



E-ISSN: 2278-4136

P-ISSN: 2349-8234

[www.phytojournal.com](http://www.phytojournal.com)

JPP 2020; 9(3): 2144-2148

Received: 14-03-2020

Accepted: 16-04-2020

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## Nutraceutical value of salad vegetables to combat COVID 19

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**Abstract**

The dietary management should be considered in terms of improving immunity. Vegetables are considered essential for well-balanced diets since they supply vitamins, minerals, dietary fiber, and phytochemicals. Eating a low-fat, plant-based vegetarian diet may boost the immune system. Vegetable can be eaten as raw salads such as lettuce, radish, onion, cabbage, bell pepper, celery, beetroot, tomato, cucumber, carrot etc. are playing a major role in improving immune of human body. Hence this review tries to give out importance of salad vegetables in our diet to overcome viral infections.

**Keywords:** Salad vegetables, anti-viral properties, immunity, flavanols, nutraceuticals, COVID 19

**Introduction**

Vegetables are considered essential for well-balanced diets since they supply vitamins, minerals, dietary fiber, and phytochemicals. Each vegetable group contains a unique combination and amount of these phytonutrients, which distinguishes them from other groups and vegetables within their own group. In the daily diet vegetables have been strongly associated with improvement of gastrointestinal health, good vision, and reduced risk of heart disease, stroke, chronic diseases such as diabetes, and some forms of cancer. Some phytochemicals of vegetables are strong antioxidants and are thought to reduce the risk of chronic disease by protecting against free radical damage, by modifying metabolic activation and detoxification of carcinogens, or even by influencing processes that alter the course of tumor cells. All the vegetables may offer protection to humans against chronic diseases. Nutrition is both a quantity and a quality issue, and vegetables in all their many forms ensure an adequate intake of most vitamins and nutrients, dietary fibers, and phytochemicals which can bring a much-needed measure of balance back to diets contributing to solve many of these nutrition problems. The promotion of healthy vegetable products has coincided with a surging consumer interested in the healthy functionality of food. Because each vegetable contains a unique combination of phytonutrients, a great diversity of vegetables should be eaten to ensure that individual's diet includes a combination of phytonutrients and to get all the health benefits. Particularly intake of salad vegetables depart more nutrients to body compared to processed one. Salad vegetable is a cold dish of various mixture of raw or cooked vegetables, usually seasoned with oil, vinegar or other dressings.

**Role of salads in human health**

Vegetables contain a variety of micronutrients critical to physical and mental function (Kaplan *et al.*, 2007) [28]. Antioxidants such as vitamin C and carotenoids are said to play a pivotal role in protecting the body against oxidative stress, which is responsible for the causation and progression of neurodegenerative diseases, chronic inflammatory disease, atherosclerosis, some cancers, and some forms of depression (Byers and Perry, 1992; Irshad and Chaudhuri, 2002; Raison and Miller, 2011) [10, 26, 35]. Furthermore, the water-soluble vitamins (vitamin C, and B vitamins), and certain minerals (calcium, magnesium, and zinc), are important for optimal cognitive and emotional functioning (Huskisson *et al.*, 2007; Kaplan *et al.*, 2007) [25, 28]. Presence of fibre in vegetables reduces the risk of accumulation of more cholesterol and improves the digestion. It is a mixture containing a specified ingredient served with dressings without cooking. Vegetable suitable for eating as raw salads are lettuce, radish, onion, cabbage, bell pepper, celery, beetroot, tomato, cucumber, carrot, etc.

**Nutraceutical role of salad vegetables****Tomato**

Tomato is the second most consumed and widely grown vegetable in the world after potato. Tomato is consumed fresh as well as in many processed forms.

In addition to their culinary role in the diet, tomatoes represent a low energy dense food with unique constituents that may positively affect health. The major phytochemicals in tomato are the carotenoids consisting of 60% to 64% lycopene, 10% to 12% phytoene, 7% to 9% neurosporene, and 10% to 15% carotenes (Clinton, 1998) [16]. Tomato have the world richest sources of lycopene. In addition to lycopene, tomatoes are one of the top contributors of potassium (Anon, 2005) [2]. Tomato fruits are also an excellent source of ascorbic acid, about 200 mg/kg and are the major source of vitamin C next to citrus. Tomato contains small but significant amounts (1 - 2 mg/kg) of lutein,  $\alpha$ -,  $\beta$ -, and  $\gamma$ tocopherols, and conjugated flavonoids (Albushita *et al.*, 2000) [1]. People consuming diets rich in tomato and tomato based products, which are rich in the carotenoid lycopene were found to be less likely to develop stomach and rectal cancers than those who consume lesser amounts of lycopene rich vegetables (Giovannucci, 1999) [20].

