



(REVIEW ARTICLE)



Cytotoxic activities of medicinal plants on different cancer cell lines

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International Journal of Science and Research Archive, 2024, 11(01), 2595–2600

Publication history: Received on 13 January 2024; revised on 24 February 2024; accepted on 26 February 2024

Article DOI: <https://doi.org/10.30574/ijrsra.2024.11.1.0342>

Abstract

The foundation of contemporary medicine is still the therapeutic uses of medicinal herbs, which have a long history of use. As a result, these plants are extremely important to medicine, it is critical to understand that a variety of chemotherapeutic drugs have been isolated and identified from medicinal plants and are utilized in the treatment of cancer. Herbal medications have always had a big impact on trade and health. Many natural chemicals and their derivatives have been shown to have anticancer properties, leading to the identification and demonstration of anticancer properties in numerous plants. Cancer affects people of all economic levels and is a serious health concern. In this regard, herbal remedies may become essential for the prophylaxis and management of cancer.

Keywords: Cancer; Herbal medicine; Chemotherapy; p53; Cell line

1. Introduction

Cancer is characterized by aberrant cell proliferation that has the ability to spread from one bodily tissue to another. (1). It's the most prevalent and deadly illness of the modern day. Since most known cancer treatments have side effects and different cancers respond differently to different treatments, new approaches must be developed (2). It's the most common and fatal disease in the modern era. It is necessary to create new strategies because the majority of approved cancer treatments have negative effects and because different malignancies react differently to various treatments. (3). One of the main issues with cancer cells is their capacity to evade apoptosis as a result of unknown alterations, which lead to accumulation and, eventually, migration to different regions of the body. A successful anticancer medication should be able to target cancer cells only, excluding normal cells. This can be accomplished by helping cancer cells regain their ability to undergo apoptosis and by helping them to overcome multidrug resistance (MDR). MDR can be caused by a number of mechanisms, such as the overexpression of transporters that bind to the adenosine triphosphate (ATP) or the deletion or inactivation of key tumor suppressor genes, like p53. figure -1 (4).

2. Medicinal Plants

Plants and microbes have been utilized as natural sources for a wide range of pharmaceuticals. because they can treat a variety of illnesses, including lung, prostate, colon, and breast cancers. Additionally, a number of natural items' anti-cancer properties are currently being researched to find possible anti-cancer drugs. These substances could improve the efficacy of cancer-specific targeted therapy. Over the past 50 years, the majority of plant secondary metabolites and their derivatives have been used in clinical settings to treat cancer. (5).

The role that extracts from medicinal plants can play in preventing cancer has received a lot of attention in recent years. Plants are rich sources of a wide variety of chemical substances, many of which have positive effects on human health. Roughly half of the treatment compounds found to be effective against cancer are plant-based. Clinical trials employ a

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number of plant-based compounds, including derivatives of vincristine, vinblastine, camptothecin, and taxol, to treat different kinds of cancer. (6).

Since ancient times, people have made widespread use of natural products for a variety of reasons. In the past century, scientific advancements have led to the successful isolation of active ingredients in pure form from a wide range of plants for use in medicine. As a result, many phytochemicals have found extensive application as active pharmaceuticals or as model substances in the creation of extremely powerful medications. (7).

The first written records of hundreds of medicinal herbs, such as opium and myrrh, can be found on the clay tablets. Throughout history, herbal treatments have been used to treat a variety of illnesses. Herbal medicine relies heavily on plant extracts to treat illnesses and improve patients' health. (8)

Additionally, in many developing nations, herbal products continue to serve as fundamental healthcare resources. Consequently, exploring plants for their potential as herbal medicines becomes crucial in the quest for antitumor compounds (9).

The use of plant-based medications as a key supply of chemotherapeutic agents has considerable promise. Initially produced from plants, some of the currently utilized chemotherapeutic drugs include flavopiridol for colorectal cancer, paclitaxel for breast cancer, and vinca alkaloids for leukemia. (2)

The vast majority of currently licensed anticancer medicines are undoubtedly either derived from various natural sources, including structurally optimized phytochemicals, or are active phytoconstituents. When the value of natural products as anticancer drugs was first realized in the 1950s, numerous significant plant-based anticancer therapies, such as vincristine, vinblastine, paclitaxel, teniposide, and etoposide, were discovered..(10). Chemotherapeutics derived from plants are obtained either through direct isolation or derivation from lead structures (11)

