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RECENT ADVANCEMENT ON ANTICANCER NATURAL DRUGS

Prayag Raval[1]* and Viratkumar Khatri[2]

[1]Aavis Pharmaceuticals, Hoschton, Gorgia, USA – 30548.

[2]Hemchandracharya North Gujarat University, Patan, Gujarat, India-384265.

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***Corresponding Author**
Prayag Raval
Aavis Pharmaceuticals,
Hoschton, Gorgia, USA –
30548.

ABSTRACT

Cancer poses a substantial public health burden in both developed and developing countries. Cancer is an abnormal and uncontrolled growth of cells in the body that can lead to death. Cancer rates are consistently increasing on a global scale. Various pharmaceuticals are currently accessible in the market to treat diverse forms of cancer. Nevertheless, none of these medications have been substantiated to be entirely efficacious and secure. Various natural substances and their derivatives have been identified as potent anti-cancer medications. Consistently, researchers are uncovering the anti-cancer properties of several plants. The process of identifying novel pharmaceutical compounds is characterized by a significant investment of time and effort. Novel derivatives can enhance the effectiveness of specific natural substances and their analogs in fighting cancer by utilizing active pharmacophore models. Issues like as medication resistance, solubility, and metabolic limitations can be addressed with appropriate molecular changes. Medicinal herbs, combined with their isolated lead components, are employed as an alternate form of treatment for neoplastic cells. Neoplastic cells are characterized by the aberrant and uncontrolled proliferation of cells in the body, resulting in the formation of cancer. Several potent compounds derived from natural sources have been discovered as treatments that effectively combat cancer. The chemical compounds are designed with the aim of creating powerful drugs to fight against cancer.

KEYWORD: Cancer, Cancer Cells, Chemotherapy, Natural Products, Medicinal Plants, Herbal Medicine.

1. INTRODUCTION

Throughout history, natural substances, especially plants, have been used to heal various illnesses for thousands of years. Terrestrial plants have been employed as therapeutic medicines in ancient civilizations like Egypt, China, India, and Greece. Over the course of time, a substantial quantity of modern medications have been obtained from these plants. The first recorded evidence of the medicinal use of plants may be traced back to around 2600 BC, as reported by the Sumerians and Acadians. Cancer is a hereditary disease of great importance in humans that has the potential to be treated using medicinal herbs. Every year, a significant number of people are diagnosed with cancer, and most of these cases result in death. Cancer is the abnormal and uncontrolled growth of cells in the human body, which can lead to death. Cancer cells commonly invade and destroy normal cells. Cancer cells originate from a disturbance in the body's balance, and by correcting this disturbance, the cancer can potentially be treated. Although billions of dollars have been spent on cancer research, our comprehension of the essence of cancer remains inadequate. Every year, a substantial number of people are diagnosed with cancer, leading to death. According to the American Cancer Society, cancer-related deaths make up around 2-4% of the total annual mortality globally. Hence, cancer causes the death of more than 3.5 billion individuals annually on a global scale. Several chemopreventive medications are utilized in cancer treatment; however, their effectiveness is limited due to the damage they cause. Escalating costs linked to conventional therapies like chemotherapy and radiation, coupled with the lack of effective drugs for treating solid tumors, have led individuals in different countries to increasingly turn to folk medicine, which involves the use of medicinal plants. Assess different technologies such as Oral Biologics, Osmotic medication delivery system, and vasodilator medicines. These plants have a remarkable capacity to produce chemicals that attract researchers in their quest for novel chemotherapeutic medicines. Among the 5000+ current anti-cancer clinical trials recorded by the National Cancer Institute in July 2023, over 200 trials focus on combinations of medications to treat different types of cancer.[1,2]

2. CANCER AND ITS CLASSIFICATION

Cancer is an umbrella term that encompasses a variety of malignant diseases that can affect different parts of the body. These illnesses are characterized by a rapid and uncontrolled proliferation of aberrant cells, which can form a mass or tumor, or metastasize to other parts of the body, causing abnormal growth. If the process is not stopped, it may progress until it results in the death of the organism. The main methods employed to treat late-stage cancer in

