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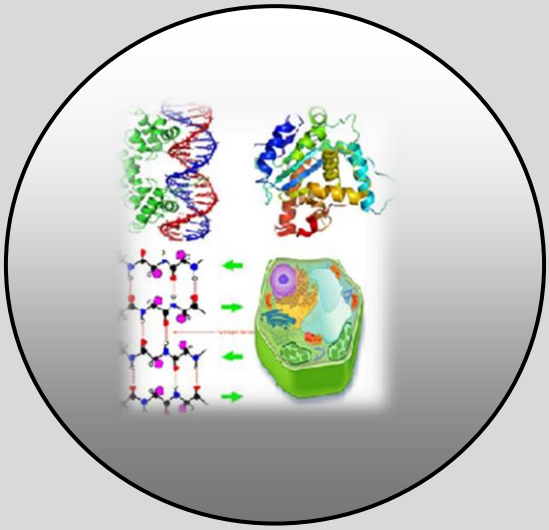

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REVIEW ARTICLE

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Medicinal Plants products for Cancer Prevention: A Review

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ABSTRACT

Cancer is one of the main causes of death globally and considered as a major challenge for the public health system. The high toxicity and the lack of selectivity of conventional anticancer therapies make the search for alternative treatments a priority. In this review, we describe some of the medicinal plant-derived natural products used as anticancer agents. Studies covered by this review should provide a solid foundation for researchers and physicians to enhance basic and clinical research on developing alternative anticancer therapies.
Keywords: Anticancer therapies, natural products, plant extracts, curcumin and allicin.

INTRODUCTION

Conventional cancer therapies involve surgery, radiation, and chemotherapy. The use of chemotherapy is associated with cancer recurrence, emergence of resistance, and the development of severe side effects. Plants have been considered for many years as an essential source of medicine to treat different ailments. One of the oldest records to use plant products in medicine come from clay tablets in cuneiform that were created by Sumerians in Mesopotamia (2600 BC). These tablets showed the use of more than 1000 plant-based products in medical treatment. The use of plants to treat diseases was also popular among ancient Egyptians. Historical records revealed the use of more than 700 plant-derived products in medical treatments.

The limited efficiency and serious side effects associated with the use of conventional anticancer therapies encouraged scientists to focus on the discovery and development of new anticancer agents derived from natural products. Secondary metabolites from plant sources like flavonoids, alkaloids, terpenoids, saponins, and others have been reported as important sources for potent anticancer agents. The majority (more than 60%) of anticancer drugs that showed high efficiency in clinical use was obtained from plants, aquatic organisms, and microorganisms. In this review, we summarize 25 anticancer agents derived from plants.

After gaining a lot of success still treatment of cancer is real challenge because the detection of cancer at the late stage as well the drugs used for treatment affects both healthy and cancerous cells. This increases the demand for alternative medicine, new treatments and prevention methods. Prevention is always better than cure. Chemoprevention refers to the use of bioactive plant compounds or dietary components to block, inhibit, reverse or retard tumorigenesis. And also it can use in conjugation with chemotherapeutics treatment. It is reported that about one-third of cancer can be cured if it is diagnosed at an early stage and one-third can be preventable. About 60% of drugs had been isolated from natural sources and used in the treatment of cancer.

Cancer Chemoprevention

Chemoprevention deemed to be one of the most promising areas in current cancer research. It is a pharmacological intervention to arrest or reverse the process of carcinogenesis. Chemicals, natural products, bioactive plant compounds or dietary components are used to block, inhibit or reverse the development of cancer. Depiction and use of effective cancer chemopreventive agents has become an important issue in public health-related research**.** Appropriate use of chemopreventive agent ultimately depends on the understanding of its mechanism of action at all levels namely molecular, cellular, tissue and organ levels as well as in animals as a whole.

Chemical compounds or substances produced by living organisms (Plants, Marine Organisms, Microorganism) are found in nature that usually has a pharmacological or biological activity for use in pharmaceutical drug discovery and drug design. One of the major sources of inspiration for drug discovery and are important in the treatment of life-threatening conditions viz. cancer.

Historical Perspectives

First written records on the medicinal uses of plants appeared ~2600 BC from the Sumerians and Akkaidians. *Ebers Papyrus* documented over 700 drugs, represents the history of Egyptian medicine dated from 1500 BC. Chinese *Materia Medica,* documented more than 600 medicinal plants, with the first record dating from about 1100 BC. Ayurvedic system recorded in Susruta and Charaka dates from about 1000 BC. Dioscorides, the Greek physician (100 AD), described in *De Materia Medica* more than 600 medicinal plants. World Health Organization estimates that ~85% of the world's inhabitants rely on traditional medicine for their primary health care (Hartwell, 1982, Medicinal Plants in Therapy, 1985).

