



## DIETARY SOURCE OF ANTI CANCER AGENTS

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### ABSTRACT

Cancer is the second leading cause of death worldwide. There are several medicines available in the market to treat the various types of cancer but no drug is found to be fully effective and safe. The major problem in the cancer chemotherapy is the toxicity of the established drugs. In an effort to develop effective alternative strategies that increase the therapeutic efficacy and minimize the systemic toxicity of chemotherapeutic agents, more efforts are being directed towards the investigation of dietary sources and other phytotherapeutic agents for their synergistic efficacy in combination with anticancer drugs. Nutritional experts are searching for suitable naturally occurring dietary factors which are or may be anti-carcinogenic. The present text aims to provide information about dietary approaches in treatment and prevention of cancer.

**Key words:** Chemotherapy, Phytotherapeutic agents, Synergistic efficacy, Anti-carcinogenic.

### INTRODUCTION

Cancer is a major public health burden in both developed and developing countries. It is an abnormal growth of cells in body that can lead to death. Cancer cells usually invade and destroy normal cells. Cancers may be caused in one of three ways, namely incorrect diet, genetic predisposition, and via the environment. As many as 95% of all cancers are caused by life style and may take as long as 20–30 years to develop. Current estimates from the American Cancer Society and from the International Union Against Cancer indicate that 12 million cases of cancer were diagnosed last year, with 7 million deaths worldwide; these numbers are expected to double by 2030 (27 million cases with 17 million deaths)[1]. There are several medicines available in the market to treat the various types of cancer but no drug is found to be fully effective and safe. The major problem in the cancer chemotherapy is the toxicity of the established drugs. In an effort to develop effective alternative strategies that increase the therapeutic efficacy and minimize the systemic toxicity of chemotherapeutic agents, more efforts are being directed towards the investigation of dietary sources and other phytotherapeutic agents for their synergistic efficacy in combination with anticancer drugs. Natural dietary agents including fruits, vegetables, and spices have drawn a great deal of attention from both the scientific community and the general public owing to their demonstrated ability to suppress cancers. Recent studies

suggest that the consumption of food rich in fruits, vegetables and spices have a lower incidence of cancers (stomach, esophagus, lung, oral cavity and pharynx, endometrium, pancreas and colon) [2]. The medicinal plants and their products, particularly vegetables have antioxidant activity leading to anti cancer effect. Many doctors recommend that people wish to reduce the risk of cancer must eat vegetables everyday in their diet. Oncologists are trying to identify antioxidants present in consumable fruits and vegetables rich in vitamins, amino acids, and carotenes which can be utilized in the prevention and treatment of cancer. Nutritional experts are searching for suitable naturally occurring dietary factors which are or may be anti-carcinogenic [3]. Here the present article gives a better therapeutic approach to cancer by the maximum use vegetables against different cancers.

### A. Some vegetables used as anticancer agents:

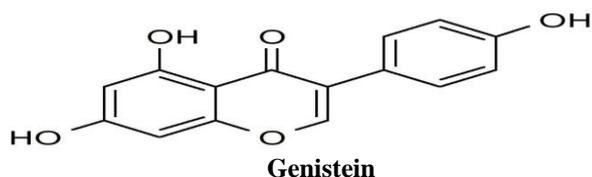
#### 1. Soyabean

**Biological source:** *Glycine max*

**Family:** Fabaceae

A 5% dietary supplementation with selectively hydrogenated soybean oil (SHSO) inhibited the growth of prostate cancer by 80% in vivo. The SHSO also showed strong cytotoxicity on human prostate cancer cells (DU145 and PC3). Genistein, a phytoestrogen derived from soybean were major bioactive compounds shown to have anticancer activities [4].