humans are surgery, radiation therapy, and the use of cancer chemotherapeutic drugs. Cancer chemotherapeutic treatments often provide temporary respite from symptoms, prolongation of lifespan, and occasional cases of complete recovery. Lately, there has been a notable emphasis on the development of potential pharmaceuticals that can effectively combat cancer. A multitude of chemical derivatives belonging to the recognized class of cancer chemotherapy agents have been synthesized. However, these derivatives demonstrate a greater frequency of adverse effects. An efficient antineoplastic drug should specifically eradicate or incapacitate cancerous cells while minimizing damage to normal cells. Achieving this objective is challenging, if not impossible, which is why individuals with cancer frequently encounter unfavorable side effects throughout treatment. However, despite a considerable amount of synthetic work, the improvements made to the original drugs have been minimal. There is a continuous need for new prototypes and templates to be used in the development of potential chemotherapeutic drugs. By providing such templates, natural materials are meeting this requirement. A plethora of novel structures has been discovered through recent research on tumor-inhibiting chemicals originating from plants.[1,3,4,5]

Type of Cancers

a. Cancers of Blood and Lymphatic Systems

- Hodgkin’s disease
- Leukemia’s
- Lymphomas
- Multiple myeloma
- Waldenstrom's disease

b. Skin Cancers

- Malignant Melanoma

c. Cancers of Digestive Systems

- Esophageal cancer
- Stomach cancer
- Cancer of pancreas
- Liver cancer
- Colon and Rectal cancer
- Anal cancer

d. Cancers of Urinary system

- Kidney cancer
- Bladder cancer
- Testis cancer
- Prostate cancer

e. Cancers in women

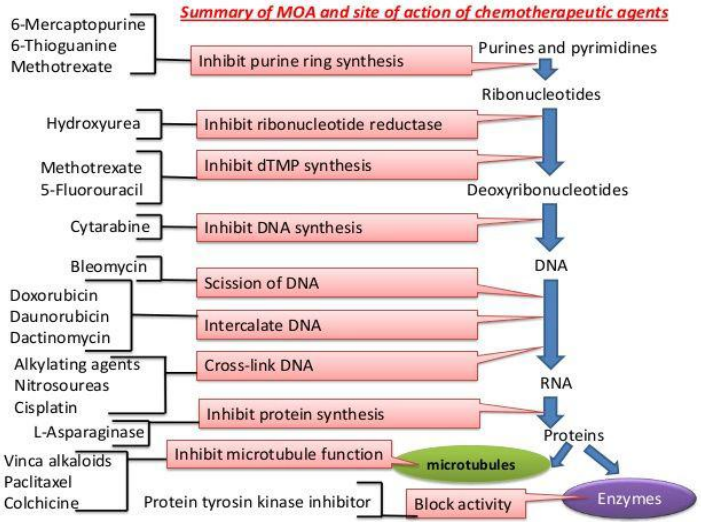
- Breast cancer
- Ovarian cancer
- Gynecological cancer
- Choriocarcinoma