### Bell pepper

All fresh peppers are excellent sources of vitamins C, K, carotenoids, and flavonoids (Bosland, 1996) [9]. Antioxidant vitamins A and C help to prevent cell damage, cancer, and diseases related to aging, and they support immune function. They also reduce inflammation like that found in arthritis and asthma. Vitamin K promotes proper blood clotting, strengthens bones, and helps protect cells from oxidative damage. 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. Beta-cryptoxanthin, another carotenoid in red peppers, is holding promise for helping to prevent lung cancer related to smoking and secondhand smoke. Besides being rich in phytochemicals, peppers provide a decent amount of fiber. Significant differences in vitamin C were observed between cultivars, but not between species. On average, fruits contain between 1 to 2 g/kg vitamin C, which is equivalent to 200% to 300% of the recommended daily allowance for adult men and women (Howard *et al.*, 2000) [24]. Comparing various bell peppers, red bell peppers have significantly higher levels of nutrients than green (Dias, 2012) [18].

### Cucumber

Cucumber contains some vitamin C, pro vitamin A as  $\beta$ -carotene in the skins, fibre in skin and seeds, and potassium. Cucumber is not a nutrient-dense food. For example, in a comparison of 10 common vegetables, selected on the basis of per capita consumption, cucumber (cultivar unspecified), ranked at the bottom in terms of antioxidant activity, phenolic compound content and antiproliferative activity in relation to human liver cancer cells (Chu *et al.* 2002) [14]. One compositional feature that makes cucumber interesting is that one source stated that silicon is important in connective tissue, such as skin, hair and nails (Atkinson, 1982) [7]. It is one of only a few foods to contain silicon.

### Onion

*Allium cepa* have been recognized for their medicinal value since ancient time period. Onion were reported to exhibit strong antiviral activity (Chen *et al.*, 2011) [12]. Onion have a good amount of flavonols and organosulfur compounds which impart medicinal property to these plants. It contains flavonoids such as anthocyanins and flavanols (Slimstad *et al.*, 2007) [40]. Isorhamnetin, Kaempferol Myricetin, and Quercetin are flavanols present in these plants (Anon, 2019)

[4]. Organosulfur compounds like quercetin and allicin which are associated with inhibition of viral infection (Sharma, 2019) [37]. The amount of Quercetin is more as compared to other flavanols. Quercetin and kaempferol as main flavanols. These compounds have been found to affect the growth of many viruses (Kumar and Pandey, 2013) [30]. Quercetin, a main flavanol compound in onion and garlic, have been reported to inhibit the translation and replication of RNA of many human viruses Quercetin derivatives can increase zinc uptake, which can inhibit RNA Polymerase (Sreenivasulu *et al.*, 2010) [42]. It was proved that Polio-virus (Castrillo and Carrasco, 1987) [11], Rhinovirus (Hellen, *et al.*, 1989) [23], SARS-CoV (Chen *et al.*, 2006) [13], Hepatitis C virus (Gonzalez *et al.*, 2009) [21], Ebola virus (Qiu *et al.*, 2016) [34], Enterovirus (Yao *et al.*, 2018) [50] were affected in the host cell by quercetin derivatives.

These bioactive compounds can hinder virus attachment to the host cell. They can alter transcription and translation of viral genome inside the host cell and hence also affect the viral assembly. Inhibition of viral entry into the cell and inhibition of RNA polymerase have also been postulated as mechanism of antiviral actions of this vegetable. Flavonoids present in onion and garlic have a strong inhibitory effect on virus multiplication. Phytochemicals present in these plants have been observed to block the formation of protein and genetic material in the virus (Castrillo and Carrasco, 1987; Zandi *et al.*, 2011) [11, 51].

