



A comprehensive review on role of medicinal plants in cancer prevention

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Abstract

Cancer is a large disease group that occurs when abnormal cells divide rapidly and can spread to other tissues and organs. These rapidly growing cells may cause tumors. They may also disrupt the body's regular function. Worldwide cancer is one of the leading causes of death, according to the World Health Organization cancer threat was found in almost 1 in 6 deaths in 2020. The main cause of cancer is mutations or changes to the DNA in your cells. Genetic mutations can be inherited. Cancer may occur after birth due to many environmental factors. From ancient times, indigenous residents of India have used specific medicinal plants to fight cancer. Various types of different drugs may be utilized for the presentation of cancer. Over 90% of traditional medicine recipes/remedies contain important medicinal compositions of medicinal values of plants. In this review article we have tried to summarize the valuable information on the medicinal values of different plants for cancer treatment. It will be milestone data for further study of the medicinal values of plants.

Keywords: Cancer, medicinal plant, prevention, medicine

Introduction

Cancer is a disease that begins with genetic and epigenetic alterations occurring in specific cells, some of which can spread and migrate to other tissues (Hanahan D, Weinberg RA, 2011) [14]. Cancer is the second leading cause of death at worldwide parameters. Although great achievements have been made in the treatment and control of cancer, significant deficiencies and room for improvement remain but along with these services, there may be many undesired side effects that sometimes occur during chemotherapy. Plant-derived products have benefits over synthetic medicine, increasing the utilization of medicinal plants in the healthcare sector as several plants' derived compounds show potential role against cancer treatment. Plant-based anticancer agents have many important contents such as including vincristine, Taxol, vinblastine, stigmastrol, camptothecin, resveratrol, etc, and these are used in clinical across the world. Many plants have important milestones and good treatment roles for cancer prevention (Arpita Roy, 2017).

The emergence of important anticancer agents from natural sources requires more research to develop more drugs to treat this disease. Medicinal plants contain a wide range of secondary metabolites which include flavonoids, flavones, anthocyanins, lignans, coumarins, isocatechins, and catechins. These bioactive compounds are mainly responsible for the anti-oxidant prosperity of medicinal plants in the recent scenarios for cancer diagnosis and prevention, such treatments include chemotherapy, radiotherapy, and chemically derived drugs. Treatments like chemotherapy can put patients under a lot of strain and further complications and health issues. Therefore, there is a focus on using alternative pathways for treatments and therapies for cancer treatments. Currently, almost 60% of the anti-cancer treatment derivatives are obtained from biological sources such as plant, marine, and microorganism sources. Secondary metabolites in plants have several biological effects including anti-inflammatory, anti-cancer, analgesic, and cardiovascular effects.

Several plants of medicinal value identified for their role in cancer prevention and these plants consumed for many years by residents for cancer treatments. Some of these seem to work but there may not be sufficient scientific data (double-blind trials, for example) to confirm their efficacy for cancer prevention, such plants should qualify and count as important cancer-preventing medicinal plants as a crude drug. (Evans, 2008) [11].

The extract's phenolic compounds increased cancer cells' inhibition due to their abundant antioxidant properties. Phenolic compounds in medicinal plants play an important role in preventing and treating cancer. Phenolic compounds include phenolic acids, flavonoids, tannins, curcuminoids, coumarins, lignans, quinones, etc., and have properties such as antioxidants, anticoagulants, and anti-inflammatory effects. These isolated derivatives of medicinal plants have been investigated in various cancer cell lines, including strawberries and raspberries, which have been found valuable in breast, colon, and prostate cancer cell lines also different concentrations of these phenolic compounds show the capacity to inhibit cell growth (Dai j, 2018 and Zhang Y 2008) [9].

Natural dietary agents including fruits, vegetables, and spices have drawn much attention from the scientific community and the general public due to their demonstrated ability to suppress cancers. Recent studies suggest that the consumption of food rich in fruits, vegetables, and spices has a lower incidence of cancers (stomach, oesophagus, lung, oral cavity, pharynx, endometrium, pancreas, and colon) (Block G, 1992 and Bhanot *et al*, 1996 & Reddy L, 2003) [7, 24].

