ABSTRACT:
More than 80% people in developing countries depend on traditional medicine or plants and their products for their primary health needs. Indigenous medicinal plants cure different diseases, including cancer without causing any toxicity. Vegetables prevent human from several severe and chronic diseases. We must consume daily at least 400 g of vegetables and fruits including at least 30 g of pulses, nuts and seeds. People who eat much quantity of vegetables have about one-half the risk of cancer and less mortality from cancer. Antioxidant vegetables prevent the human from many severe and chronic diseases, including cancer, cardiovascular disease, diabetes, hypertension, leprosy, rheumatism, epilepsy, liver and urinary disorders, stroke, inflammation, paralysis, etc. The vegetables contain several phytochemicals possessing antioxidant activity. The antioxidants protect the cells from damage caused by ‘free radicals’ - the highly reactive oxygen compounds. Major groups of the vegetable phytochemicals which shows antioxidant activity include vitamins (A, C, E, K), carotenoids, terpenoids, flavonoids, polyphenols, saponins, enzymes and minerals. All these compounds prevent from various cancers and other diseases. Hence, the present article explores out some antioxidant vegetables which are commonly taken in the diet, and act against cancer and other diseases.

KEYWORDS: Antioxidants, cancer and other diseases, indigenous medicinal plants, phytochemicals, vegetables.

INTRODUCTION
Plants and their products have been used for treating various diseases of humans as well as animals since times immemorial. According to WHO estimates, more than 80% people in developing countries depend on traditional medicine for their primary health needs. Ethnomedicinal survey exhibits a number of valuable data on indigenous medicinal plants, which are being used against various diseases such as cancer, diseases of heart, liver, lung, stomach, intestine, spleen and skin, diabetes, diarrhea, hypertension, rheumatism, nervous disorders, stroke, inflammation, fever, cough, cold and ulcer. Thus the plants not only maintain the health and vitality of individuals, but also cure different diseases, including cancer without causing any toxicity. A recent survey shows that more than 60% of cancer patients use medicinal plants at some point in their therapy (1-4). Cancer is a very severe disease, which kills annually about 3500 per million populations all over the world. Several chemopreventive agents are used to treat cancers, but they cause toxicity that prevents their usage. Although more than 1500 anticancer drugs are in active development with over 500 of the drugs under clinical trials, there is an urgency to investigate much effective drugs with no toxicity. In India, only limited research works have been done to cure cancer by herbal extracts which are mainly confined to adrak, tamatar and neem(5-6). As one of the major plant resources (natural products), the vegetables prevent humans from several severe and chronic diseases. Consumption of fruits and vegetables is widely accepted as lowering the risk of most common cancers. Many doctors recommend that people wishing to reduce their risk of cancer eat several pieces of fruits and several portions of vegetables every day. An inverse relationship has been suggested between the consumption of fruits and vegetables and the incidence of cancer in multiple organs, including lung, larynx,
mouth, pharynx, gastrointestinal tract and pancreas (1,7-8). A report of the WHO study on diet, nutrition and prevention of chronic diseases recommended that we daily consume at least 400 g of vegetables and fruits including at least 30 g of pulses, nuts and seeds. People who eat much quantity of vegetables have about one-half the risk of cancer and less mortality from cancer (9). The intake of 400-600 g/day of vegetables and fruits can reduce the occurrence of many common forms of cancers, and diets rich in plant foods can also lower the risk of heart disease and many chronic diseases (10). The author further stated that one-third of all cancer deaths in the United States could be avoided through dietary modification, which includes an abundant intake of vegetables and fruits. Hence, consuming a diet rich in antioxidant vegetables will provide health-protective effects. Vegetables contain several phytochemicals which possess strong antioxidant activities. The antioxidant vegetables prevent from the cancer and other diseases by protecting cells from damage caused by ‘free radicals’- highly reactive oxygen compounds.

