

THERAPEUTIC APPROACH TO CANCER BY VEGETABLES WITH ANTIOXIDANT ACTIVITY

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ABSTRACT

Cancer is the second leading cause of human deaths in the world. However, the potential treatment of cancer is still under investigation. In fact, the plants may occupy a good place in the treatment of cancer with no ill effect. The medicinal plants and their products, particularly vegetables have antioxidant activity leading to anticancer effect. Thus, more than 80% people in developing countries depend on traditional medicine or plants for their primary health needs. Plants used as vegetables prevent human from several diseases, including cancer. Many doctors recommend that people wish to reduce the risk of cancer must eat several portions of vegetables every day. The vegetables contain many phytochemicals having antioxidant activity. The antioxidants protect the cells from damage caused by 'free oxygen radicals'. The main phytochemicals which show antioxidant activity are vitamins, carotenoids, terpenoids, flavonoids, polyphenols, saponins, enzymes and minerals. Hence, the present article gives a better therapeutic approach to cancer by the maximum use of antioxidant vegetables against different cancers.

KEYWORDS: Therapeutic approach to cancer, Medicinal plants, Antioxidant vegetables, Phytochemicals.

INTRODUCTION

Cancer (malignant tumor) is a disease of human and other multicellular animals. It may be uncontrollable and incurable, and may occur at any time at any age in any part of the body. On the other hand, cancer is a frightful disease because the patient suffers pain, disfigurement and loss of many physiological processes. It is caused by a complex, poorly understood interplay of genetic and environmental factors. Being chronic in nature it is difficult to cure cancer as the cells proliferate to their maximum. At present, cancer is the second leading cause of death and claims over 6 million people every year¹⁻².

Although many cancers can be controlled, the chronicity of the disease and expenses on supportive treatment are the valid reasons of not getting the cancer cured. Recent researches revolve round the urgency to evolve suitable chemotherapy consistent with new discoveries for the treatment of cancer with no toxic effect on normal cells. Toxicological aspects of drug warrant serious consideration without which the therapeutic concept of clinical efficacy will remain misconceived. Chemotherapy being a major treatment modality used for the control of advanced stages of malignancies and as a prophylactic against possible metastasis, exhibits severe toxicity on normal tissues. The plant kingdom serves as food and medicinal sources, and thus maintains the health and vitality of human beings as well as animals without causing any toxicity. India is the largest producer of medicinal plants and is rightly called the "Botanical garden of the World". In the indigenous or traditional system of medicine, many medicinal plants and their preparations are now used for the treatment of different diseases, including cancer^{1,3-4}. More than 50% of all modern drugs in clinical use are of natural products, many of which have the ability to include

apoptosis in various tumour cells of human origin^{4,5}. According to WHO estimates, more than 80% people in developing countries depend on traditional medicine or plants for their primary health needs. A recent survey shows that more than 60% of cancer patients use medicinal plants at some point in their therapy^{3,4,6}. Medicinal plants, including vegetables are known to have good immunomodulatory antioxidant activities, leading to anticancer effect. They act by stimulating both non-specific and specific immunity, and may promote the host resistance against infection by re-stabilizing body equilibrium and conditioning the body tissues^{1,3}. Hence, the consumption of vegetables is widely accepted as lowering the risk of different types of cancer. Vegetables contain several phytochemicals having potent antioxidant activities. The antioxidant vegetables prevent from the cancer by protecting cells from damage caused by 'free radicals'- highly reactive oxygen compounds. Thus, consuming a diet rich in vegetables with antioxidant activity may protect from the occurrence of cancer.

SOME SCIENTIFIC REPORTS ON THE ROLE OF VEGETABLES IN CANCER

Some antioxidant vegetables, including spices and oils have been mentioned in Table 1, describing the vegetables in alphabetical order along with their Hindi/English names, parts used, main active components and specific antioxidant/anticancer activities.

