

Role of Plants Belong to Cruciferous Family as an Anti-Cancer Agent

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Abstract: ***Introduction:** Cancer is still one of the most prime causes of mortality and claims over 6 million deaths worldwide. Scientists are giving their best to confront this disease; however, the sure-shot cure is still awaited. Although there are so many options for the treatment of cancer but they all have certain side effects. Nowadays, scientists are keener to know about the complementary and alternative plant-derived natural medicine for treating cancer with minimum side effects. Various epidemiological studies done by scientist provide evidence that Cruciferous vegetables are rich source of nutrients and phytochemicals that may work symbiotically to help avert the risk of cancer in humans. The present review explores the various studies done in this topic to gather more relevant information and knowledge regarding the subject. **Method:** Extensive electronic search was done to collect relevant studies from PubMed, Cochrane and EMBASE etc. and then analyzed and summarized here for the benefit of readers interested to do further studies on the anti-cancerous properties of plants belonging to cruciferous family. **Result:** Several studies have demonstrated the protective and anti-cancerous activities of cruciferous plants and these are highly recommended as a preventive diet especially for breast cancer, stomach cancer and pancreatic cancer.*

Keywords: Anticancer agent, broccoli, cancer, cruciferous plants, cabbage, cauliflower

1. Introduction

Scientists all over have been exploring herbal and dietary components to look for therapeutic agents for cancer treatment as well as adjuvant therapy for cancer so as to counteract the side effects caused by conventional chemotherapy and radiation therapeutic interventions. Plants from cruciferous family are one such potential candidate as anticancer agent. Members of cruciferous family contain many health promoting and potentially protective phytochemicals including Isothiocyanates, folic acid, phenolic, carotenoids, selenium, glucosinolates and ascorbic acids. These bioactive compounds offers powerful support for protecting against the ubiquitous cancerous agents encountered every day in our environment. Cruciferous vegetables are receiving more attention due to its health-promoting properties and the successful clinical trials against the risk of the cancer. The consumption of cruciferous vegetables protects against cancer more effectively than the total intake of various fruits and vegetables. The emanate affirmation from *in vivo* and *in vitro* studies over the past 20 years has revealed that isothiocyanates are chemo-preventive agents. Phenethyl isothiocyanate (PEITC) is present as gluconasturtiin in cruciferous vegetables with phenomenal anti-cancerous effects. PEITC is well known to not only avert the initiation phase of carcinogenesis process but also to obstruct the progression of tumor-genesis.

Cruciferous vegetables- A potent Anti Cancerous agent

Cancer is related to rival of modernism and advanced pattern of irregular and stressed life. Nowadays scientists are keener to know about the complementary and alternative medicine for treating cancer. Ayurveda, the oldest Indian native medicine system of plant drugs is known from very early times for

preventing or conquering various tumors using natural drugs. Fortunately, scientific evidence has now established that cruciferous vegetables contain essential anti-cancerous components that offer powerful protection against carcinogens¹ (Jain *et al.*, 2010). Cruciferous vegetables belongs to the family Brassicaceae (also called Cruciferae) with many genera, species, and cultivars being raised for food production such as cauliflower, cabbage, kale, garden cress, bok Choy, broccoli, Brussels sprouts and similar green leafy vegetables. Most cruciferous vegetables are rich in vitamins and minerals such as folate and vitamin K. They are also an excellent source of vitamin A and C. They contain phytonutrients-plant based compounds that may help in lowering down the inflammation and reduce the risk of different diseases. Cruciferous vegetables also have significant value for depression, pain, cardio protection etc. they are the superior source of antioxidant too. Broccoli, cauliflower, watercress and other cruciferous vegetables uniquely contain health promoting phytonutrients that have been shown to prevent the onset and stop the progression of colon, prostate, breast, cervical, thyroid and other types of cancers. These natural compounds also promote a healthy estrogen metabolism in the body. Researchers have been investigating possible associations between intake of cruciferous vegetables and the risk of cancer. A dietary deficiency of phyto-nutrients found in cruciferous vegetables may contribute to the onset of cancer in various ways. Every day, one get exposed to cancer-inducing compounds in our environment, cruciferous vegetables adequately enhance the body's ability to neutralize these carcinogens, thus providing essential cancer-preventive support. Numerous studies have suggested that cruciferous vegetables and the risk of human cancer are inversely associated with each other.

Cruciferous vegetables help to reduce the risk of cancer-

A lot of studies have been already done by the scientists regarding the intake of cruciferous vegetables. Various cohort and epidemiological studies reviewed by **Higdon et al., (2007)** states an inverse association between the high intake of cruciferous vegetables and risk of human cancer². Whereas **Allison et al., (2007)** give affirmation that sulforaphane significantly obstruct the growth of various human breast cancer cell lines that are representative of comprehensive breast tumor phenotypes³. Further they conclude that sulforaphane activates apoptosis, inhibits HDAC activity, and reduces the utterance of key proteins involved in breast cancer proliferation in human breast cancer cells. **WU X et al., (2009)** extensively studied potential anti-carcinogenic activity of isothiocyanates and suggested that isothiocyanates targets multiple pathways including apoptosis, oxidative stress, the MAPK pathway, and the cell cycle machinery⁴. **Abdulah et al., (2009)** stated that selenium enrichment of broccoli has the potential to enhance the anticancer properties of broccoli sprouts. Their results suggest that selenium-enriched broccoli sprouts could potentially be used as an alternative selenium source for prostate cancer prevention and therapy⁵.