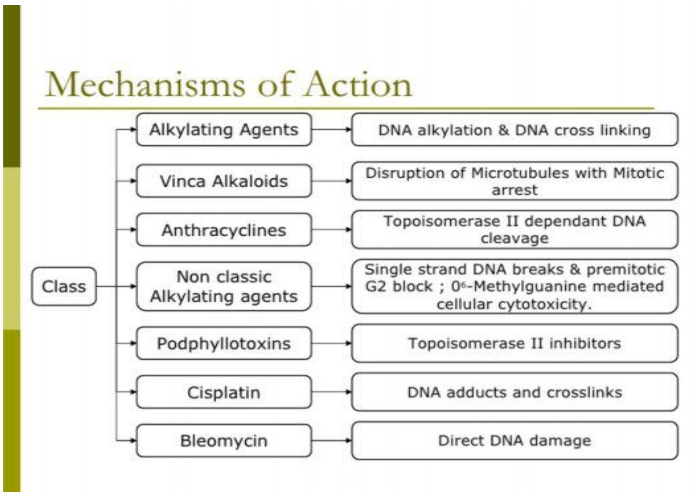
f. Miscellaneous cancers

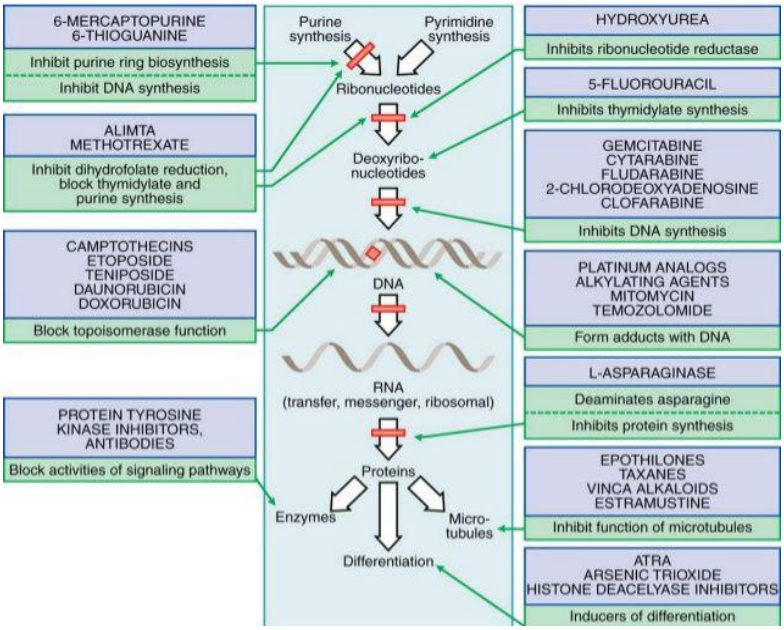
- Brain cancer
- Bone cancer
- Characinoid cancer
- Nasopharyngeal cancer
- Retroperitoneal sarcomas
- Soft tissue cancer
- Thyroid cancer

Worldwide, breast cancer is the most prevalent type of cancer. Within the population of South African women, the incidence of breast cancer is approximately 1 in 31. In India, breast cancer is the second most prevalent cancer among women, following uterine cervical cancer.[1,6,7]

Principle on Cancer Therapy







3. CHEMOTHERAPY

Although adjuvant CTX is frequently used for primary tumors, its main objective is to control the evident dissemination of the disease. Cancer cells, because of their excessively active growth-signaling pathways, are extremely susceptible to a range of drugs that particularly target substances and processes involved in cellular reproduction and expression. However, as these processes also have an influence on normal cells, the effect is not exclusive but rather selective, resulting in the unwanted side effects reported with these medications. Cells that undergo frequent division, such as those found in the bone marrow and the lining of the intestines, are particularly susceptible. Genetic anomalies in cancer cells can cause aberrant cell cycle events, which could potentially be targeted without affecting normal cells. Cytotoxic medications exhibit a wide spectrum of activity, rendering them a potent yet indiscriminate kind of therapy. Nevertheless, their utilization is restricted to brief durations because of their limited tolerability. Without a doubt, the treatment's impact can often cause more distress than the disease itself. The adverse consequences include xerosis, alopecia, emesis, dysgeusia, anorexia, coagulopathy, fatigue, immunosuppression, and possible infertility.[1,8,9]

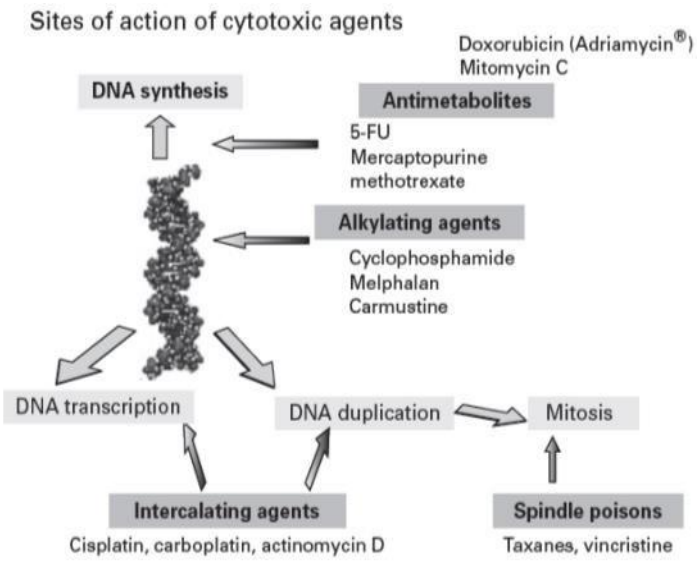


Figure 1: Sites of action of cytotoxic agents.[1]

