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Role of Ayurvedic drugs as possible chemo protectors in cancer

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Abstract

Cancer is the leading cause of mortality worldwide. Although substantial progress has been made in the treatment and control of cancer progression, there are still significant flaws and space for improvement. During chemotherapy, a number of unfavorable side effects might arise. Natural therapies, such as the use of plant-derived compounds in cancer treatment, have the potential to lessen negative side effects. A few plant products are now being used to cure cancer. However, there are a slew of plant compounds with promise anti-cancer capabilities in vitro that have yet to be tested in humans. In light of this, Ayurveda, which takes a holistic approach to disease treatment, could be a viable alternative to individual plant isolates in the treatment of cancer. To assess the efficacy of these plant components in treating cancer in humans, more research is needed. The focus of this study will be on the plant-derived chemical compounds that have showed promise as anticancer medicines in recent years, as well as their probable mechanisms of action as chemo protectors as adjuvant to conventional cancer treatment.

Keywords: Ayurveda; Cancer; Chemo protection; Integrated approach

1. Introduction

Cancer continues to be one of the world's top causes of morbidity and mortality. Cancer is the second greatest cause of death among non-communicable diseases, after cardiovascular disease [1]. Cancer kills one in every eight people on the planet, more than AIDS, TB, and malaria combined [2]. In comparison to the rest of the globe, cancer incidence and mortality are greater in North America, Australia, New Zealand, and Western Europe [2]. Cancer is responsible for one out of every four fatalities in the United States. The global mortality toll from cancer is expected to rise from 7.1 million in 2002 to 11.5 million by 2030 [3].

Surgery, chemotherapy, and radiation therapy have traditionally been used to treat cancer. Despite significant advancements in these treatments over the last decade, radiation or chemotherapy can only destroy a small percentage of tumor cells, with a high level of cytotoxicity towards healthy cells as a side effect. While surgery can help cure cancer, it is restricted to benign and delimited metastases, which contribute for only 10-15% of cancer cases. Due to their lack of selectivity, traditional anti-cancer drugs have substantial side effects, such as predisposition for generating drug-resistant cancer cells [4].

2. Cytotoxicity of Chemotherapeutic Drugs

Chemotherapy is commonly used to treat cancer. Cancer cells retain many of the regulatory activities that regular cells do not. As a result, they continue to divide even when normal cells do not. Chemotherapeutic medicines are more sensitive to cancer cells with this characteristic. A substantial collection of useful chemotherapeutic drugs has been established after almost five decades of systemic medication research and development. Chemotherapeutic therapies,

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on the other hand, are not without their own set of issues. Chemotherapeutic treatments can result in a wide range of side effects. 5-fluorouracil, for example, is a popular chemotherapeutic drug that has been proven to cause myelotoxicity [5], cardiotoxicity [6], and even operate as a vasospastic agent in rare but reported occurrences [7]. Doxorubicin, another commonly used chemotherapeutic, has been linked to cardiac toxicity [8, 9] renal toxicity [10] and myelotoxicity [11]. Similarly, the chemotherapeutic drug bleomycin is notable for its pulmonary toxicity [12]. Furthermore, bleomycin has a cutaneous toxicity [13]. Cyclophosphamide, a medicine used to treat a variety of cancers, has been reported to cause bladder damage, including hemorrhagic cystitis, immunosuppression, alopecia, and cardiotoxicity at large doses [14].

Chemotherapeutic drug toxicity can be a serious issue in the treatment of cancer utilizing allopathy or traditional medicine. For the treatment of cancer, various therapies have been proposed, many of which employ plant-derived compounds. The vinca alkaloids (vinblastine, vincristine, and vindesine), epipodophyllotoxins (etoposide and teniposide), taxanes (paclitaxel and docetaxel), and camptothecin derivatives (camptotecin and irinotecan) are the 4 kinds of plant-derived anticancer drugs now on the market Plants, as a reservoir of natural compounds with chemoprotective potential against cancer, nevertheless have a lot of promise to provide innovative treatments. Taneja and Qazi have proposed a number of chemicals derived from medicinal plants that may have anti-cancer properties [15]. This article will go through some of the plants that have recently been investigated and may have therapeutic potential. The mechanisms of action of these plant compounds are also addressed.

3. Chemoprotective Agents and Cancer

Plants have been known to have anticancer effects for ages. The isolation of podophyllotoxin and other lignans from the common May apple (*Podophyllum peltatum*) led to the development of medications to treat testicular and small cell lung cancer [16]. The National Cancer Institute (NCI) has evaluated more than 35,000 plant species for anticancer properties. Around 3,000 plant species have been found to exhibit anticancer activities that can be replicated [17].

