

Vegetables: A Wealthy Source of Phytochemicals and Nutraceuticals

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Introduction

Increasing population, inadequate food coupled with malnutrition and various kinds of diseases are bigger challenges in developing countries like India. Along with these we can also include recent pandemic COVID-19, In order to get cure or to prevent all these kinds of uncertainty usually we go with drug. But now a day's people have become more conscious about the health so they are preferring natural available materials for the prevention and curing of disease, which includes Nutraceuticals.

Nutraceuticals have been commercially explored recently as sustainable alternatives for the control and prevention of large number of diseases. They have received considerable attention because they are safe, efficacious and have potential nutritional value as well as therapeutic effects. Vegetables being major source of our diet, these are low in calories are packed with vitamins, minerals, antioxidants and phytochemicals hence acts as most important source of biologically active nutraceuticals. Nearly 2/3rd of world population that is 6.1 billion people believe in healing power of plant-based material, because of their affordability, availability, and safety and traditional cures (National geographic magazine, 10 July 2020).

Classification of vegetables based on color groups and nutritional importance (Rai et al 2012)

- 1. Green vegetables:** These vegetables contain like broccoli, cabbage, asparagus, pea, cabbage, leafy vegetables etc comes under this category and these vegetables contains chlorophyll, fiber, lutein, zeaxanthin, calcium, iron, Vit-C etc. These are helpful to us as they reduce the risk of cancer, decreases the blood pressure, low density lipo proteins, improves retinal health, vision and fights against free radicals

2. **White vegetables:** This group of vegetables contains beta glucans, epigallocatechin gallate it is found in garlic and it is also called as garlic acid helps in weight loss and prevents heart diseases, SDG and ligans are also found in garlic. These provide powerful immune system. The phytochemicals present in these white vegetable helps in activation of natural killer B and T cells, and reduce the risk of colon cancers. Natural killer cells are type of white blood cells which are the component of innate immunity, these cells are activated by the phytochemicals present in the vegetables and they play a major role in host rejection in both tumor and virally infected cells, in absence of antibodies (Lee et al., 2021). This reduces the risk of hormone related cancer by balancing the hormone level in the body.
3. **Red colored vegetables:** Tomato, cherry tomato, red capsicum is the major source of the red pigment that is Lycopene these red colored vegetables also contains ellagic acid, quercetin, allicin etc. By the consumption of these vegetables reduces the risk of cancer by preventing tumor formation, lower blood pressure, LDL cholesterol levels. The main role of Lycopene is that they act as antioxidants by scavenging free radicals.
4. **Yellow/ orange vegetables:** These vegetables like carrot, pumpkin, squashes, yellow capsicum, yellow cherry tomato etc. belonging to this group are rich in beta carotene pigments contains zeaxanthin, flavanoid, lycopene, potassium and Vitamin C. The phytochemicals present in these vegetables reduces age related cell degeneration, prevents from lung cancer, required for retinal health, decreases LDL cholesterol, blood pressure, help full in formation of collagen fibers in the joints, fight against harmful free radicals and useful for encouraging alkaline balance in our body
5. **Blue/ purple vegetables:** These vegetables like brinjal, purple broccoli, purple cabbage etc are rich in anthocyanin pigments, lutein, zeaxanthin, resveratrol, Vitamin C, fiber, flavonoids, ellagic acid, nasunin and quercetin. The phytochemicals present in these vegetables support retinal health, decreases over LDL cholesterol, boost immune system activity, acts as anti-carcinogen and limits the activity of cancer cells.

Gomati et al. (2017) have suggested some important vegetables that can be used as a source of vitamins and minerals that are represented here

Carbohydrates	Sweet potato, potato and cassava
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Protein	Pea, Lima bean, French bean and cowpea
Vitamin A	Carrot, spinach and pumpkin
Vitamin B1	Tomato, chilli, garlic, leek and pea
Vitamin C	Chilli, capsicum, cabbage and drum stick
Calcium	Hyacinth bean, amaranthus, palak
Iron	Amaranthus, palak, spinach, lettuce, bitter gourd
Phosphorus	Pea, limabean, taro, drumstick leaves
Vitamin B5	Palak, amaranthus, bitter gourd, pointed gourd
Iodine	Tomato, sweet pepper, carrot, garlic, okra
Sodium	Celeryt, green onion, Chinese cabbage and radish

The nutraceutical role of popular vegetables these are given here

- 1. Tomato:** It is a good source of Lycopene (60% to 64%), Phytotene (10% to 12%), Neurosporene (7% to 9%), top contributors of potassium, excellent source of ascorbic acid (200 mg/kg), major source of vitamin C next to citrus and contains small but significant amounts of lutein (1 - 2 mg/kg). Hence these compounds will help in prevention of the stomach and rectal cancers.
- 2. Bell pepper:** It is rich in Vit C (1-2g/Kg) that prevents cell damage supports immune functions, Vit K promotes blood clotting, lycopene prevents bladder, pancreas and cervix cancer, beta cryptoxanthin prevents lung cancer and red bell pepper has more nutrients than green.
- 3. Cucumber:** It contains small amount of Vitamin C, pro vitamin A as β -carotene in the skins, fiber in skin and seeds, and potassium. Source of silicon they are important for connective tissues, skin, hair and nails. It is one of only a few foods to contain silicon.
- 4. Onion:** Chen *et al.* (2011) have reported that onion exhibits strong antiviral activity and contains good amount flavanoides (flavonols, kaempferol, and anthocyanins) and organosulfur compounds (Quercetin and allicin) associated with viral infection. Quercetin, a main flavanol compound in onion and garlic, has reported to inhibit the translation and replication of RNA of many human viruses. The human virus like Polio-virus (Castrillo and Carrasco, 1987), Rhinovirus (Hellen, *et al.*, 1989), SARS-CoV (Chen *et al.*, 2006), Hepatitis C virus (Gonzalez *et al.*, 2009), Ebola virus