In view of the above facts, some antioxidant vegetables (including spices and oils) commonly taken in the diet have been presented in this review article. Table 1 contains these vegetables in alphabetical order along with their Hindi/English names, parts used, main active components, antioxidant/anticancer and other biological activities.

### Table 1: Some antioxidant vegetables useful in cancer and other diseases

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Part used</th>
<th>Main active components</th>
<th>Antioxidant/anticancer and other biological activities</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <em>Abelmoschus esculentus</em> (L.) Moench (Bhindi, Lady’s finger)</td>
<td>Fruit, seed</td>
<td>Carotene, vitamins (B, C), amino acids</td>
<td>Seeds inhibit cancer growth; diuretic, antitussive, stimulant, antispasmodic; given in dysentery.</td>
<td>17-20</td>
</tr>
<tr>
<td>2. <em>Allium cepa</em> Linn. (Piyaz, onion)</td>
<td>Bulb</td>
<td>Diallyl disulphide, allicin, allin, quercetin antioxidant flavonoid, vitamins (C, E)</td>
<td>Diallyl disulphide inhibits stomach cancer; quercetin may cure lung and other cancers; analgesic, anti-inflammatory, anti-diabetic; given in jaundice, asthma, epilepsy, paralysis.</td>
<td>8-9,12,18, 20-21</td>
</tr>
<tr>
<td>3. <em>Allium sativum</em> Linn. (Lasun, garlic)</td>
<td>Bulb</td>
<td>Sulphur compounds (diallyl sulphide, diallyl disulphide, allyl propyl disulphide), allicin</td>
<td>Allicin inhibits cancers of stomach, liver, colon, breast, endometrium; sulphur compounds inhibit cancer cells proliferation; anti-inflammatory, anti-diabetic; given in CVD.</td>
<td>9-10,12,18, 20</td>
</tr>
<tr>
<td>4. <em>Beta vulgaris</em> Linn. (Chukandar, beet)</td>
<td>Whole plant</td>
<td>Vitamins (A, B, C), iodine, betanin</td>
<td>Given in liver disorders, paralysis, asthma, inflammation.</td>
<td>12,17,20</td>
</tr>
<tr>
<td>5. <em>Brassica campestris</em> Linn. (Sarson, mustard)</td>
<td>Seed oil</td>
<td>Dithiolthiones, isothiocyanates</td>
<td>Given in urinary problems, rheumatism, tumours/cancers</td>
<td>9,12,20</td>
</tr>
</tbody>
</table>
(Rai, brown mustard)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed oil</td>
<td>Flavonol glycosides, diethylthiols, isothiocyanate</td>
<td>Given in inflammation, rheumatism, paralysis.</td>
</tr>
</tbody>
</table>

(Phoolgobhi, cauliflower)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprout</td>
<td>Ascorbigen, vitamins (A, B, C), sulphoraphane, diethylthiols, isothiocyanate</td>
<td>Anticancer against cancers of bladder, lung, stomach, colon, rectum, breast; cardiotonic, antiinflammatory; given in biliousness, urinary diseases.</td>
</tr>
</tbody>
</table>

8. *Brassica oleracea* var. *capitata* Linn.  
(Pattagobhi, cabbage)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf</td>
<td>-do-</td>
<td>-do-</td>
</tr>
</tbody>
</table>

(Shaljum, turnip)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root, leaf</td>
<td>Ascorbigen, vitamins (A, C), Ca</td>
<td>Diuretic; given in various tumours/ carcinomas.</td>
</tr>
</tbody>
</table>

10. *Capsicum annum* Linn.  
(Lal mirch, red chili)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
</table>
| Fruit      | Carotene, vitamin C, glutathione, flavonoids     | Stimulant, stomachic; given ir neuralgia, rheumatism, sore throat, diarhhea.  
Given in peptic ulcer, cardiac diseases |