### Carrot

Carrot is a taproot which is rich in beta-carotene. Liu *et al.*, 2010 [32], found that in a cell culture system,  $\beta$ -carotene could decrease the hepatosteatosis induced by the hepatitis C virus (HCV) by inhibiting RNA replication. Through its activity of provitamin A and its role in the inhibition of reactive oxygen species,  $\beta$ -carotene has been confirmed to have a positive effect on the progression of the hepatitis virus (HBV and HCV), preventing the development of carcinoma hepatocellular (Yadav *et al.*, 2002) [49]. Beta-carotene is a powerful antioxidant that can reduce inflammation and boost immune function by increasing leucocytes in the body. Lin *et al.*, 2012 [31] described the anti-inflammatory effect of beta-carotene and its potential use as anti-inflammatory agent for DNA virus infection.

### Beetroot

Beetroot, an annual or biennial cultivated form of *Beta vulgaris*. Red beetroot (*Beta vulgaris*), as a naturally occurring root vegetable and a rich source of phytochemicals and bioactive compounds including betalains (e.g., betacyanins and betaxanthins), flavonoids, polyphenols, Saponins (Baiao *et al.*, 2017) [8] and inorganic Nitrate (NO<sub>3</sub>); it is also a rich source of diverse minerals such as potassium, sodium, phosphorous, calcium, magnesium, copper, iron, zinc and manganese (Singh and Hathan, 2014) [39].

As a source of nitrate, beetroot ingestion provides a natural means of increasing *in vivo* nitric oxide (NO) availability and has emerged as a potential strategy to prevent and manage pathologies associated with diminished NO bioavailability, notably hypertension and endothelial function. Beetroot is also being considered as a promising therapeutic treatment in a range of clinical pathologies associated with oxidative stress and inflammation (Clifford *et al.*, 2015) [15]. Beetroot is also one of the few vegetables that contain a group of highly bioactive pigments known as betalains (Vulic *et al.*, 2014) [47]. Its constituents, most notably the betalain pigments, display

potent antioxidant, anti-inflammatory and chemo-preventive activity *in vitro* and *in vivo*. This has sparked interest in a possible role for beetroot in clinical pathologies characterised by oxidative stress and chronic inflammation such as liver disease (Vulic *et al.*, 2014) [47], arthritis (Pietrzowski *et al.*, 2010) [33] and even cancer (Das *et al.*, 2013).

### Radish

Radishes exist in a variety of shapes and sizes, as well as colour, ranging from red to white and even black. On a per weight basis radishes have high levels of vitamin C, more, for example than a fresh tomato (Athar *et al.*, 2003) [6]. They also contain some fibre, potassium and folate, but like many salad vegetables are high in water so are not nutrient-dense. The peppery taste of radishes is evidence of the presence of glucosinolates/isothiocyanates. Anthocyanins are present in red-skinned cultivars. Cooking destroys the enzyme myrosinase, which converts the glucosinolates to isothiocyanates, so eating raw (as with radishes) is best. Sulforaphane, the isothiocyanate to which glucotaphanin is converted, is also being investigated with regard to treating *Helicobacter pylori* infection and blocking gastric tumour formation (Fahey *et al.*, 2002) [19].

### Lettuce

Lettuce has been referred to as a 'nutritional desert'. Lettuces are an ancient food, featuring in Ancient Egyptian tomb drawings dating back to around 2500 BC. Most kinds of lettuce are a good source of vitamin C, folate, fibre and pro vitamin A (in the form of  $\beta$ -carotene). Most cultivars provide the carotenoids  $\beta$ -carotene and lutein/zeaxanthin and assorted flavonoids. In humans, one of their various benefits of carotenoid is believed to be protecting both the macula lutea of the eye and the skin against the same photooxidative damage (Sies and Stahl 2003) [38]. Many carotenoids are being considered as potential cancer prevention agents, although trial results are mixed.  $\beta$ -carotene has been used as a so-called oral sun protectant due to its antioxidant properties, and its efficacy has been proven in studies (Stahl *et al.*, 2000) [43]. Phenolic compounds, because of their structure, are very efficient scavengers of free radicals and are metal chelators (Shahidi *et al.* 1997) [36]. In addition to these antioxidant characteristics, other potential health-promoting bioactivities of the flavonoids include anti-allergic, anti-inflammatory, antimicrobial and anti-cancer properties (Hedges and Lister, 2005) [22].