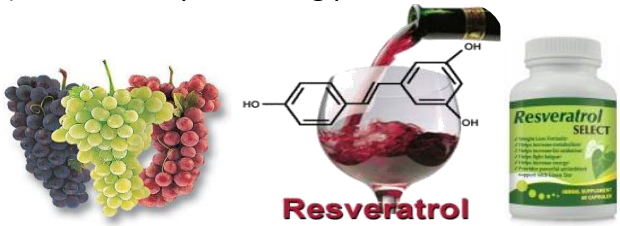
Plant-Derived Products as Anticancer Agents

Curcumin

Curcumin is one of three components of diferuloyl methane phenolic compounds known as curcuminoids. It is a major active constituent found in the dried rhizomes of *Curcuma longa* (family: Zingiberaceae), which is commonly known as turmeric (Jang et al., 1997). It has two aromatic *O*-methoxy phenolic groups, a β-dicarbonyl moiety and a seven-carbon linker containing two enone moieties; its IUPAC name is (1*E*,6*E*)-1,7-bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione).

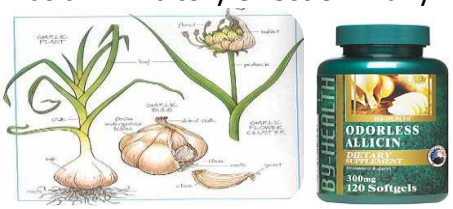
Resveratrol

Resveratrol is found in the skin of red grapes and is a constituent of red wine. In 1997, Jang et. al. reported that topical resveratrol applications prevented skin cancer development in mice treated with a carcinogen. Clinical trials to investigate the effects on colon cancer and melanoma (skin cancer) are currently recruiting patients.



Allicin

It is an organosulfur compound obtained from garlic (*Allium sativum*), a species in the family Alliaceae.It was first isolated and studied in the laboratory by Chester J. Cavallito and John Hays Bailey in 1944 (6).Allicin has an inhibitory effect on many kinds of tumor cells.



Tea Catechins

Green tea, made with leaves of *Camellia sinensis*. It originates from China and spread throughout the other Asian countries like Japan, Korea and recently to many western countries. It is composed of polyphenols especially catechins, among which the most abundant is epigallocatechin-3-galate (EGCG). EGCG is the most effective chemo preventive agent. EGCG inhibits the proliferation of cancer cells by inducing apoptosis.

Sulforaphane

Isothiocyanate is obtained from various cruciferous vegetables. Enzyme myrosinase transforms glucoraphanin, a glucosinolate, into sulforaphane upon damage to the plant. The compound reaches high intracellular and plasma concentrations and has been shown to inhibit HDAC activity in human cancer cell lines.

Piperine

An alkaloid present in *Piper sp.* (Family: Piperaceae) has medicinal attributes that are very beneficial to one's health. Uses of it range from medicinal uses to culinary uses in the Western world. Some studies show promise with regards to cancer research and piperine. Rodent studies have shown a reduction in symptoms relating to various cancers, but at this juncture, more study needs to be conducted.

Betulinic Acid

A pentacyclic triterpene, is a common secondary metabolite of plants, primarily from *Betula sp. (Family: Betulaceae).* Betulinic acid was isolated from *Zizyphus sp. (Z. mauritiana, Z. rugosa, Z. oenoplia;* Family: Rhamnaceae*).* It is selectively cytotoxic against human melanoma cell lines. A systemic and topical formulation of Betulinic Acid for potential clinical trials by the NCI is ongoing.

Ursolic Acid

Ursolic Acid is a pentacyclic triterpene acid mainly used in cosmetics. It also inhibits growth of various types of cancer cells through STAT3 activation pathway and in human fibrosarcoma cells by reducing the expression of matrix metalloproteinase-9 by acting through the glucocorticoid receptor. As medicine, it is well tolerated and can be used topically and orally. Ursolic acid is present in many plants, including apples, basil, bilberries, cranberries, elder flower, peppermint, rosemary, lavender, oregano, thyme, hawthorn, prunes. Apple peels contain high quantity of ursolic acid and related compounds which are responsible for the anti-cancer activity of apples.