Therefore, in this review, an effort has been made to summarize to conclude the important and valuable aspects of the medical value of plants for cancer prevention because medicinal plants have different types of most valuable phytochemicals and other important molecules that are important in the prevention of cancer threat.

Medicinal plants for cancer prevention

According to various studies, these medicinal plants, such as Zingiber officinale, Curcuma longa, Phyllanthus emblica,

and *Catharanthus roseus*, exhibit cytotoxic, antioxidant, anti-inflammatory immunomodulatory, and antiproliferative properties, and these are using herbal supplements to treat cancer increasing patient survival rates and enhancing patient quality of life (Omara T, 2020).

Dominic O. Ochwang (2014) [10] observed that Sixty-five plants of 59 genera and 32 families were identified as better alternatives in therapeutic intervention against cancers. Fresh or dried leaves and stem barks were the most frequently used plant parts. Instructed to patients were almost exclusively oral, with the exceptions being topical application, especially in the case of breast cancer and skin sarcomas.

These medicinal plants have many beneficial and important phytochemical compositions for their anticancer properties including polyphenols, brassinosteroids, and taxols. Polyphenolic compounds including flavonoids, tannins, curcumin, resveratrol, and gallacatechins are all considered to be applicable in anticancer properties. Flavonoids are from polyphenolic compounds and constitute a large family of plant secondary metabolites with 10,000 known structures. Brassinosteroids are naturally occurring compounds found in plants that play important roles in hormone signalling to regulate growth and differentiation of cells also elongation of stem and root cells, and apart from it have roles in resistance and tolerance against disease and stress. Also, BRs are used for the regulation of plant senescence (M. Greenwell and P.K.S.M. Rahman, 2015).

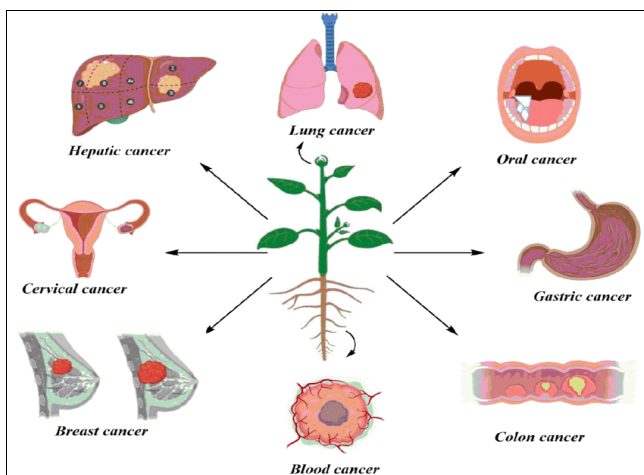


Fig 1: Illustration of the activity of plants against several types of cancers (Tariq Khan, 2019) [33]

Cancer is a major threat globally and recovering rate with many drugs is less, these drugs have many major side effects on health so natural products with higher effectiveness and lower side effects are desired. Medicinal herbs are important for cancer treatment due to their multiple chemical compounds that help discover new active materials against cancer. Plants produce a wide range of chemical compounds that have no direct role in the plant's growth. These compounds are called secondary metabolites. Mostly secondary metabolites are Alkaloids, terpenoids, flavonoids, pigments, and tannins are important constituents of these compounds that are important in cancer prevention. Secondary metabolites serve as anti-inflammatory, anticancer, and many other roles. Different improvements are reported in common cancer treatments by finding secondary compounds of natural products and medicinal herbs. It is believed that the anticancer effects of plants

develop by suppressing cancer's stimulating enzymes, repairing DNA, stimulating the production of antitumor enzymes in cells, increasing body immunity, and inducing antioxidant effects (Mansouri E, 2015, Kooti W 2014 and Sakarkar DM 2011) [16, 20, 27].

Astragalus cytosus: In research on HeLa cancer cells, the effect of toxicity of this plant's extract on cancer cells was shown. Also, in a clinical study of 24 patients suffering from lung cancer, 21 patients showed a positive response to this plant extract.