11. *Chenopodium album* Linn.  
(Bathua, Lamb’ quarters)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole plant, leaf, seed</td>
<td>Amino acids (leucine, isoleucine, lycine), vitamin C</td>
<td>Given in peptic ulcer, cardiac diseases.</td>
</tr>
</tbody>
</table>

12. *Citrus limon* Linn.  
(Nibu, lemon)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>Vitamin C, flavonoid, flavone, limonoid, limonene (serpenoid), nobiletin, tangeretin, glucarate</td>
<td>Flavonoid, tangeretin, nobiletin, limonoid and limonene inhibit cancer growth; nibu inhibits human breast cancer; given in metastasis, leukaemia, rheumatism, diarrhoea, liver disorders.</td>
</tr>
</tbody>
</table>

13. *Coriandrum sativum* Linn.  
(Dhaniya, coriander)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf, fruit</td>
<td>Essential oil, vitamin C, carotene, borneal, limonene, α pinene</td>
<td>Antioxidant, antiinflammatory, diuretic, stomachic, stimulant, hypolipidemic; given in rheumatism, jaundice, ulcer.</td>
</tr>
</tbody>
</table>

(Khira, cucumber)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit, seed</td>
<td>Vitamin C, 14 α-methyl-phytosterol, amyrins (α, β)</td>
<td>Haemostatic, diuretic, tonic, astringent, antipyretic; given in bronchitis, jaundice, tumour, haemorrhage.</td>
</tr>
</tbody>
</table>

15. *Curcuma longa* Linn.  
(Haldi, turmeric)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhizome (Tuber)</td>
<td>Curcumin, β pinene, camphene, eugenol, curcuminoinds, β sitosterol</td>
<td>Active against esophagus, colon, liver, bladder and prostate cancers, leukaemia, fibrosarcoma, stomach papilloma; hepatoprotective, hypo-lipidemic cardiotonic, anti diabetic.</td>
</tr>
</tbody>
</table>

(Gajar, carrot)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root, leaf</td>
<td>Carotene, flavonoid, carotenoid, glycoside</td>
<td>Given in leprofosy, chest troubles, tumours, bronchitis, jaundice.</td>
</tr>
</tbody>
</table>

17. *Dolichos lablab* Linn.  
(Sem, butter bean)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pod, seed</td>
<td>Proteins, amino acids, vitamins (A, B, C)</td>
<td>Stomachic, antiseptic; given in abdominal pain, diarrhoea, vomiting</td>
</tr>
</tbody>
</table>

(Soybean)

<table>
<thead>
<tr>
<th>Part</th>
<th>Constituents</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>Phytoestrols, saponins, lignans, isoflavonoids, isoflavones</td>
<td>Lowers the risk of breast, prostate, colon, stomach, rectum and lung cancers; isoflavonoids and isoflavones inhibit growth of many cancers.</td>
</tr>
</tbody>
</table>

Continue….
19. *Lycopersicon esculentum* Mill. (Tamatar, tomato)  
Fruit  
Vitamins (A, B, C), essential amino acids, lycopene  
Antioxidant, anticancer, intestinal antisepctic, cholagogue, stimulant; given in lung and heart diseases.

20. *Mentha spicata* Linn. (Pudina, garden mint)  
Leaf  
Limonene, flavonoid, sesquiterpene  
Antioxidant, antiinflammatory, antiulcerogenic; given in asthma.

21. *Momordica charantia* Linn. (Karela, bitter gourd)  
Leaf, fruit, seed  
Linolenic & palmitic acids, momordin, vitamins  
Active against colon, breast, bladder and prostate cancers, lymphoma, leukaemia; anti diabetic; given in asthma, bronchitis.

22. *Murraya koenigii* (L.) Spreng (Mitha neem, curry-leaf tree)  
Leaf  
Carotene, vitamins, alkaloids  
Stomachic, carminative; given in hysteria, diarrhoea, dysentery.