4. ONCOGENES AND TUMOR SUPPRESSOR GENES

The progression of cancer is regulated by two distinct sets of genes. Oncogenes, the primary set of genes, contribute to multiple biological activities, such as cell division. However, the overexpression of these genes leads to the transformation of a normal cell into a malignant cell. In contrast, the second set of genes, referred to as tumor suppressor genes, inhibit the

formation of cancer cells by several mechanisms. Cancer cells display reduced expression of tumor suppressor genes, while showing increased expression of oncogenes. Table 1 presents a succinct summary of the main oncogenes and tumor suppressor genes, together with their specific roles in the advancement of cancer. Cancer therapy can effectively target oncogenes and their products. Other targets include enzymes involved in cell division, such as topoisomerases, which aid in the unwinding of DNA during replication. The diverse array of organic chemicals obtained from plants provides a multitude of treatment possibilities that can specifically and efficiently target different types of cancer cells.[1,2,10,11,12]

5. PLANT DERIVED ANTI-CANCER DRUGS

1) Vinca Alkaloids

The first medications used in medical treatment were vinca alkaloids, notably vinblastine (VLB) and vincristine (VCR), which were derived from the Catharanthus roseus plant of the Apocynaceae family.The identification of these pharmaceuticals occurred as part of a study focused on discovering oral hypoglycemic drugs. While the researchers were unable to confirm this function, they did notice a significant decrease in white blood cell counts and bone marrow depression in rats due to the use of plant extracts. Additionally, the application of plant extract has been found to increase the lifetime of mice that have been transplanted with lymphocytic leukemia. The plant's indigenous range was restricted to Madagascar, however, the samples used for identifying vincristine and vinblastine were sourced from the Philippines and Jamaica. Vinorelbine (VRLB) and vindesine (VDS) are two instances of semi-synthetic derivatives of vinca alkaloids. These treatments are mostly administered either alone or in combination with other chemotherapy drugs to treat different forms of cancers. VLB is employed for the treatment of lymphomas, leukemias, breast cancer, testicular cancer, lung malignancies, and Kaposi’s sarcoma. The VCR has proven to be beneficial in the treatment of leukemia, namely acute lymphocytic leukemia in children.[1,13,14,15]

2) Podophyllotoxin Derivatives

Species belonging to the Podophyllaceae family, such as Podophyllum peltatum Linn. and Podophyllum emodii, have an extensively documented history of being used for therapeutic purposes, specifically in the treatment of skin cancers and warts. The Native Americans have employed Podophyllum peltatum for the management of "cancer". The curiosity was ignited by the revelation in the 1940s that a concentrated solution of the dried roots, referred to as podophyllin, efficiently cures venereal warts when directly applied to the affected region. The

main dangerous pharmaceutical compounds were identified as podophyllotoxins and were initially separated in 1880. Nevertheless, the precise configuration of podophyllotoxins was only ascertainable in the 1950s as a result of developments in spectroscopic techniques. During this timeframe, additional chemicals known as lignans, which have resemblance to podophyllotoxins, were identified and subjected to human testing. Nevertheless, they were finally discarded due to their proven inefficacy and detrimental side effects. Etoposide and teniposide were discovered as a result of the substantial research carried out at Sandoz Laboratories in Switzerland throughout the 1960s and 1970s. These chemicals have since been used as successful medical therapies for lymphomas, as well as bronchial and testicular cancers. Among the 5000+ current clinical trials for anti-cancer medicines registered by the National Cancer Institute (NCI) in July 2023, over 200 of them incorporate medication combinations containing etoposide. The purpose of these trials is to evaluate the efficacy of certain medication combinations in treating different types of cancers.[1,16,17]

3) Allium Sativum (Allicin)

Allium sativum, sometimes known as garlic or lasun, is used in India to treat a wide variety of illnesses. Allicin is a major component present in uncooked garlic, whereas ajoene is a chemical that is produced by the reorganization of allicin. The substance's cytotoxicity has been assessed using human primary fibroblasts, a stable non-tumorigenic cell line obtained from baby hamster kidney cells, and a tumorigenic lymphoid cell line derived from a Burkitt lymphoma. The cytotoxic activity varied between 2 and 50 µg/ml. Organo-sulfur compounds generated from garlic, such as S-allylcysteine, have been discovered to hinder the growth of chemically induced and transplantable malignancies in several animal models. Administering garlic orally to male Wistar rats at a dosage of 250 mg/kg, three times a week, has effectively suppressed the growth of tongue cancer caused by 4-nitro quinoline-1-oxide. This is apparent from the absence of carcinomas during the beginning stage and the decreased prevalence of carcinomas during the subsequent stage. Garlic consumption may provide a safeguarding effect against cancer.[1,18,19]