It is generally known that medicinal plants have a wide range of antioxidant and immunomodulatory qualities in addition to anticancer effects. These compounds have the ability to induce both specific and non-specific immunity. They may strengthen the host's resistance to infections by restoring physiological equilibrium and training bodily tissues.(12)

Lead components that can halt the progression of cancer are being found by utilizing the anticancer qualities of diverse medicinal plants. Secondary metabolites found in medicinal plants include terpenoids, alkaloids, flavonoids, and steroids. These compounds each have unique pharmacological properties. steroids, each of which have unique pharmacological properties. A number of therapeutic plants show promise in preventing the growth of cancer cells. This article provides a thorough summary of many medicinal plants and their main (13).

Alkylating compounds, anti-metabolites, platinum analogs, and anti-tumor antibiotics are examples of common cancer chemotherapeutic medications. However, patients experience a great deal of stress during the administration of chemotherapy and radiation, which can have a negative effect on their health. This has led to the current investigation of novel anti-cancer medications originating from nature, especially plants. For thousands of years, plants have been the mainstay of ancient medical systems, offering long-lasting cures to humans. Thousands of years of practical use have led to the discovery of plants' medicinal potential. (8).

About 15 million more cases of cancer are anticipated by the World Health Organization (WHO) by 2020. Conventional cancer therapies include hormone therapy, radiation therapy, chemotherapy, and surgery. However, the necessity to investigate alternate anti-cancer therapy has been highlighted by the rise of resistance and the incidence of harmful or hazardous side effects linked with these treatments. Natural compounds are acknowledged as an important source of possible chemotherapeutic treatments and as having Plant-derived natural products, in particular, have gained widespread acceptance as valuable sources, with numerous drugs already derived from plants playing a role in treating various human ailments, including cancer. (14)

The application of medicinal plants (MP) for cancer treatment is currently a topic of significant interest. This is primarily due to the considerable number of drugs with anticancer activities derived from natural products. Furthermore, because MP are utilized as complementary and alternative therapy (CAM) all over the world Studies on the effectiveness of cancer drugs have demonstrated that blocking nuclear factor kappa B (NF- κ B) can enhance apoptosis-induced cell death. It's interesting to note that a number of natural products have been linked to the suppression of this factor since they show cytotoxic effect on human cancer cell lines. Sesquiterpene lactones (SQL) have been shown to have biological actions, such as inhibiting NF- κ B, when triggered by the highly reactive α -methylene γ -butyrolactone group. Several

active sesquiterpene lactones (SQL) have demonstrated anticancer activity against several human cancer cell lines. Parthenolide is one such SQL. and cynaropicrin, which is cytotoxic to leukocyte cancer cell lines (Jurkat T cells and U937) (15).

Numerous plants have been examined thus far to investigate their potential anti-carcinogenic qualities. Plant extracts containing active phytoconstituents and/or a combination of additional secondary metabolites have the potential to be beneficial in the chemoprevention process. offer potential efficacy throughout the chemoprevention process. In light of these potentials, numerous research groups frequently conduct comprehensive screenings of plant extracts worldwide in an effort to identify potential anticancer medicines derived from plant (16)

The National Cancer Institute has examined over 114,000 extracts for anti-cancer efficacy after gathering roughly 35,000 plant samples from 20 different nations. More than 3000 species The National Cancer Institute studied about 114,000 extracts to evaluate their anti-cancer potential after gathering about 35,000 plant samples from 20 different nations. There have been reports of over 3,000 plant species having anti-tumor effects. Figure (1) (17).