23. *Nelumbo nucifera* Gaertn. (Kamal, lotus)  
Whole plant  
Alkaloids, vitamins, quercetin flavonoid  
Antioxidant, antipyretic, demulcent, diuretic; given in neurasthenia, uterine hemorrhage, leprosy, liver diseases.

24. *Phaseolus vulgaris* (French bean)  
Fruit  
Amino acids, anthocyanin, quercetin  
Antioxidant, anticancer; urine flow stimulator; given in diabetes.

25. *Raphanus sativus* Linn. (Muli, radish)  
Root, leaf  
Vitamin C, anthocyanin, glucosinolates  
Cardiotonic, analgesic, laxative; given in asthma, dysuria, calculi, bronchitis, problems of liver and heart.

26. *Solanum melongena* Linn. (Began, brinjal)  
Fruit, seed  
Solasodine, glucarate  
Stimulant, antigllositic; given in cough, indigestion, liver complaints.

27. *Solanum tuberosum* Linn. (Alu, potato)  
Tuber  
Solanine, solasodine, lutein, vitamins (A, C), glucarate  
Diuretic, aperient, nutritive; given in leg ulcer, cough, weakness.

28. *Spinacia oleracea* Linn. (Palak, spinach)  
Whole plant  
Vitamins, carotene, lecithin, amino acids  
Antibacterial, laxative; given in inflammation of lung, liver and bowel.

29. *Trigonella foenumgraecum* Linn. (Methi, fenugreek)  
Leaf, seed  
Choline, trigonelline, saponin, amino acids, vitamins, quercetin  
Given in various cancers, bronchitis, inflammatory affections, rheumatism.

30. *Zingiber officinale* Linn. (Adrak, ginger)  
Rhizome  
Camphene, gingerol, zingiberene, borneol, cineol, curcumin, proteins  
Antioxidant, anticancer, antipyretic, analgesic, antiinflammatory, astringent; given in swelling, tumours, colic, diabetes, heart disease.

### SOME SCIENTIFIC REPORTS

A large body of scientific evidence indicates that an association exists between inadequate antioxidant status and increased risk for many diseases, including cancer, cardiovascular disease (CVD), diabetes, hypertension, leprosy, rheumatism, epilepsy, diseases of skin, eye, stomach, liver, lung, intestine, kidney and spleen, stroke, inflammation, fever, paralysis, asthma, diarrhea, osteoporosis, osteoarthritis and peripheral arterial disease. Antioxidant vegetables have beneficial...
effect against several of these diseases. Vegetables contain compounds such as sulphoraphane that induces GSH transferase, thereby helping detoxifying many types of carcinogens. Increased consumption of vegetables can increase the plasma antioxidant capacity and is associated with the lower risk of cancer and CVD (11). Vegetables are most effective against those cancers that involve epithelial cells such as cancers of lung, esophageus, stomach, colon, pancreas and cervix. The protective effect of vegetables has also been observed for hormone related cancers (8). The alcoholic extracts of dhaniya, haldi, karela and adrak were tested for tumour inhibitory effect. Haldi and karela were most effective against metastatic prostate cancer cell lines (7). Vegetables with the highest anticancer activity included lasun, soybean, pattagobhi, gajar; with a modest level of cancer-protective activity included piyaz, nibu, haldi, phoolgobhi, tamatar; with a low level of anticancer activity included khira (12).

The major groups of the vegetable phytochemicals which shows antioxidant activities include vitamins (A, C, E, K), carotenoids, terpenoids, flavonoids, polyphenols, saponins, enzymes and minerals. All of these prevent from the cancer and other diseases (3,5-6,9,13-14). Some phytochemicals which provide protection against cancer are: allyl sulphides present in lasun and piyaz; glucarates in nibu, began and alu; phytates, lignans, isoflavones and saponins in soybean; isothiocyanates in sarson, phoolgobhi and pattagobhi; and flavonoids, carotenoids and terpenoids in different vegetables. These phytochemicals block various hormone actions and metabolic pathways which are associated with the development of cancer (9).