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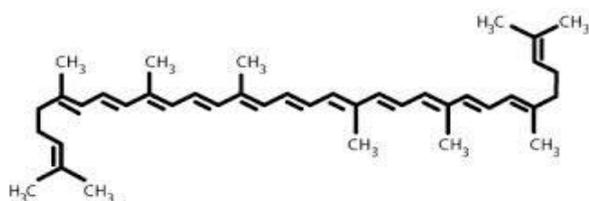


## 2. Tomato

**Biological source:** *Solanum lycopersicum*

**Family:** Solanaceae

The combined effects of low concentration of lycopene, a major component in tomato and eicosapentaenoic acid (EPA) could synergistically inhibit the proliferation of human colon cancer HT-29 cells. The inhibitory mechanism was associated with suppression of phosphatidylinositol 3- kinase/Akt signaling pathway. Furthermore, treatment of lycopene and EPA also synergistically blocked the activation of downstream mTOR molecule. Immunocytochemical staining results revealed that lycopene and EPA could also up-regulate the expression of apoptotic proteins such as Bax and Fas ligand to suppress cell survival [5].

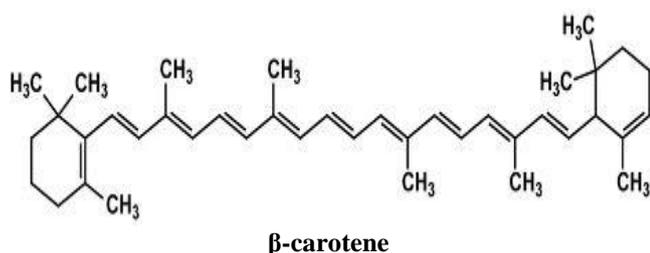


## 3. Carrot

**Biological source:** *Daucus carota*

**Family:** Apiaceae

$\beta$ -carotene derived from carrot were major bioactive compounds shown to have anticancer activities. Treatment of leukemia cell lines with carrot juice extract induced apoptosis and inhibited progression through the cell cycle. Lymphoid cell lines were affected to a greater extent than were myeloid cell lines and normal hematopoietic stem cells were less sensitive than most cell lines [6].



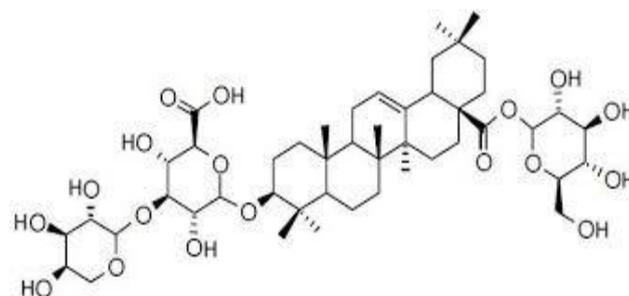
## 4. Bitter gourd

**Biological source:** *Momordica charantia*

**Family:** Cucurbitaceae

of bitter gourd significantly reduced the incidence of ACF (Aberrant Crypt Foci). The ability of bitter melon to reduce the incidence of ACF may be due to the compound momordin, which is found in bitter gourd. It was observed that bitter gourd had phenolic content, indicating that it may play a role in the cancer prevention

as the results from the animal study showed. Reduction of ACF by bitter gourd in the animal study could have been due to its antioxidative potential [7].

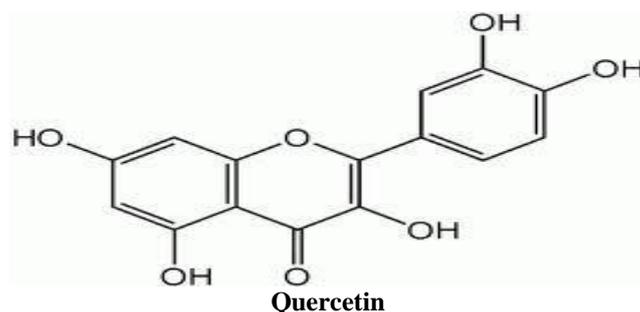


## 5. Drumstick

**Biological source:** *Moringa oleifera*

**Family:** Moringaceae

The antiproliferative and apoptotic events of *Moringa oleifera* leaf extract (MLE) was seen in human tumor (KB) cell line. The antiproliferative effect of MLE was also associated with induction of apoptosis as well as morphological changes and DNA fragmentation. It is due to the presence of quercetin. Thus, *M. oleifera* leaf extracts has potential for cancer chemoprevention and can be claimed as a therapeutic target for cancer [8].

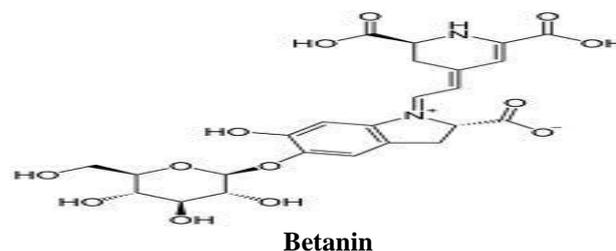


## 6. Beet root

**Biological source:** *Beta vulgaris*

**Family:** Amaranthaceae

The FDA approved red food color E162 of beet root, can be effective in suppressing the development of multi-organ tumors in experimental animals. It decreases the growth rate of the PC-3 cells (androgenindependent human prostate cancer cells). Beetroot extract have showed significant cytotoxic effect normal human skin FC and liver HC cell lines. The results suggest that betanin, the major betacyanin constituent, may play an important role in the cytotoxicity exhibited by the red beetroot extract [9].



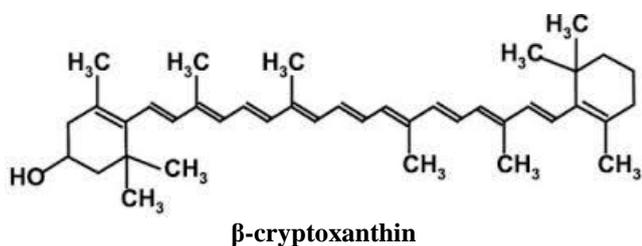
**B. Some fruits used as anticancer agents:**

**7. Papaya**

**Biological source:** *Carica papaya*

**Family:** Caricaceae

Papaya leaf extract showed a concentration-dependent anticancer effect on each of the cancer cell lines and suppressed DNA synthesis by suppressing the incorporation of *3H*-thymidine. It inhibited the proliferative responses of both haematopoietic cell lines and solid tumor cell lines. In peripheral blood mononuclear cells, papaya extract reduced the production of IL-2 and IL-4 whereas increased the production of Th1 type cytokines such as IL-12p40, IL-12p70. The expression of 23 immunomodulatory genes was enhanced by the addition of papaya extract. The results suggest that  $\beta$ -cryptoxanthin the major constituent, may play an important role in the cytotoxicity [10].

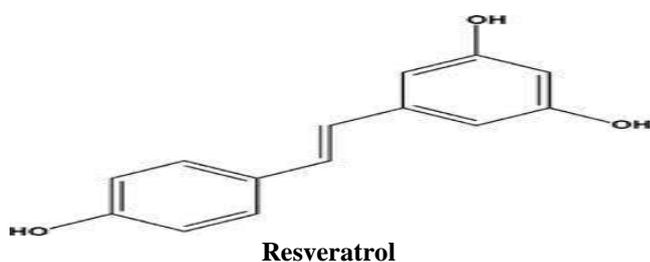


**8. Grapes**

**Biological source:** *Vitis vitefera*

**Family:** Vitaceae

Aromatase (especially tumor aromatase) is known to play an important role in promoting breast cancer in post menopausal women by converting androgens to estrogens. Grape juice (*Vitis vitefera*, Family Vitaceae) has been found to contain relevant phytochemicals which inhibit estrogen biosynthesis by competing for the substrate androstenedione chemicals in grape juice and simultaneously act as weak agonist of estrogen receptor. Resveratrol produced in the skin of red grapes protect against cancer by acting as powerful antioxidants [11].