Many research have looked at the chemoprotective characteristics of plants, such as the anticarcinogenic actions of *Abrus precatorius* on Yoshida sarcoma in rats, fibrosarcoma in mice, and tumour cells in ascites [18]. Similarly, Dhar et al. investigated the anticancer effects of *Albizzia lebbeck* in mice with sarcoma and *Alstonia scholaries* in humans with benzo[a]pyrene-induced forestomach carcinoma. [19] *Anacardium occidentale* in hepatocellular carcinoma, *Asparagus racemosa* in human epidermoid carcinoma, *Boswellia serrata* in human epidermal cancer of the nasopharynx, sarcoma in Erthyrina suberosa, *Euphorbia hirta* in Freund virus leukaemia, *Gynandropis pentaphylla* in hepatoma, *Nigella sativa* in Lewis lung carcinoma and *Withania somnifera* in various tumors [19].

4. Essential Chemical Constituents of Medicinal Herbs having Anti - Cancer Properties

A variety of plants' anticancer properties are still being investigated, and some have showed encouraging results. The following tables [20] go over some plants and plant derivatives that have showed potential as anticancer agents.

Table 1 GUDUCHI (*Tinospora cardifolia*)

Chemical Constituents	***In Vitro* Effects**	***In Vivo* Effects**
20 β-hydroxyecdysterone, Cordioside, Columbin	Cytotoxic against HeLa cells	Significant tumor regression and abidance in mice with Ehrlich ascites carcinoma

Table 2 BHUKARTAKA (*Ziziphus nummularia*)

Chemical Constituents	***In Vitro* Effects**	***In Vivo* Effects**
Betulin, Betulinic acid	Cytotoxic, but only to cancer cells; Induces apoptosis by the production of reactive oxygen species (ROS), inhibition of topoisomerase 1, and activation of MAP kinase Inhibits angiogenesis, regulates transcriptional activators, and inhibits cell death mediated by P53 and CD95. Induces loss of mitochondrial membrane potential Cyt.c and Smac deliverance	

Table 3 KALAMEGHA (*Andrographis paniculata*)

Chemical Constituents	*In Vitro* Effects	*In Vivo* Effects
Andrographolide	An alcoholic extract was found to be cytotoxic to a spectrum of cancer cell lines. SOD, Catalase, and GST antioxidant enzymes are increased, while LDH and MDA are decreased.	Andrographolide declines tumor in mice

Table 4 MANDUKAPARNI (*Centella asiatica*)

Chemical Constituents	*In Vitro* Effects	*In Vivo* Effects
Asiaticoside, hydrocotyline, vallerine, pectic acid, sterol, stigmasterol, flavonoids, thankunosides and ascorbic acid	Leaf extract of *C. asiatica*, suppresses the proliferation of altered cell lines in a dose-dependent manner antitumor activity due to inhibition of DNA synthesis	

Table 5 HARIDRA (*Curcuma longa*)

Chemical Constituents	*In Vitro* Effects	*In Vivo* Effects
Curcumin	Cell growth is inhibited in a wide range of cell lines. NFk-B, AP-1, EGR-1, COX-2, LOX, NOs, MMP-9, TNF, Chemokine, EGFR, and HER2 are all downregulated. Inhibits JNK pathway, serine/threonine kinase pathway Inhibits metastasis by reducing MMP-2 Induces apoptosis *in vitro* by decreasing mito-chondrial membrane potential, release of Cyt c, activation of caspases 3 and 9, and downregulation of anti-apoptotic proteins Bcl-XL and Integrin associated Protein	Reduces VGEF and bFGF mediated angiogenesis In rodents, it avoids colon and stomach malignancies

Table 6 BHUMYAMALAKI (*Phyllanthus amarus*)

Chemical Constituents	*In Vitro* Effects	*In Vivo* Effects
Nirtetralin, niranthrin, phyllanthin, phyltetralin	Inhibits cell proliferation in a variety of cancer cells by inhibiting cdc 25 tyrosine phosphatase activity. In Sacchromyces cerviacae mutant cell cultures, inhibits topoisomerase I and II activity. Interferes with DNA repair and causes cell cycle halt. Purified lignins serve as an MDR reversal agent	In mice with Dalton's lymphoma ascites (DLA) and Erlich ascites carcinoma, oral treatment of isolate extends life span and lowers tumour size (EAC) Plant extract decreases n-nitrosodiethylamine (NDEA)-induced tumor incidence In mice with Lewis lung cancer, plant extract exerts anti-angiogenic properties.