Noscapine

Also known as Narcotine, Nectodon, Nospen, and Anarcotine, is a benzylisoquinoline alkaloid from *Papaver somniferum* (Family: Papaveraceae). First isolated and characterized in 1817 under the denomination of Narcotine. Primarily used for its antitussive (cough-suppressing) effects. It has also been shown to have anticancer activity. In cancer treatment, noscapine appears to interfere with microtubule function, and thus the division of cancer cells in a way similar to the taxanes.

Limonoid/ Limonene / Nobiletin / Tangeretin

These are present in *Citrus limon* (Nibu; Family: Rutaceae). Tangeretin and nobiletin are potent inhibitors of tumor cell growth and can activate the detoxifying P450 enzyme system. Limonoids inhibit tumour formation by stimulating the GST enzyme. Limonene (a terpenoid) also possesses anticancer activity. Nibu fruit is used for inhibition of human breast cancer cell proliferation and delaying of mammary tumorigenesis.

Phenoxodiol

A synthetic analog of daidzein, a well-known isoflavone from soybean (*Glycine max;* Family Papilionaceae). Developed as a therapy for cervical, ovarian, prostate, renal, and vaginal cancers, and induces apoptosis through inhibition of anti-apoptotic proteins including XIAP and FLIP. Phenoxodiol is currently undergoing clinical studies in the United States and Australia.

Orentin / Vicenin

Water-soluble flavonoids isolated from the leaves of Indian holy basil (*Ocimum sanctum*, Family: Lamiaceae). Flavonoids that offered radioprotection in mice were identified to be orientin and vicenin which spared the tumor tissues. The mechanism of action attributed to free radical scavenging in cancer.

Gossypol

A yellow pigment isolated from Pima cotton (*Gossypium barbadense,* Family: Malvaceae), Gossypol is a phenolic aldehyde that permeates cells and acts as an inhibitor for several dehydrogenase enzymes. It has proapoptotic properties, probably due to the regulation of the Bax and Bcl2. It also reversibly inhibits calcineurin and binds to calmodulin. It inhibits the replication of the HIV-1 virus. It is an effective protein kinase D inhibitor. It also causes low potassium levels, and thus causes temporary paralysis.

Caffeoylquinic Acid

Chlorogenic, dicaffeoylquinic and tricaffeoylquinic acids, derivatives of caffeoylquinic acid present in tubers of *Ipomoea batatas* (Shakarkand; Family: Convolvulaceae) showed potential cancer chemoprotective effect. 4-Ipomeanol (a furanoterpenoid) has been found to exhibit anticancer activity against non-small cell lung cancer lines.

Withanolides

Active constituent of Indian herbal medicine Ashwagandha (*Withania sominifera,* Family: Solanaceae) suppresses cancer cell proliferation accompanied by apoptosis through inhibiting NFκB. It is derived from the root of the plant, currently being explored for their brain regenerative properties eg. Withanolides 1-19; Withaferin A; Withanolide D; Withanosides I-VII; Ashwagandhanolide.

CONCLUSIONS

- Plant-derived products exhibit high potential as anticancer agents. Plants have been a prime source of drug(s) for the treatment of many forms of cancer.
- Compound(s) isolated from the plant may not only serve as the drug but leads to the development of potential novel agents.
- More than 270,000 higher plants existing on this planet, but only a small portion has been explored biochemically.
- It is anticipated that plants can provide potential bioactive compounds for the development of new 'leads' to combat cancer diseases.

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REFERENCES

Hartwell, J.L. (1982). Plants used against Cancers: A Survey. Lawrence, Mass: Quarteman Publication, USA

Medicinal Plants in Therapy (1985). Bull. WHO: 63(6):965-981.

Jang,M.,L. Cai, G.O. Udeani, K.V Slowing, C.F., Thomas, C.W., Beecher, H.H. Fong, N.R. Farnsworth, A.D., Kinghorn, R.G., Mehta, R.C., Moon and J.M. Pezzuto (1997). Cancer chemopreventive activity of resveratrol, a natural product derived from grapes. *Science*. 10; 275(5297):218-20.

Cavallito, C.J. and Bailey,J.H. (1944). "Allicin, the Antibacterial Principle of Allium sativum. I. Isolation, Physical Properties and Antibacterial Action". *Journal of the American Chemical Society*. 66 (11): 1950

Cragg, G.M., Kingston, D.G.I. and Newman, D.J. (2005). Anticancer Agents from Natural Products. Taylor & Francis Group, Boca Raton, FL. Brunner-Routledge Psychology Press.

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