4) Andrographis Paniculata

Phytochemical analysis of the ethanol extract from the above-ground parts of Andographis paniculata has led to the identification of 14 individual compounds. The majority of these chemicals consist of flavonoids and labdane diterpenoids. The chemicals have been evaluated for their cytotoxic effects against various cell lines. These isolates were found to possess a

potent potential to inhibit tumor growth in all cell lines that were investigated. Three active compounds were identified in the dichloromethane fraction of the methanol extract of Andrographis paniculata. Subsequently, these compounds were assessed and demonstrated to possess both cytotoxic and potent immunostimulating properties. However, there were also recorded adverse effects linked to it, including gastrointestinal pain, headache, foul taste, and fatigue. Excessive amounts of Andographis paniculata have the potential to interfere with the regular operation of the liver.[1,20,21]

5) Annona Muricata

Annona muricata is the scientific designation for Graviola. Graviola has an important class of medicinal chemicals known as acetogenins. Acetogenins have been found in different components of the graviola plant, including as the fruit, seeds, leaves, and bark. Preliminary experiments have shown that acetogenins inhibit the production of adenosine triphosphate, therefore obstructing the activity of the pump that removes cancer drugs from the cell. This inhibition allows chemotherapy to have a stronger impact. Furthermore, scientific studies suggest that acetogenin exhibits chemotherapeutic characteristics, specifically targeting drug-resistant types of cancer. Ingesting graviola orally can result in the development of symptoms that resemble those of Parkinson's disease. Various specific acetogenins have been recognized as cytotoxic to various cancer cell lines, such as lung solid human-breast cancer, tumor carcinoma, pancreatic carcinoma, prostatic adenocarcinoma, colonic adenocarcinoma, human lymphoma, liver cancer, and multiple-drug resistant human-breast adenocarcinoma.[1,22]

6) Apis Mellifera

Apis mellifera is the scientific classification for the honey bee, a species that plays a crucial role in honey production. Honey is employed in the Indian medical system to accelerate the healing of skin lesions, ulcerations, and burns. A protein derived from the honeybee species Apis mellifera has been discovered to promote the proliferation of rat liver cells that are being cultured in a laboratory setting. Additionally, this protein also hinders the process of programmed cell death. Furthermore, it has exhibited cytotoxic properties on both healthy human lymphocytes and HL-60 cells. Hamzaoglu et al. (2000) inoculated cancer cells into the neck wounds of mice and then divided the mice into two groups. The cohorts of mice that were administered surgical incisions treated with honey both prior to and following the

procedure displayed a significant decrease in malignant tumors at the site of the wound. This research has the potential to be utilized in the field of human surgery.[1.23]

7) Bidens Pilosa

Bidens pilosa is a conventional medicinal plant recognized for its composition of polyacetylenes, flavonoids, terpenoids, phenylpropanoids, and various other chemicals. A comprehensive research investigation was undertaken on different extracts of Bidens pilosa, followed by subsequent fractionation, leading to the extraction and identification of a potential marker chemical called phenyl-1,3,5-Heptatriyne. The marker compounds were utilized to evaluate the toxicity of regular blood cells in research on erythrocyte osmotic fragility, along with other extracts. The anti-cancer efficacy of Bidens pilosa was assessed by examining the impact of its hexane, chloroform, and methanol extracts and their fractions on several cancer cell lines. The findings revealed the anti-cancer characteristics of the extracts, with the hexane extract exhibiting the most notable effect.[1,24]

8) Bolbostemma Paniculatum

Through the process of extraction and separation, the Chinese herb Bolbostemma paniculatum (Cucurbitaceae) was used to isolate and identify a triterpenoid saponin known as Tubeimoside-V. Further investigation on tubeimoside-V has revealed its capacity to trigger apoptosis in glioblastoma cells, highlighting its essential role in anticancer therapy. Furthermore, other tubeimosides, namely tubeimodes-I, tubeimoside-II, and tubeimoside-III, have demonstrated noteworthy cytotoxic activity. The reason for this activity is most likely their capacity to inhibit DNA synthesis and maybe induce the reversal of tumor cell characteristics.[1,25]

9) Cannabis Sativa

Research conducted in a controlled laboratory environment on the specific components present in marijuana (Cannabis sativa) indicates that these substances possess the capacity to inhibit the proliferation of human breast cancer cells and perhaps eradicate tumors. Studies involving the use of marijuana to malignant brain tumors demonstrated a significant improvement in the survival rate of mice.Cannabinoids are the bioactive components of Cannabis sativa. