luteolin	Cauliflower, celery, sweet pepper	A carotenoid with ocular benefits.
	Ferulic acid	Turnip	Have anti-oxidizing characteristics that can moisturize skin, help with light and weather damage, and may help reduce age spots.
	Sulphoraphane	Broccoli	Used against breast cancer
	Proanthocyanin	Red cabbage, eggplant	Aid in urinary tract infections by preventing germs like <i>E. coli</i> from adhering to the urinary tract wall.
	Resveratrol	Red onion	Anti-inflammatory inhibits the COX-1 enzyme; decreases blood cell adherence to vessel walls; has been found to diminish skin and breast cancer.
	Butylphthalide	Celery	It is used to treat high blood pressure
	Zeaxanthin	Carrot, celery, kale, lettuce	It is used to promote eye health and to treat age-related macular degeneration.

Table 4: Availability of phytochemicals in major vegetable crop variety (Parulekar *et al.*, 2019) [26]

Crop	Varieties	Phytochemicals	Availability
Carrot	Pusa Asita	Anthocyanin	339.29 mg/100 g
	Pusa Rudhira	Lycopene	10.77. 55 mg/100 g
	Pusa Nayanjyoti	Beta carotene	7.55 mg/100 g
	Pusa Vrishti	Beta carotene	1.44 mg/100 g
	Pusa Yamdagni	Lycopene	4.05 mg/100 g
	Pusa Meghali	Lycopene	4.60 mg/100 g
			Lycopene
Radish	Pusa Jamuni	Anthocyanin	
	Pusa Gulabi	Lycopene	
Tomato	Pusa Uphar	Vitamin C & Lycopene	
	Pusa Rohini		
	Pusa Hybrid -2		
Paprika	KTPL-19	Capsanthin	
Brinjal	Punjab Sadabahar	Anthocyanin	
Beet leaf	Pusa Bharati	Ascorbic acid	
	Pusa Jyoti	Vitamin A, C, Fe, Ca	
Vegetable Mustard	Pusa Sag-1	Carotene & Vitamin C	
Red cabbage	Red Acre	Anthocyanin	30.1-98.3µ mol/100 g
Bitter gourd	Pusa Aushadi	Beta carotene	
Cauliflower	Pusa Betakesari	Beta carotene	800-1000 µg/100 g
Pumpkin	Pusa Hybrid-1	Vitamin A	3331 IU/100 g
	Pusa Vikas		

	Arka Chandan		
Water melon	Arka jyoti Durgapura lal Durgapura kesar	Carotene	
Onion	Pusa Ridhi Pusa Madhvi Pusa Soumya	Quercetin	107.42 mg/100 g 101.2 mg/100 g 74.6 mg/100 g
Garden pea	Pusa Pragati Arkel	Protein	
French bean	Pusa Parvati	Protein	
Broad bean	Pusa Sumeet	Protein	
Lablab bean	Pusa Sem-2 Pusa Sem3	Protein	
Sweet potato	BhuSona Bhu Krishna Sree Kanak	β -carotene Anti-oxidants Anthocyanin	14.0 mg 100 g-1 90.0 mg 100 g-1
Potato	MS/8-156 (Kufri Neelkanth)	Anthocyanins Carotenoids	100 μ g/100 g fresh wt. 200 μ g/100 g fresh wt.
Tapioca	Sree Visakhm	Carotene	466 IU 100 gm-1
Chenopod	Bathua Local Pusa Bathua -1	Ascorbic acid Ascorbic acid	60.6 mg/100 g fw. 23.0 mg/100 g fw.
Spinach	PS -1	Ascorbic acid	51 mg/100 g fw.
Amaranthus	Pusa Lal Chaulai Pusa Kiran	Carotenoids Carotenoids	69.4 mg/100 g fw. 59.0 mg/100 g fw.
Basella	Local Red Local Green	Carotenoids	10.2 mg/100 g

Conclusion

Indigenous people have a long history of using medicinal plants to cure a variety of illnesses. Recently, nutraceuticals have been identified as viable alternatives for the treatment and prevention of numerous ailments. Due to their safety, effectiveness, and possible nutritional and therapeutic value, they have attracted a lot of attention. Vegetables, which are low in calories and high in vitamins, minerals, antioxidants, and phytochemicals, are among the natural dietary supplements. They are an important component of the human diet and a significant source of biologically active nutraceuticals. Lycopene from tomatoes, lutein from kale, carotenoids from carrots, etc. are some popular photo-nutraceuticals. Most nutraceuticals derived from vegetables are claimed to have a variety of therapeutic advantages. For instance, lutein and zeaxanthin prevent cataracts and macular degeneration; beta-carotene and lycopene safeguard the skin from UV damage; and lutein and lycopene may improve cardiovascular health. The significance of different phytochemicals in the prevention of chronic degenerative diseases needs to be further studied. A wider range of food ingredients allows food designers to offer meal options that suit the public's expressed need for healthy cuisine.

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