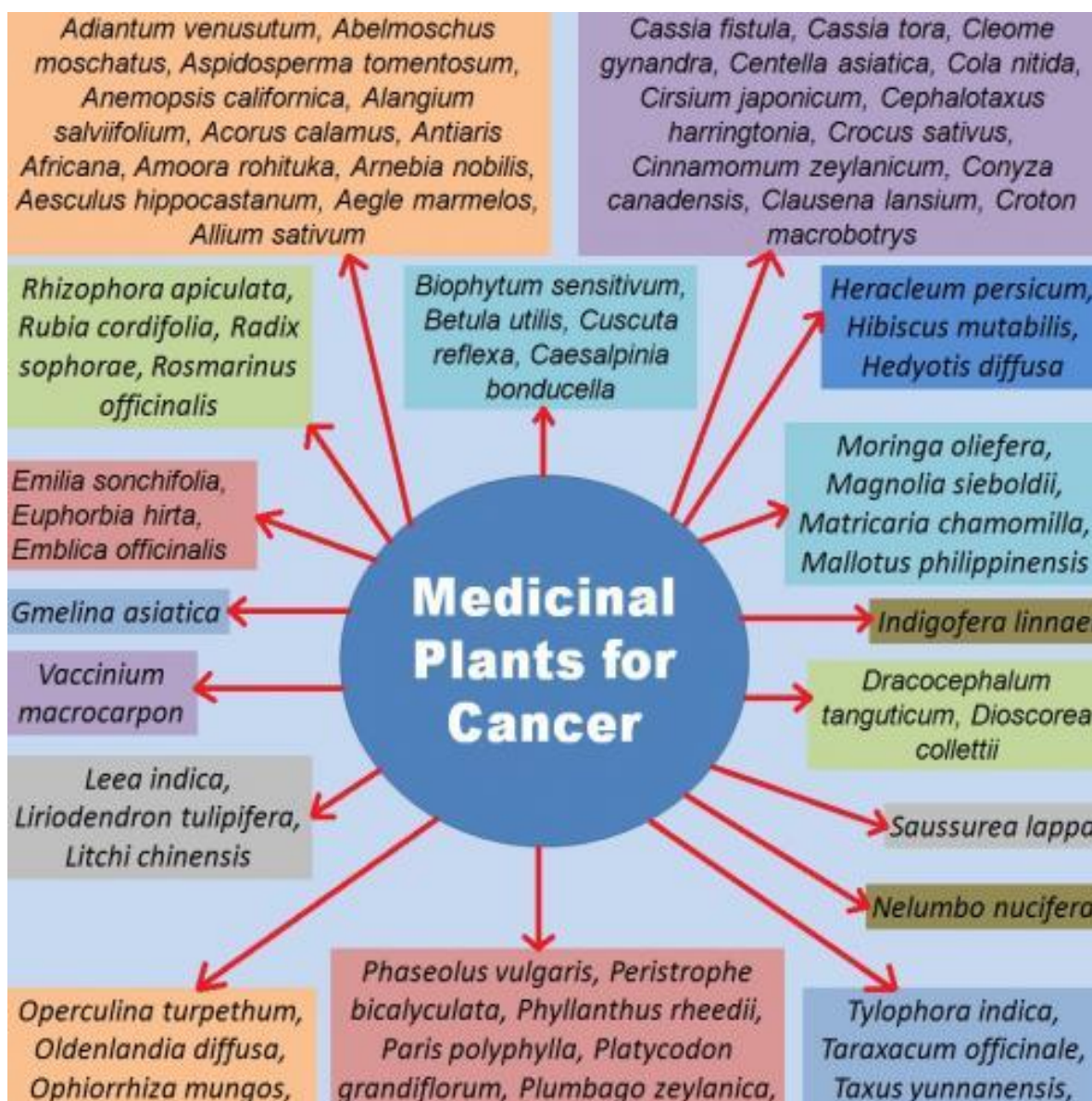


Figure 1 Medicinal Plants for Treatment of Cancer (17)

In both *in vitro* cell cultures and *in vivo* animal models, a number of secondary metabolites derived from plant extracts, including taxol, ursolic acid, combretastatins, podophyllotoxin, and camptothecin, have shown excellent anticancer action. Many of these substances are also well-known for having strong antitumor effects on different cell types. (18).

Whereas, several pure compounds have been tested for their anticancer potential. Nevertheless, An increasing number of studies emphasize the value of composite formulations' synergistic effects or mixtures of components found in the extract of the entire plant (19). Thus, screening various plant extracts to investigate their potential for preventing cancer in vitro and/or in vivo is very desirable. (20)

Essential preventive measures for most cancers include dietary changes, quitting smoking, effective treatment for inflammatory illnesses, and usage of nutritional supplements that boost immunity. Currently, chemically produced pharmaceuticals, radiation therapy, and chemotherapy are used to treat cancer. (21)

Restoring the capacity for self-defense, regulation, and restoration is the aim of herbal medicine. Many contemporary drugs are made from medicinal herbs. Herbal products come in liquid, pill, paste, powdered, or raw (extract) form. Some herbal products have been linked to toxicity and negative effects. The majority of the time, misidentification of plants, incorrect use of herbal products, incorrect labeling of plant materials, and other similar reasons lead to the problem. Toxic results can occur when drugs are used inappropriately, excessively, or not properly prepared. (22).