Avicennia marina: Flavonoid compounds of its leaf extract have anticancer effects on human breast cancer BT-20 cells. In another study, by separating naphthoquinone from the leaf of the plant, the anticancer effect of this compound on laryngeal cancer cells (kb) was shown. A cytotoxic effect of the extract on breast cancer cells (row 231MDA-MB) is confirmed (Sharaf M 2000, Momtazi Borojeni A, 2011) [21, 29].

Boswellia serrata: The hydroalcoholic extract of this plant causes the death of cervical cancer cells (HeLa cell) and this effect is dependent on dosage and time. Monoterpene, diterpene, and triterpene, and boswellic acid are the main ingredients of frankincense resin, which can induce apoptosis in cancerous cells (Moussaieff A, 2006) [22].

Catharanthus roseus: Its main compound is alkaloids, and used for circulatory disease treatment, and provides relief to normal cerebral blood flow obstruction. Vinblastin and vincristine are the two well-known compounds that significantly affect the human neoplasm. Vincristin sulfate arrests mitosis and is utilized for the treatment of acute leukemia in children and vinblastin sulphate is utilized for the treatment of choriocarcinoma, neuroblastoma, and carcinoma of lung, breast, and other organs. *Catharanthus roseus* has more than 400 alkaloids, among them vincristine and vinblastine are two important (Maher T, 2021) [19]. Vincristine and vinblastine cure acute lymphoblastic leukaemia cells and similarly, vincristine is used for the treatment of juvenile leukaemia.

Citrus: Many studies Favor the role of citrus in medicinal importance. Citrus peels have important phytochemicals including phenols, limonoids, flavonoids, and polysaccharides. Zhao *et al* (2022), extracted and purified an acidic polysaccharide from the peels of *Citrus aurantifolia*. The main components of the acidic polysaccharides (CA) are rhamnose (Rha), arabinose (Ara), galactose (Gal), glucose (Glu), mannose (Man) and galacturonic acid (GalA). The antitumor activity of CAs was observed in mice transplanted H22 hepatoma cells. CA stops the cell cycle of the tumor in the S phase so that multiplication is restricted. CA enhances the immune response against cancer cells by increasing the levels of tumor-infiltrating CD8+ T lymphocytes. so that inhibition of expression of anti-apoptotic proteins BclxL and Mcl-1 occurs. Findings conclude that acidic polysaccharides from citrus peels are beneficial in treating hepatocellular carcinoma characterized by a pectic polysaccharide, rhamnagalacturonan II (CPE-II) from peels of Citrus. Citrus peels are an abundant source of polyhydroxy flavonoids lymphosarcomas, (PHFs) such as hesperidin, neo hesperidin, and naringin; and polymethoxyflavones (PMFs),

most of these components have the potential property of antitumor compounds, PMFs are reported to significantly inhibit metastasis by restricting cell adhesion and its invasion. The cell cycle is restricted in the G1 stage by inhibiting cyclin-dependent kinases (Cdk) and enhancing Cdk inhibitor proteins.

Curcuma longa: Turmeric is a plant with the scientific name *Curcuma longa* from the Zingiberaceae family. Turmeric has many traditional values in clinical aspects for many years. The research on the cytotoxic properties of turmeric on liver cancer cells (Hep-2) indicated that the cytotoxicity mediated by curcumin in a dose-dependent manner leads to apoptosis of cancer cells through the mitochondrial pathway. The results of studying the effects of its extract on telomerase activity in breast cancer showed the anti-proliferative and inhibitory effects of telomerase. The anticancer potential of curcumin against cancers, including leukemia, lymphoma, digestive, urinary, reproductive, breast, uterus, ovary, lung, melanoma, colon cancers, and brain tumors has been shown (Anand P, Sundaram C, 2008) [3].

Carica papaya: Decrease cancer markers and prevent cancer progression. Reduces prostate cancer cell growth and proliferation (Ashish B, 2021) [4].

Glycyrrhiza glabra: Extract contents of the root lead to morphological changes in the mammary cell line 4T1 and reduce their viability. Its root extract leads to BCL2 phosphorylation and, like Taxol, restricts the cell cycle at the G2/M phases in tumor cell lines. Glycyrrhizin is a triterpene glycoside that is the main compound in root extract and acts as an antiproliferative agent against tumor cells specifically for breast cancer cell line (MCF 7) and HEP-2 and is also important in leads to apoptosis. (Baltina LA, 2003 and Rossi T, Castelli M, 2003) [5, 25].