Urszula Dziki et al., (2014) studied on antioxidant and anticancer capacity of bread enriched with broccoli sprouts (BS). They had provided a valuable data, which confirms the chemo-preventive potential of bread enriched with BS and indicate that BS comprise valuable food supplement for stomach cancer chemoprevention⁶. **Amjad et al., (2015)** studied Sulforaphane and its chemo-preventive and antineoplastic activity against prostate cancer. Further they done chemo-preventive studies in TRAMP Mice & clinical trials in humans using sulforaphane, where they concluded that the dietary supplements enriched with SFN have great potential for the prevention of prostate cancer⁷. **Novio et al., (2016)** illustrated the role of Brassicaceae isothiocyanates on prevention prostate cancer. Isothiocyanates could have effect on different prostate cancer cell populations, including Cancer stem cells and androgen-dependent and androgen-independent epithelial cells, both *in vitro* and *in vivo*. They concluded that isothiocyanates provide a new approach for the chemoprevention and treatment of prostate cancer⁸. **Sita et al., (2018)** aimed to provide an overview on the potential activities of sulforaphane related to the cellular mechanisms involved in glioblastoma (GBM) progression⁹. **Xuling Su et al., (2018)** stated that SFN exerts its anti-cancerous effects by modulating key signaling pathways and genes involved in the induction of apoptosis, cell cycle arrest, and inhibition of angiogenesis¹⁰.

2. Conclusion

Hence, it can be concluded that cruciferous plants are a potential candidate for anticancer medicine. A number of studies carried out world over have given scientific proof as to the mechanism and action of active compounds found in cruciferous plants like isothiocyanates, sulforaphane, folic acid, phenolic, caratenoids, selenium, glucosinolates and ascorbic acids that have anticancer and antioxidant properties.

Thus, plants like cabbage, cauliflower and broccoli should be promoted and recommended to cancer patients as well as healthy people for the prevention of cancer.

References

- [1] Jain R, Kosta S, Tiwari A. Ayurveda and cancer. *Pharmacognosy Res.* 2010;2(6):393–394.
- [2] Higdon, J. V., Delage, B., Williams, D. E., & Dashwood, R. H. (2007). Cruciferous vegetables and human cancer risk: epidemiologic evidence and mechanistic basis. *Pharmacological research*, 55(3), 224–236.
- [3] Allison Pledge-Tracy, Michele D. Sobolewski and Nancy E. Davidson *Mol Cancer Ther* March 1 2007 (6) (3) 1013–1021.
- [4] Wu X, Zhou QH, Xu K. Are isothiocyanates potential anti-cancer drugs?. *Acta Pharmacol Sin.* 2009;30(5):501–512.
- [5] Abdulah R, Faried A, Kobayashi K, et al. Selenium enrichment of broccoli sprout extract increases chemosensitivity and apoptosis of LNCaP prostate cancer cells. *BMC Cancer.* 2009;9:414. Published 2009 Nov 30.
- [6] Gawlik-Dziki, Urszula et al. “Anticancer and Antioxidant Activity of Bread Enriched with Broccoli Sprouts.” *BioMed research international* (2014).
- [7] Amjad AI, Parikh RA, Appleman LJ, Hahm ER, Singh K, Singh SV. Broccoli-Derived Sulforaphane and Chemoprevention of Prostate Cancer: From Bench to Bedside. *Curr Pharmacol Rep.* 2015;1(6):382–390.
- [8] Wu, Qi-jun et al. “Pre-diagnostic cruciferous vegetables intake and lung cancer survival among Chinese women.” *Scientific reports* (2015).
- [9] Sita G, Hrelia P, Graziosi A, Morroni F. Sulforaphane from Cruciferous Vegetables: Recent Advances to Improve Glioblastoma Treatment. *Nutrients.* 2018 Nov 14;10(11).
- [10] Su X, Jiang X, Meng L, Dong X, Shen Y, Xin Y. Anticancer Activity of Sulforaphane: The Epigenetic Mechanisms and the Nrf2 Signaling Pathway. *Oxid Med Cell Longev.* 2018;2018:5438179.
- [11] Royston KJ, Tollefsbol TO. The Epigenetic Impact of Cruciferous Vegetables on Cancer Prevention. *Curr Pharmacol Rep.* 2015;1(1):46–51.
- [12] Novío, Silvia & Cartea, Maria & Soengas, Pilar & Freire-Garabal, Manuel & Núñez-Iglesias, María. (2016). Effects of Brassicaceae Isothiocyanates on Prostate Cancer. *Molecules.* 21. 626. 10.3390/molecules21050626.