It has been recommended⁷ by many doctors that people wish to reduce the risk of cancer must eat several portions of vegetables every day. A study of the WHO on diet, nutrition and prevention of chronic diseases recommended that we daily consume at least 400 g of vegetables, 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 cancer⁸. It has been further stated⁸ 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. A large body of scientific evidence indicates that an association exists between inadequate antioxidant status and increased risk for many diseases, including cancer. Antioxidant vegetables have beneficial effect against several diseases. Vegetables contain compounds such as sulphoraphane that induces GSH transferase, there by helping detoxifying many carcinogens. Increased consumption of vegetables can increase the plasma antioxidant capacity and is associated with the lower risk of cancer. Vegetables are most effective against those cancers that involve epithelial cells such as cancers of lung, esophagus, stomach, colon, pancreas and cervix. The protective effect of vegetables has also been observed for hormone related cancers. 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. Vegetables with the highest anticancer activity are lasun, soybean, pattagobhi, gajar; with a modest level of cancer-protective activity are piyaz, nibu, haldi, phoolgobhi, tamatar; with a low level of anticancer activity is khira^{7,10-11}.

The main phytochemicals which show antioxidant activity are vitamins (A, C, E, K), carotenoids, terpenoids, polyphenols (ellagic acid, gallic acid, tannins), flavonoids (quercetin, anthocyanins, catechins, flavones, flavonones, isoflavones), enzymes (superoxide dismutase, catalase, glutathion peroxidase), minerals (Cu, Mn, Se, Zn), polysaccharides, saponins, lignins and xanthones. All of these prevent from the cancer^{4,8,12-13}.

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 cancer⁸. 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 cancers⁹. 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. Nibu has been used to inhibit the breast cancer cell proliferation, delay mammary tumorigenesis, and cure metastasis and leukemia cancers⁸⁻⁹. A variety of isoprenoid

compounds have been found in the vegetables which show anticancer activities. These compounds include tocotrienols (related to tocopherols) and terpenoids (e.g., limonene, geranoil, menthal and carvone). They increase the tumour latency and decrease the tumour multiplicity^{7,9}.

There are many vegetable pigments such as flavonoids, carotenoids and anthocyanins which protect us from various diseases. Flavonoids extend the activity of vitamin C, act as antioxidant and have antitumour activities. Quercetin (a flavonoid) chiefly present in red and yellow piyaz and French bean possesses both anticarcinogenic activity. 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 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. 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 curcumins in adrak and haldi^{1,8-9}. Vegetables and fruits also contain a variety of isoprenoid compounds that exhibit antitumour/ anticancer activities. These compounds include tocotrienols (related to tocopherols) and terpenoids (e.g., limonene, geranoil, menthal and carvone). Overall, these compounds increase tumour latency and decrease tumour multiplicity^{7,9}.

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Table 1: Some antioxidant vegetables useful against cancer/tumour