Table 7 LAKSHMANA PHALA (*Annona atemoya*)

Chemical Constituents	*In Vitro* Effects	*In Vivo* Effects
Bullatacin	• Cytotoxic against tumor cell lines • Chromatin margination as well as tumour cell condensation induce cell death.	

Table 8 KALAGAURA (*Mappia foetida*)

Chemical Constituents	*In Vitro* Effects	*In Vivo* Effects
Camptothecin	• Nucleic acid production inhibitors that are effective in HeLa and L-120 cells • Inhibits topoisomerase-1 (topo −1) • inhibits the growth of colon cancer cells and rhabdomyosarcoma cells in humans. • A potent chemotherapy drug against leukemia	• In the xenograft model system, it causes partial or total clearance of breast cancer. • The lymphoma, leukaemia, and solid epithelial tumour Phase II studies

Table 9 ASHWAGANDHA (*Withania somnifera*)

Chemical Constituents	*In Vitro* Effects	*In Vivo* Effects
Withaferin A	• Induces apoptosis in a range of cancer cells by rapidly generating reactive oxygen species (ROS). • In HL-60 cells, amplification of apical death receptors and modified ratios of members of the Bcl2 protein family lead to downstream stimulation of caspase-3 and PARP cleavage, resulting in nucleosomal DNA cleavage. • Withaferin root and leaf extracts exhibit cytotoxic effects against a variety of cancer cell lines and induce cell death via RNOS production.	• W.somnifera formulation is highly effective in producing tumor regression by >50% in EAC and EAT models • Increases T cell and CD40 expression in the EAT murine tumour model by increasing Th1 cytokine expression, CD3.

Table 10 DEVADARU (*Cedrus deodara*)

Chemical Constituents	*In Vitro* Effects	*In Vivo* Effects
Lignans, Wikstromol, Matairesinol and dibenzyl butyrolactol	• In a panel of human cancer cell lines, lignan extracts from the stem wood of Cedrus deodara show cytotoxicity.	Shows tumor regression in murine models

	• Increases the number of sub-G0 cells in HL-60 and MOLT-4 cells. • Causes the production of DNA ladders and nitric oxide (NO), both of which contribute to apoptosis.	

Table 11 SHALLAKI (*Boswellia serrate*)

Chemical Constituents	*In Vitro* Effects	*In Vivo* Effects
Triterpenic acids	• Causes apoptosis in cancer cell lines of various types • Inhibits DNA synthesis and cell growth of HL-60 • Inhibits topoisimerse I and II	Effective against brain tumors

5. Discussion

Anticancer medicines have showed potential in a number of plant-derived compounds. Single ingredients isolated from natural products have been studied for their usefulness as chemo preventive agents. Herbs are included in the ayurveda system of medicine's treatment regimens for a variety of ailments and conditions. Cancer is described as an inflammatory or non-inflammatory swelling in the Charaka and Sushruta samhitas, and is referred to as either Granthi (small neoplasm) or Arbuda (large neoplasm) (major neoplasm). *Tinospora cordifolia*, is well-known for its therapeutic characteristics, which include anti-inflammatory, anti-arthritic, and anti-allergic effects [21]. It has been proven to have anticancer properties in vitro [22]. Anti-oncogenic activities of *Andrographis paniculata* extracts have been discovered [23]. Oral administration of *Centella asiatica* extracts delayed the progression of solid and ascites tumors in tumor-bearing mice and extended their overall lifespan [24]. In vitro studies have revealed that turmeric inhibits tumor cell invasion and metastasis [25]. In mice with Dalton's lymphoma ascites (DLA) and Erlich ascites carcinoma (EAC), oral administration of *Phyllanthus amarus* extract dramatically improved life span and decreased tumour size [26]. As a result, there is proof that plant compounds can have anticancer qualities with low adverse effects.

6. Conclusion

Any feasible approach for preventing and regulating cancer's onset and progression is critical. The use of medicinal plant products to moderate or stop the carcinogenic process is a viable alternative to traditional allopathic medicine in the treatment of cancer. Many herbs have been studied in clinical trials and are presently being researched to learn more about their tumoricidal capabilities against different cancers. There appear to be new approaches to cancer physiopathology care that incorporate not only cytotoxic but also molecular techniques. Controlling the cancer phenotype is the purpose of these integrative techniques, which go beyond destroying the afflicted cells. More research into plants and plant-derived compounds could lead to the development of effective anticancer drugs.

Compliance with ethical standards

Disclosure of conflict of interest

The author of this paper hereby declares that there is no conflict of interest.

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