(Qiu *et al.*, 2016), Enterovirus (Yao *et al.*, 2018) activity has been affected in the host cell by quercetin derivatives. These bioactive compounds can hinder virus attachment to the host cell and alter transcription and translation of viral genome inside the host cell and thereby inhibits the viral assembly in host thereby prevents from viral diseases.

5. **Carrot:** The β -carotene content of these carrots will prevent the infection to liver caused by hepatitis c virus and help in boosting immune function by increasing leucocytes (These leucocyte cells are involved in detecting the foreign bodies and eliminate them from the body) in the body.
6. **Radish:** The peppery taste of radishes is evidence of the presence of glycosylates/isothiocyanates. Sulforaphane is helpful in treating *Helicobacter pylori* infection and blocking gastric tumor formation (Fahey *et al.*, 2002)
7. **Beetroot:** Rich in bioactive compounds including betalains (betacyanins and betaxanthins), flavonoids, polyphenols and saponins. It also contains diverse mineral elements like calcium, magnesium, copper, iron, zinc and manganese (Singh and Hathan, 2014). Effective against chronic inflammation such as liver disease, arthritis and cancer
8. **Lettuce:** Good source of vitamin C, folate, fibre and pro vitamin A (in the form of β -carotene). Carotenoids β -carotene and lutein/zeaxanthin helpful in protecting both the macula lutea of the eye and the skin against the photooxidative damage (Sies and Stahl, 2003)
9. **Celery:** It contains bioactive compounds such as phthalides, are responsible for the distinctive smell and taste of celery. Celery is used in treating inflammatory condition like gout and arthritis. Contains flavanoid apigenin.
10. **Crucifers:** Glucosinolates protect against lung cancers (Traka, 2010). And the bioactive compound helps in boosting the immune system.



Conclusion

Presently, people are becoming more health conscious and preferring Phyto nutraceuticals and functional foods over pharmaceuticals to improve their health and prevention of diseases. As a quote says that prevention is better than cure eating having vegetables in our daily diet which are source of these essential phytochemicals, they provide us enough nutraceuticals required for our body to boost immune system and keeps us away from many diseases.

Nutraceutical is growing health care industry in India. Surely it will be playing important role in developments of future therapeutics but it depends on control of purity, efficacy and safety. Hence collaborative research work pharmaceutical, food, chemical industry is much required. Your health is your greatest wealth so eat healthy live healthy.

References

- Lee, J., Han, Y., Wang, W., Jo, H., Kim, H., Kim, S., Yang, K.M., Kim, S.J., Dhanasekaran, D.N. and Song, Y.S., 2021. Phytochemicals in cancer immune checkpoint inhibitor therapy. *Biomolecules*, 11(8), p.1107.
- Chen L, Li J, Luo C, Liu H, Xu W, Chen G et al. Binding interaction of quercetin-3- β -galactoside and its synthetic derivatives with SARS-CoV 3CLpro: Structure-activity relationship studies reveal salient pharmacophore features. *Bioorganic and Medicinal Chemistry*. 2006; 14:8295-8306.
- Hellen CUT, Kraeusslich HG, Wimmer E. Proteolytic processing of polyproteins in the replication of RNA viruses. *Biochemistry*. 1989; 28:9881-9890



- Qiu X, Kroeker A, He S, Kozak R, Audet J, Mbikay M, Chrétien M. Prophylactic Efficacy of Quercetin 3- β - O - d-Glucoside against Ebola Virus Infection. *Antimicrobial Agents and Chemotherapy*. 2016; 60:5182-5188.
- Gonzalez O, Fontanes V, Raychaudhuri S, Loo R, Loo J, Arumugaswami V et al. The heat shock protein inhibitor Quercetin attenuates hepatitis C virus production. *Hepatology*. 2009; 50:1756-1764
- Yao C, Xi C, Hu K, Gao W, Cai X, Qin J et al. Inhibition of enterovirus 71 replication and viral 3C protease by quercetin. *Virology Journal*. 2018; 15:116-116.
- Fahey JW, Haristoy X, Dolan PM, Kensler TW, Scholtus I, Stephenson KK et al. Sulforaphane inhibits extracellular, intracellular, and antibiotic-resistant strains of *Helicobacter pylori* and prevents benzo[a]pyrene induced stomach tumors. *Proceedings of the National Academy of Sciences of the United States of America*. 2002; 99:7610-7615.
- Singh B, Hathan BS. Chemical composition, functional properties and processing of beetroot—a review. *Int J Sci Eng Res*. 2014; 5(1):679-684.
- Sies H, Stahl W. Non-nutritive bioactive constituents of plants: lycopene, lutein and zeaxanthin. *International Journal of Nutrition Research*. 2003; 73:95-100.
- Traka M. Broccoli Consumption Interferes with Prostate Cancer Progression: Mechanisms of Action. *Acta Horticulturae*. 2010; 867(5):19-25