### Celery

Celery has a long history as a medicinal plant, but has only relatively recently been considered a food source and eaten as a vegetable. It was traditionally used as a diuretic, which is now attributed to its potassium and sodium content. Celery contains some vitamin C, a small amount of vitamin A as  $\beta$ -carotene, sodium, potassium, calcium, and fibre. Celery contains bioactive compounds such as phthalides, 3-n-butylphthalide and sedanolide, which are believed to be responsible for the distinctive smell and taste of celery. This suggests they are also likely to be present in the stalks, though in lesser amounts. In an animal experiment, 3-n-butylphthalide lowered blood pressure through its dilatory effect upon blood vessels.

Apigenin, another flavonoid, has not been widely studied, but has been shown to have some anti-cancer and anti-inflammatory activity (Joseph *et al.*, 2002; Smolinski and Pestka 2003) [27, 41]. It is one of the few sources of luteolin, a

little studied compound as yet but one that may have cardiovascular benefits.

Red celery contains  $\beta$ -carotene, lutein/zeaxanthin and the flavones, luteolin and apigenin. Cultivars contain anthocyanins in their skin (Stintzing and Carle 2004; Wu and Prior 2005) [44, 48]. These compounds are believed to have a wide variety of benefits, including anti-inflammatory. One of the most commonly cited folk remedies using celery relates to treating inflammatory conditions such as gout and arthritis. Celery and celery seed supplements are often marketed as targeting these complaints., anti-cancer, and cardiovascular protective.

### Crucifers

Cruciferous vegetables (Brassicaceae or Cruciferae family) which include, cabbage, broccoli, cauliflower, Brussels sprouts, kales, kailan, chinese cabbage, turnip, rutabaga, radish, horseradish, rocket, watercress and mustards. Cruciferous vegetables were proven to help boost immunity. Broccoli, cauliflower, and artichoke are frequently consumed flowering vegetables. Broccoli is a good source of iron, phosphorus, vitamins A and C, and riboflavin. Cauliflower is also a good source of vitamin C. The nutritional value of the outer leaves of cauliflower and broccoli is much higher than the flower buds. They can be consumed raw in salads or cooked. Artichoke is a good source of minerals, especially potassium, calcium, and phosphorus, and has high dietary fiber content (Ulger *et al.*, 2018) [46]. Vitamin C shows *in vivo* anti-viral immune responses at the early time of infection, especially against influenza virus, through increased production of IFN- $\alpha/\beta$  (Kim *et al.*, 2013) [29]. Crucifers provide the richest sources of glucosinolates in the human diet. Crucifers rich in glucosinolates including broccoli, cabbage, Brussels sprouts, and kale have been shown to protect against lung, prostate cancer, breast cancer, and chemically induced cancers (Traka, 2010) [45].

Researchers claim that sulforaphane, a chemical found in this vegetable, switches on the antioxidant genes and enzymes in specific immune cells. This effect combats free radicals in our body and prevent the disease getting worsened. Broccoli has also been found to have anti-viral properties against influenza viruses (Antonenko *et al.*, 2013) [5].

Crucifers improves the effect of immune system by ensuring that immune cells in the gut and the skin known as intra-epithelial lymphocytes (IELs) function properly. Marc Veldhoen of the Babraham Institute in Cambridge, experimeted a vegetable poor diet on mice. On observation after feeding otherwise healthy mice a vegetable-poor diet for two to three weeks, 70 to 80 percent of these protective cells disappeared. Those protective IELs exist as a network beneath the barrier of epithelial cells covering inner and outer body surfaces, where they are important as a first line of defense and in wound repair. Veldhoen and their crew founds that the numbers of IELs depend on levels of a cell-surface protein called the aryl hydrocarbon receptor (AhR), which can be regulated by dietary ingredients found primarily in cruciferous vegetables (Anon, 2011) [3].

### Conclusion

On reviewing the nutraceutical potentials of salad vegetables utilized in our daily diet, salad vegetables are reasonable in maintain one persons physical health. The production of various salad vegetables for basic food diet is possible in India makes our daily nutritious. Proper diet are necessary in tackling diseases rather than treating with drugs. Nutritional

supplement is necessary to effectively counter viral illness and their ill effects. Hence a diet with a combined immune boosting and antiviral effects are important.

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