Therefore, it's critical to look into the effectiveness of herbal remedies in order to prevent unfavorable outcomes. Consequently, scientists have devised techniques to evaluate the possible medicinal worth of plant extracts in the treatment of cancer. Many plants have already been employed in cancer treatment. Many bioactive substances with a broad range of biological activity, The utilization of medicinal plants in the manufacture of various medications holds significant importance. Medicinal plants are thought to be excellent suppliers of many different components that can be utilized in the creation of new drugs. The goal is to identify a primary component that can halt the spread of cancer by utilizing the anticancer characteristics of different medicinal plants. Terpenoids, alkaloids, flavonoids, and steroids are examples of secondary metabolites found in medicinal plants. Each of these compounds has unique pharmacological properties (23).

Plant-based anticancer medications show remarkable effectiveness in blocking cancer cell lines. Because of their capacity to create chemicals with potential applications in medicine, these plants are highly sought for. Traditional societies throughout have been using a variety of additional medicinal plants for both cancer prevention and therapy. Promising candidates for future cancer treatment include notable plant-derived components like curcumin, allicin, vincristine, vinblastine, silymarin, hecogenin, glycyrrhizin, berberine, camptothecin, and gallic acid, which are essential active agents in plants. (24).

About 60% of the pharmacological compounds used in the modern treatment of cancer come from natural sources; the majority of these sources come from the kingdom of plants. Podophyllum lignans, Taxus diterpenes, Camptotheca alkaloids, and vinca alkaloids are a few of them. Thirteen of the sixteen new plant-derived drugs undergoing clinical trials are now in phase I or II trials, while three have advanced to phase III. Among them, it has been demonstrated that meisoindigo, which is obtained from the Chinese plant *Indigofera tinctoria*, and flavopiridol, which is isolated from the Indian tree *Dysoxylum binectariferum*, have anticancer properties with less toxicity than traditional medications (25).

Across the world, medicinal plants are a common substitute for traditional cancer treatments in many nations. There are currently approximately 3000 plant species known to have anticancer effects throughout the world. Plant-derived products are used to treat cancer in 10% to 40% of cases worldwide; among Asian patients, this figure rises to 50%. It is estimated that Europe spends \$5 billion a year on herbal anticancer products alone. (26). Polyphenolic compounds encompass a spectrum of bioactive molecules, namely flavonoids, tannins, curcumin, resveratrol, and gallacatechins, all recognized for their potential as anticancer agents. Resveratrol is discernible in various consumables such as peanuts, grapes, and red wine, while gallacatechins are prevalent in green tea. The incorporation of polyphenols into an individual's dietary regimen is hypothesized to enhance overall health and mitigate cancer risk owing to their inherent natural antioxidant properties (27).

Flavonoids are a large class of secondary metabolites found in plants that are classified as polyphenolic compounds and have 10,000 known structures. These substances function as physiologically active agents in plant systems, and scientists are growing increasingly interested in them due to their potential health advantages. (28).

Conventional medical systems tackle diseases holistically, taking mind-body-physiology into account. Many plants have been studied to determine their flavonoid content and look into the effects of these substances on cancer cells. These include ferns and plants that are utilized in traditional Chinese medicine, such as the litchi leaf. One particular part of the plant, the seed, has a high concentration of flavonoid chemicals, including flavones, flavonols, anthocyanins, chalcones, and many others (29). Purified flavonoids have demonstrated anticancer properties against various human cancers including; cervical carcinoma (Hela), breast cancer (MCF-7) and hepatoma (Hep-G2). The potential of plant

secondary metabolites, including flavonoids, polyphenols, and brassino steroids, as anticancer drugs has been thoroughly studied. Together, these substances have demonstrated anticancer properties that include antioxidant activity, apoptosis induction, cancer cell cytotoxicity, target selectivity, and growth suppression of cancer cells. (30).

3. Conclusion

Cancer affects people of all economic levels and is a serious health concern. In this regard, herbal remedies may become essential for the prophylaxis and management of cancer. Terpenoids, alkaloids, flavonoids, and steroids are examples of secondary metabolites found in medicinal plants. Each of these compounds has unique pharmacological properties against cancer.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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