Botanical (with Hindi or English) Name	Part used	Main active components	Specific antioxidant/anticancer activity	References
1. <i>Abelmoschus esculentus</i> (L.) Moench (Bhindi, Lady's finger)	Fruit, seed	Carotene, vitamins (B, C) & amino acids.	Seeds inhibit cancer growth.	14-15
2. <i>Allium cepa</i> Linn. (Piyaz, onion)	Bulb	Diallyl disulphide, allicin, allin, quercetin antioxidant flavonoid & vitamins (C, E). Sulphur compounds	Diallyl disulphide inhibits stomach cancer & quercetin may cure lung and other cancers.	7-8,10, 14-15
3. <i>Allium sativum</i> Linn. (Lasun, garlic)	Bulb	(diallyl sulphide, diallyl disulphide, allyl propyl disulphide) & allicin. Dithiolthiones & isothiocyanates.	Allicin inhibits cancers of stomach, liver, colon, breast and endometrium; & sulphur compounds inhibit cancer cells. Given in tumours/cancers.	8-10,14-15
4. <i>Brassica campestris</i> Linn. (Sarson, mustard)	Seed oil	Ascorbigen, vitamins (A, B, C), sulphoraphane & isothiocyanate.	Given in cancers of bladder, lung, stomach, colon, rectum and breast.	8,14-15
5. <i>Brassica oleracea</i> var. <i>botrytis</i> Linn. (Phoolgobhi, cauliflower)	Sprout (flowers)	-do-	-do-	7-10,14-15
6. <i>Brassica oleracea</i> var. <i>capitata</i> Linn. (Pattagobhi, cabbage)	Leaf	Ascorbigen, vitamins (A, C) & Ca.	Given in various tumours/ carcinomas.	8-10,14-15
7. <i>Brassica rapa</i> Linn. (Shaljum, turnip)	Root, leaf, seed	Vitamin C, flavonoid, flavone, limonoid, limonene (terpenoid), nobiletin & tangeretin.	Flavonoid, tangeretin, nobiletin, limonoid and limonene inhibit cancer growth & nibu	10,14-16
8. <i>Citrus limon</i> Linn. (Nibu, lemon)	Fruit	Essential oil, vitamin C, carotene borneol, Limonene & α pinene.	Flavonoid, tangeretin, nobiletin, limonoid and limonene inhibit cancer growth & nibu inhibits human breast cancer, metastasis and leukaemia. Antioxidant.	8-9
9. <i>Coriandrum sativum</i> Linn. (Dhaniya, coriander)	Leaf, fruit	Vitamin C, 14 α -methyl-phytosterol & amyryns. Curcumin, β pinene, camphene, eugenol, curcuminoids & β sitosterol.	Given in tumours.	10-11,15
10. <i>Cucumis sativus</i> Linn. (Khira, cucumber)	Fruit, seed	Carotene, flavonoid, carotenoid & glycoside. Phytates, saponins, phytosterols, lignans, isoflavonoids & isoflavones.	Active against esophagus, colon, liver, bladder and prostate cancers & given in leukaemia, fibrosarcoma and stomach papilloma. Given in tumours.	10,15
11. <i>Curcuma longa</i> Linn. (Haldi, turmeric)	Rhizome (Tuber)	Carotene, flavonoid, carotenoid & glycoside. Phytates, saponins, phytosterols, lignans, isoflavonoids & isoflavones.	Given in tumours.	8,10-11, 14-17
12. <i>Daucus carota</i> Linn. (Gajar, carrot)	Root, leaf	Vitamins (A, B, C), essential amino acids & lycopene.	Lowers the risk of breast, prostate, colon, stomach, rectum and lung cancers & isoflavonoids and isoflavones inhibit many cancers. Antioxidant & anticancer.	10,15
13. <i>Glycine javanica</i> Linn. (Soybean)	Seed	Essential oils (menthol, menthone, limonene), flavonoid & sesquiterpene.	Antioxidant & anticancer.	8-9
14. <i>Lycopersicon esculentum</i> Mill. (Tamatar, tomato)	Fruit	Linolenic acid, palmitic acid, momordin & vitamins. Vitamins (A, C).	Antioxidant & anticancer.	9,14-15
15. <i>Mentha spicata</i> Linn. (<i>M. arvensis</i>) (Pudina, garden mint)	Whole plant	Alkaloids, vitamins & quercetin flavonoid.	Antioxidant & anticancer.	10,14-15
16. <i>Momordica charantia</i> Linn. (Karela, bitter gourd)	Leaf, fruit, seed	Amino acids, anthocyanin & quercetin.	Active against colon, breast, bladder and prostate cancers & given in lymphoma and leukaemia. Anticancer.	10-11, 14-15,17
17. <i>Moringa oleifera</i> Lam. (Munga, Mungana)	Root, leaf, Whole plant	Choline, trigonelline, saponin, amino acids, vitamins & quercetin.	Antioxidant.	12,15
18. <i>Nelumbo nucifera</i> Gaertn. (Kamal, lotus)	Fruit	Camphene, gingerol, zingiberene borneol, cineol, curcumins & proteins	Antioxidant & anticancer.	10,15
19. <i>Phaseolus vulgaris</i> (French bean)	Leaf, seed		Antioxidant and anticancer & given in tumours.	8,10,15
20. <i>Trigonella foenumgraecum</i> Linn. (Methi, fenugreek)	Rhizome		Given in various cancers.	10-11,14-15
21. <i>Zingiber officinale</i> Linn. (Adrak, ginger)			Antioxidant and anticancer & given in tumours.	8,10-11, 14-15,17