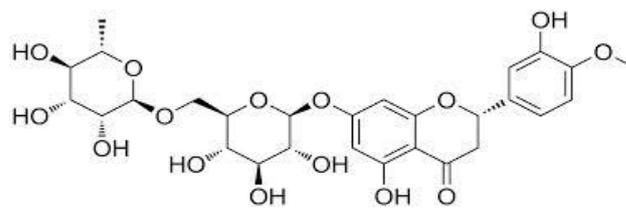


**9. Orange**

**Biological source:** *Citrus aurantium*

**Family:** Rutaceae

Extracts of orange peel used for prevention and treatment of cancer. Compositions and methods of inhibiting tumor cell growth and treating and preventing cancer are provided based on administration of an orange peel extract either alone or in combination with other phytochemicals. Various cancer Inhibitory effects of cell proliferation is the basic mechanism of orange peel extract. The results suggest that Hesperidin the major constituent, may play an important role in the cytotoxicity [12].



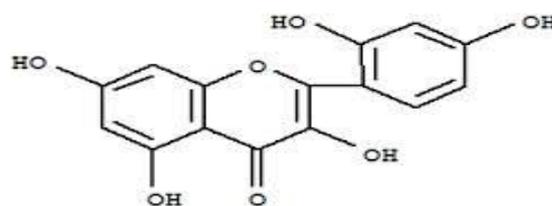
**Hesperidin**

**10. Almond**

**Biological source:** *Prunus dulcis*

**Family:** Rosaceae

The results suggest that Morin the major constituent, may play an important role in the cytotoxicity. Morin is potent cytotoxic compound against P-815 and L-1210 cells. Morin is known to display a variety of biological actions and numerous study have reported its powerful growth inhibitory activity *in-vitro* on various tumour cells [13].



**Morin**

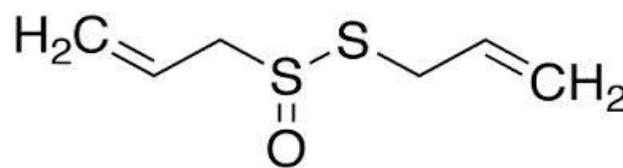
**C. Some spices used as anticancer agents:**

**11. Garlic**

**Biological source:** *Allium sativum*

**Family:** Amaryllidaceae

Garlic has anticancer activity against WEHI-164 tumor cells, and processing such as heating reduces its effect dramatically. The anticancer activities of different kinds of garlic are related to the level of allicin, flavanoids, and phenolic components. Therefore, fresh garlic has the highest content of bioactive components and the greatest anticancer efficacy [14].



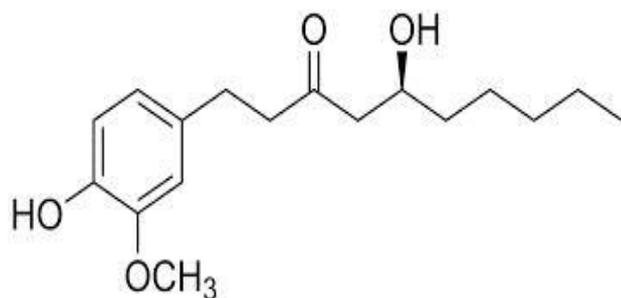
**Allicin**

**12. Ginger**

**Biological source:** *Zingiber officinale*

**Family:** Zingiberaceae

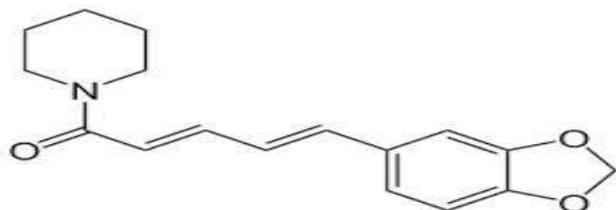
Antioxidant activities found increased significantly with increasing CO<sub>2</sub> concentration. Enriched ginger extract (rhizomes) exhibited the highest anticancer activity on MCF-7 cancer cells. Ginger is an excellent source of several bioactive phenolics, including non-volatile pungent compounds such as gingerols, paradols, shogaols and gingerones. Whole ginger extract (GE) exerts significant growthinhibitory and death-inductory effects in a spectrum of prostate cancer cells [15].