Soybean is the contributing factor in the low incidence of breast, prostate, stomach, colon, rectum and lung cancers. Soybean seed contains isoflavonoids which inhibit the growth of hormone-dependent and hormone-independent cancer cells in culture. The isoflavones in soy inhibit the growth of human breast and prostate cancers (10). These isoflavones are the potent inhibitors of cholesterol synthesis, and the sterols (e.g., β-sitosterol) and saponins in soy can block cholesterol absorption from the diet or increase cholesterol excretion from the body (9). Thus soybean may also protect from the heart disease. Nibu due to its flavonoid, tangeretin and nobiletin contents can potentially inhibits the tumor cell growth and can activate the detoxifying cytochrome P-450 enzyme system. Limonoids present in nibu inhibit tumor formation by stimulating glutathione S-transferase (GST) enzyme. Limonene (a terpenoid) content of nibu also possesses anticancer activity. Nibus has been used to inhibit the breast cancer cell proliferation, delay mammary tumorigenesis, and cure metastasis and leukemia cancers (9-10). Vegetables also contain a variety of isoprenoid compounds that exhibit antitumour/anticancer activities. These compounds include tocotrienols (related to tocopherols) and terpenoids (e.g., limonene, geranool, menthal and carvone). Overall, these compounds increase tumour latency and decrease tumour multiplicity. These compounds also elicit a significant reduction in total and LDL cholesterol levels, there by reducing the risk of heart disease (15). There are many vegetable pigments such as flavonoids, carotenoids and anthocyanins. These pigments protect us from various diseases. Flavonoids extend the activity of vitamin C; act as antioxidant; protect LDL cholesterol from oxidation to the unsafe cholesterol oxides; inhibit platelet aggregation; and have antiinflammatory and antitumour activities (16). Quercetin (a flavonoid) chiefly present in red...
and yellow piyaz and French bean possesses both anticarcinogenic activity and the ability to inhibit LDL oxidation. Anthocyanins inhibit cholesterol synthesis and thus provide protection against heart disease. The carotenoids are powerful antioxidants that provide protection against oxidative damage, and stimulate immune function. Persons with high levels of serum carotenoids have a reduced risk of heart disease and cancer. In addition, a variety of phenolic compounds (e.g., caffeic, ellagic, and ferulic acids, sesamol and vanillin) are present in vegetables. These exhibit antioxidant and anticancer activities and inhibit atherosclerosis. Adrak contains phenolic compounds (gingerol) which have antioxidant activity that is even greater than α-tocopherol (vitamin E). Compounds that stimulate the activity of GST are considered as inhibitors of cancer. Substances that stimulate GST activity are phthalides in celery seeds; sulphides in piyaz and lasun; dithiolthiones and isothiocyanates in sarson, rai, phoolgobhi and pattagobhi; liminoids in nibu; and curcuminoids in adrak and haldi (9).

CONCLUSION

Vegetables are the most important part of our food which are consumed daily but unfortunately very few of us know that they provide significant protection against many cancers and other diseases. Consumption of vegetables is widely accepted as lowering the risk of several cancers. The antioxidant vegetables prevent from cancer and other diseases by protecting cells from damage. Hence, consuming a diet rich in antioxidant vegetables will certainly provide health-protective effects. People wishing to reduce the risk of cancer must eat several portions of vegetables and several pieces of fruits every day. Though many scientific studies have been done to explore out the antioxidant, anticancer and other biological activities of several vegetables; however, there is still a great need and scope for the researchers, biologists, pharmacologists and pharmaceutical scientists to derive novel anticancer or other drugs from such vegetables.

REFERENCES

18. CSIR (1986). The Useful Plants of India. Council of Scientific and Industrial Research, New Delhi, India.