Mentha pulegium: There are natural substances that are included in Pennyroyal polygon, Mentone, piperitone, limonene, isomenthone, and Octaan-3 ol;116 in some studies the inhibitory effect of flavonoids on the proliferation of cancer cells via apoptosis induction refers to Pennyroyal (Vian MA, 2008) [34].

Nigella sativa: Many studies highlight the antioxidant protective effects on the liver of the anticancer effects of the plant *Nigella*. Phytochemical effects such as the evaluation of alcohol on the effects of *Nigella sativa* on kidney cancer cells (ACHN) indicate an apoptotic effect on these cells. In a study of colorectal cancer cells, the effects of thymoquinone on inhibiting cancer cell growth, apoptosis, and increased cell morphological changes were shown and also have no side effects on further health. It also shows the leads to programmed cell death, with anticancer activity being observed in an alcoholic extract of *Nigella sativa* (Ait Mbarek L 2007, Gali-Muhtasib H 2004 and Shoeib AM 2003, Muhtasib H 2006) [1, 12, 23, 31].

Physalis alkekengi: The Compound physalin plants belong to the group of triterpenoids. This plant has anticancer activity including, physalins B and M extracted from the plant on cancer cells (especially human cell line HeLa and Hepatum cell lines SMMC-7721 and HL-60) is verified (Li X, 2014) [18].

Piper longum: This plant has bitter glycoside, known as kutkin. Kutkin is applicable in digestive problems, liver damage, asthma, vitiligo, and wound healing. The extract is rich in caffeic esters, apocynin, and cucurbitacines aglycone compounds that have cytotoxic effects on mammalian cell lines (Kumar and Ramesh, 2014) [17].

Polygonum aviculare: *Polygonum aviculare* has many anticancer roles in cancer prevention, observation indicated that the effect of the extract has been recorded in the inhibition of proliferation of cancer cells HeLa has been reasonable. Extracts induce apoptosis for cell proliferation and expression of apoptotic genes in breast cancer cells (MCF7) (Habibi RM, 2011) [13].

Silybum marianum: Silymarin causes cell cycle arrest and apoptosis in the 4T1 cell line (Shariatzadeh SMA, 2014) [30].

Thymus vulgaris: In the prostate study on rats it was found that thyme extract inhibits the growth of abnormal and precancerous lesions and also treats & inhibits the growth of cancer cell in the head and neck region. *Thymus vulgaris* has a different phytochemical compound including flavonoids. Thymol and carvacrol are the most important plant phenol compounds that have anticancer properties for the prevention of breast cancer and colorectal cancer (Sertel S, 2011, Keeforer-Ring K 2009) [15, 28].

Conclusion

The plants mentioned in this article, such as *Zingiber officinale*, *Phyllanthus emblica*, *Curcuma longa*, and *Catharanthus roseus*, offer a wide spectrum of therapeutic qualities, including anti-cancer capabilities. Indian geographic zone has a lot of plant biodiversity among them many have anticancer and other disease-preventing properties. Synthesis of such important anticancer compounds in plants by genetic engineering should be a priority for medical science and production on the mass level is required because these natural compounds have many benefits for cancer treatment, The major thing is that these compounds don't have any other side effects on health. Furthermore, the affordability and convenience of these plants and the subsequent extraction of phytochemicals must be considered. Plants have many active compounds such as alkaloids, phenol compounds, and monoterpenes, these compounds have antioxidant properties and inhibit damage to DNA, cell cycle arrest, promote apoptosis, and inhibit angiogenesis in various tumor cells, so ultimately, we can say that plants have a strong milestone step for preventing cancer.

This review article provides valuable data about medicinal plants with their anti-cancer activity. So, it can be concluded that herbal medicinal plants have many active derivatives for the treatment of different types of cancer. Plant-based medicine should be recommended to all cancer patients due to its efficiency in treatment and also have low cost with zero other side effects.

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