Gingerol

**13. Black pepper****Biological source:** *Piper nigrum***Family:** Piperaceae

The results suggest that Piperine the major constituent, may play an important role in the cytotoxicity. Piperine completely prevented the formation of oral carcinoma, probably due to its antilipidperoxidative and antioxidant potential as well as its modulating effect on the carcinogen detoxification process [16].

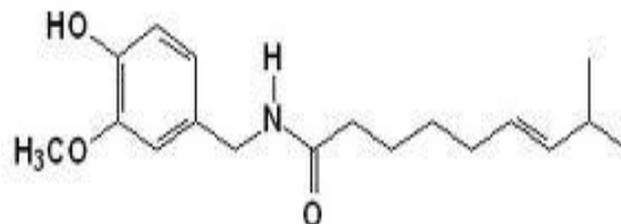


Piperine

**14. Red chilli****Biological source:** *Capsaicum annum***Family:** Solanaceae

Capsaicin is a major ingredient in hot chili pepper, and recent studies demonstrated anti-cancer activities of capsaicin in various types of cancer models. Capsaicin inhibits growth of colorectal cancer and tumor

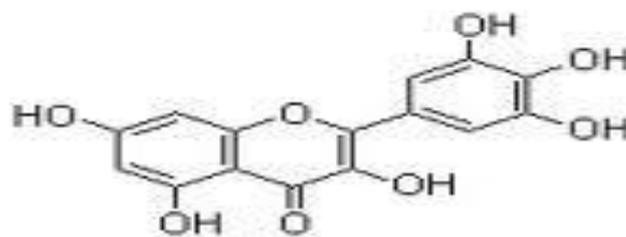
formation. Capsaicin suppresses  $\beta$ -catenin/TCF-dependent pathways through multiple mechanisms, including suppression of  $\beta$ -catenin transcription, activation of proteosomal degradation of  $\beta$ -catenin, and disruption of  $\beta$ -catenin/TCF-4 interactions in human colorectal cancer cells [17].



Capsaicin

**15. Onion****Biological source:** *Allium cepa***Family:** Amaryllidaceae

Myricetin is one of the principal phytochemicals in onions. Topical treatment with myricetin inhibited repetitive UVB-induced neovascularization in SKH-1 hairless mouse skin. The induction of vascular endothelial growth factor, matrix metalloproteinase (MMP)-9 and MMP-13 expression by chronic UVB irradiation was significantly suppressed by myricetin treatment. Thus myricetin suppresses UVB-induced angiogenesis by regulating PI-3 kinase activity in vivo [18].



Myricetin

**Table 1. Dietary sources as anticancer agent**

Sr. No.	Source	Botanical Name	Active constituent
1	Soyabean	<i>Glycine max</i> Family: Fabaceae	Genistein
2	Tomato	<i>Solanum lycopersicum</i> Family: Solanaceae	Lycopene
3	Carrot	<i>Daucus carota</i> Family: Apiaceae	$\beta$ -carotene
4	Bitter gourd	<i>Momordica charantia</i> Family: Cucurbitaceae	Momordin
5	Drumstick	<i>Moringa oleifera</i> Family: Moringaceae	Quercetin
6	Beet root	<i>Beta vulgaris</i> Family: Amaranthaceae	Betanin
7	Papaya	<i>Carica papaya</i> Family: Caricaceae	$\beta$ -cryptoxanthin
8	Grapes	<i>Vitis vitefera</i> Family: Vitaceae	Resveratrol
9	Orange	<i>Citrus aurantium</i> Family: Rutaceae	Hesperidin
10	Almond	<i>Prunus dulcis</i> Family: Rosaceae	Morin
11	Garlic	<i>Allium sativum</i> Family: Amaryllidaceae	Allicin
12	Ginger	<i>Zingiber officinale</i> Family: Zingiberaceae	Gingerol
13	Black pepper	<i>Piper nigrum</i> Family: Piperaceae	Piperine
14	Red chilli	<i>Capsaicum annum</i> Family: Solanaceae	Capsaicin
15	Onion	<i>Allium cepa</i> Family: Amaryllidaceae	Myricetin

Figure 1. Dietary sources as anticancer agent



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