Medicinal properties of vegetable crops

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Abstract
Vegetables play a vital role in human nutrition and health by providing nutrients, vitamins, antioxidants, phytosterols, and dietary fiber. In the developing world, vegetable farming is a considerable part of the agricultural economy of different nations. Due to the potential health benefits provided by bioactive medicinal molecules such as lycopene, resveratrol, tannins, indoles, glucosinolates, polyphenols, phytoestrogens, carotenoids and anthocyanins etc; vegetables are receiving increased attention now a days. These bioactive medicinally important natural compounds present in vegetables offers various health benefits like prevention of cardiovascular disease, cancer and other diseases. Chlorogenic acid and nasunin present in brinjal have anti carcinogenic, anti-obesity, and anti-diabetic properties. Lycopene present in tomato, watermelon and carrot helps to protect against cancer and fight against infection. Allylic, allyl propyl disulfide and di-allyl disulfide present in onion and garlic etc., help to protect against certain cancers and heart disease; and also acts as immune-booster. Crucifers are the important source of sulforaphane which have anti-cancer property. Flavonoids (isoflavones) rich in beans lower the cholesterol and protect against cancer. Curcubitacin present in cucurbit have anti-inflammatory and cardiovascular effects. Hence this article discusses about different bioactive compounds present in the vegetable crops and their medicinal properties.

Keywords: Antioxidants, vegetables, phytochemicals, laxative, healing

Introduction
Vegetables are considered to be protective foods since they contain low calories and higher vitamins and minerals. The presence of bioactive compounds like phytochemicals offers the vegetables medicinal values. The phytochemicals present in vegetables include carotenoids, phenolic compounds (Flavonoids, phytoestrogens, phenolic acids), phytosterols and phytostanols, tocotrienols, organo-sulfur compounds (Allium compounds and glucosinolates) and non-digestible carbohydrates (Dietary fiber and prebiotics). These phytochemicals function as antioxidants, antibacterial compounds, enzyme stimulators, etc. They also enhance health, modulate immunity and thereby prevent and cure gastrointestinal disorders, cardiovascular diseases, cancer, diabetes and other chronic diseases. Cruciferous vegetables, *Allium* sp, tomato, cucurbitis, carrot, bhendi, underexploited vegetables like lettuce, sweet potato, yams, moringa, winged bean, basella, cluster bean, etc. are good sources of bioactive compounds. In the recent past there has been a tremendous increase in the use of plant-based health products in developing as well as developed countries resulting in an exponential growth of herbal (vegetable) products globally. Hence, during upcoming time by analyzing the plants for available bioactive contents they may be introduced as future herbal medicine. Hence this article makes a review and discusses about the medicinal properties of vegetable crops.

Vegetables, like fruits, are low in calories and fats but contain good amounts of vitamins and minerals. All the Green-Yellow-Orange vegetables are rich sources of calcium, magnesium, potassium, iron, beta-carotene, vitamin B-complex, vitamin-C, vitamin-A, and vitamin K. As in fruits, vegetables too are home for many antioxidants. These health benefiting phytochemical compounds help protect the human body from oxidant stress, diseases, and cancers and help the body develop the capacity to fight against these by boosting immunity. Additionally, vegetables are packed with soluble as well as insoluble dietary fiber known as non-starch polysaccharides (NSP) such as cellulose, mucilage, semi-cellulose, gums, pectin etc. These substances absorb excess water in the colon, retain a good amount of moisture in the fecal matter, and help its smooth passage out of the body.
Thus, sufficient fiber offers protection from conditions like chronic constipation, hemorrhoids, colon cancer, irritable bowel syndrome, and rectal fissures.

**Cucurbitaceae**

This family comprises of about 13 genera and 800 species, which have purgative, anthelmintic anti-inflammatory and cardio-protective properties. The medicinal properties of cucurbits are mainly due to the presence of secondary metabolite cucurbitacin. Cucurbitacins are group of tetracyclic tri-terpenoids responsible for bitterness of cucurbits (Dhimman et al., 2012) [12]. The anti-inflammatory activity of cucurbitacin is mainly due to their ability to inhibit cyclooxygenase enzyme (Peters et al., 1997) [37].

**Bitter gourd**

Botanically *Momordica charantia* is a most important medicinal crop of cucurbitaceae family. It is rich in phytochemicals that have hypoglycemic activity (Reduce the blood sugar level). Charatin is one such phytochemical which is a mixture of sitosterol glucoside and stigma steryl glucoside which could be used to treat diabetes. Vicine, a glycoalkaloid present in the seeds of the bitter gourd and protein, polypeptide-p are also found to have hypoglycemic activity.

**Muskemelon**

The fruit is used as a tonic, laxative, diuretic and diaphoretic. The fruits are used in the treatment of chronic eczema (Dhimman et al., 2012) [12]. The fruits is also a powerful anti-oxidant.

**Bottle gourd**

The fruits are used in the treatment of jaundice, diabetes, ulcer, piles and skin diseases. Fruit juice is a excellent remedy for heart problems, urinary problems and diabetes. Dietary fiber present in fruits helps in constipation, flatulence and piles. Seeds contain lagenin, a novel ribosome inactivating protein with ribo nucleolytic activity (Prajapathi et al., 2010) [39].

**Pumpkin**

The fruit is a cooling agent, increases appetite, cures leprosy and purifies the blood. Fruits contain cucurbitane and hexane cucurbitane glycosides and other triterpenoids (Ge et al., 2006) [16]. Seeds are used to treat benign prostatic hyperplasia (Abdel-Rahman, 2006) [7]. Anti-ulcer type cucurbitane has been isolated from the seeds of pumpkin.

**Cucumber**

Cucumber fruits aid in removing constipation and indigestion. The fruit also acts as a coolant and demulcent. Glycosides having anti-ulcer properties are present in leaves and seeds of cucumber (Dhimman et al., 2012) [12].

**Ash gourd**

The fruit is recommended for the management of peptic ulcer, hemorrhages, asthma, cough, diabetes, epilepsy and other nervous disorders. Seeds contain, Hispin which is a novel ribosome inactivating protein with antifungal activity (Ng and Prakash, 2002) [33].

**Chayote**

Chow-chow or Chayote is used in the treatment of inflammation and circulatory system disorders. The fruits have anti-hypersensitive and anti-oxidant effects (Dhimman et al., 2012) [12].

**Solanaceae**

**Tomato**

Tomato is the richest source of Lycopene and Vitamin-C. Lycopene is a vital anti-oxidant that helps to fight against cancerous cell formation. High potassium helps to maintain nerve health and high iron helps to maintain blood health (Sesso et al., 2004) [41]. Tomatoes are rich in vitamin K which plays a major role in blood clotting. It also improves eye health and prevents hypertension and urinary tract infections. Anthocyanin present in tomato protects against cancer. For skin protection, tomato intake (40 g tomato pastes corresponding to a lycopene dose of approximately 16 mg) for more than 8 weeks reduced ultraviolet light induced erythema (Stahl et al., 2001) [48]. Lycopene also reduces stomach and rectal cancers (Rao et al., 2007) [5].

**Brinjal**

Phytochemicals contained in eggplant include phenolic compounds, such as caffeic and chlorogenic acid, and flavonoids, such as nasunin. Nasunin or delphinidin-3-(Coumaroyl rutinoside)-5-glucoside is the major phytochemical in eggplant. Nasunin is part of the anthocyanin purple pigment found in the peel of eggplant. Anthocyanins enriched vegetables are brinjal prevents from cardiovascular dysfunction and protective effect on pancreatic cells (Kumar et al., 2017) [25]. Chlorogenic acid also acts as potential anti-oxidant. Benefits attributed to chlorogenic acid also include antimutagenic (anti-cancer), anti-microbial, anti-low-density lipoproteins (bad cholesterol) and antiviral activities. Eggplant fruits also contain several other antioxidants including the carotenoids lycopene, lutein, and α-carotene, as well as the flavonoids myricetin and kaempferol (Miean et al., 2001) [22]. Eggplant is effective in the treatment of high blood cholesterol. (Guimaraes et al., 2000) [35].

**Chilli**

Capsaicin present in chilli has anti-bacterial, anti-carcinogenic, analgesic and anti-diabetic properties. Capsaicin is used as an analgesic in topical ointments, and skin ailments to relieve pain. It also tends to reduce LDL cholesterol levels in obese individuals. They also rich in anti-oxidants like beta carotene, lutein, zeaxanthin, cryptoxanthin and vitamin C. Red peppers are a good source of lycopene, which is earning a reputation for helping to prevent prostate cancer as well as cancer of the bladder, cervix, and pancreas (Howard et al., 2000) [28].

**Potato**

Starch present in potato offers protection against colon cancer, improves glucose tolerance and insulin sensitivity, lowers plasma cholesterol and triglyceride concentrations. Unique tuber storage protein called patatin, has activity against free radicals. Institute for Food research UK has identified compounds called as kukoamines are known for its blood pressure lowering compounds. Chlorogenic acid constitutes up to 90% of total phenols of the potato tuber. It contains Carotene-β, Cryto-xanthin-β, Lutein which have antiscorbutic, aperient, diuretic, galactagogue, stimulant, emollient, antidote, antispasmodic properties (Chakraborty et al., 2010) [9]. Cao et al. estimated the total antioxidant capacity of potato to be in the medium range among 22 commonly consumed vegetables. Potato also contributes a
small amount of selenium (0.01 mg/kg) and folate (0.35 mg/kg) to the human diet.

**Alliaceae**

**Onion**
Sulfides in onion extracts provide protection against tumor growth especially stomach and colon cancer. Onions have anti-inflammatory properties due to their vitamin C and quercetin. The high amount of fructo-oligosaccharide in onions stimulates the growth of healthy bacteria and suppresses the potentially harmful bacteria in the colon such as *Bacillus subtilis*, *Salmonella*, and *E. coli* (Chiej, 2004) [11]. The regular consumption of onion lowers blood pressure and the serum levels of cholesterol and triglyceride, while increasing HDL levels. Onions tend to decrease the risk of heart disease due to the presence of vitamin B6, which lowers homocysteine levels, an important risk factor for heart attacks and strokes. Gamma-L-glutamyl-trans-S-1-propenyl-L-cysteinesulfoxide (GPCS) in onion inhibits the osteoclasts (The cells which break down bone) activity and fights osteoporosis. (Sampath Kumar et al., 2010) [40].

**Garlic**
Garlic is one of the most important herbs for the digestive systems. It stimulates peristalsis or movement of the intestines and these creation of the digestive juices; Allicin present in garlic have anti-bacterial and anti-fungal activity (Lawson LD, 1996) [29]. Quercetin, diallylsulphide and allin present in garlic has the ability to block block cancer causing agents such as nitrosamine and aflatoxins which have been specifically linked to stomach, lung and liver cancer.

**Cruciferae**
A striking and characteristic chemical property of cruciferous plants is their high concentration of glucosinolates. Isothiocyanates and Sulforaphane are the bio-transformation products of glucosinolates blocking enzymes which are responsible for tumorous growth in liver, lung, and gastrointestinal tracts. Sulforaphane is rich in broccoli, causes cell cycle arrest and apoptosis of cancer cells and also has anti-inflammatory, antimicrobial activity. Indole-3-Carbinol, most important indole in broccoli and cabbage is also found to be anti-cancerous.

**Legumes**
Fibre from the seed coat and the cell walls of the cotyledon of peas is beneficial for gastrointestinal function and health (Dahl et al., 2012). Consumption of cluster bean leads to low serum cholesterol levels, antidiabetic properties, and prevention of cardiovascular and cancerous diseases Velvet bean possesses a phytochemical known as L-Dopa, which is a non-protein amino acid present in a higher concentration within its seed; it is used to treat Parkinson’s disease. Winged bean rich in protein (>30%) is used as antimicrobial agent in traditional medicines Apart from these legumes found to be rich in phytoestrogens and saponins. Phytoestrogens act as antioxidants that could prevent cancer by scavenging free radicals and lowering blood cholesterol Saponins are found to be anti-carcinogenic.

**Under-exploited vegetables**

**Allium hookerii**
It is also served by steaming or boiling in water for those who are suffering from urinary troubles. In fact, the herb acts to regulate the normal flow of urine and is a very common practice used by the local physicians. (Vijayan et al., 2007) [43].

**False coriander** (*Eryngium foetidum linn.*)
The root is commonly served in stomach trouble. In folk treatment, decoction of the herb @ a teaspoonful twice daily for a week after meal serves in case of high blood pressure (Shrivastava, 1996) [42].

**Amaranth** (*Amaranthus viridis linn.*)
It is considered diuretic with cooling effect. The root is efficacious in menorrhagia. In case of stone formation along the urinary tract, a preparation from the whole plant is effectively used.

**Swamp cabbage** (*Ipomoea aquatica Forsk.*)
The leaves contain plenty of minerals and vitamins, especially carotene. The herb is considered wholesome for woman suffering from nervous and general debility.

**Red spinach** (*Plumbago lanceolata Linn.*)
Fresh red spinach is more nutritive than cooked one. Drinking juice of raw green leaves helps man in curing teeth prone to caries (decay of teeth) or in bleeding gums. It is also curative in respiratory tract ailments.

**Water cress** (*Enhydras flactuans L.*)
It is laxative, anti-bilious and demulcent. The herb is also used in the treatment of nervous affection and to induce sleep. Decoction of leaves and shoots is given in urinary trouble resulted due to calculus development.

**Mango ginger** (*Curcuma amada Roxb.*)
It also acts as stomachic and carminative, cooling and useful in prurigo. Amvasta et al. (1986) reported that the rhizomes are useful on confusion and sprains.

**Conclusion**
Regular consumption of a vegetable rich diet has positive effects on health since phyto nutraceuticals of vegetables can protect the human body from several types of chronic diseases. Various components of the whole food are likely to contribute to the overall health benefit. Various phyto nutraceuticals with antioxidant properties may work directly by quenching free radicals or indirectly by participating in cell signaling pathways. Nutrients such as potassium contribute to blood pressure regulation. The dietary fiber content and type of different vegetables may also contribute to the overall health benefit, such as improving bowel transit, lowering cholesterol, helping manage blood glucose concentrations, and by transporting a significant amount of minerals and phytochemicals linked to the fibre matrix through the human gut. Thus increasing vegetables in the diet may reduce the intake of saturated fats, trans fats, and foods with higher caloric density, all of which may be related to a healthier overall diet. Because each vegetable contains a unique combination of phyto nutraceuticals (vitamins, minerals, dietary fiber and phytochemicals), a great diversity of vegetables should be eaten to ensure that individual’s diet includes a combination of phyto nutraceuticals and to get all...
the health benefits. The availability of a large diversity of vegetables year round, allied to increase in mean per capita incomes in recent years and knowledge of vegetable health benefits, have enable consumers to include a variety of health promoting phyto nutraceuticals in human diet.

References

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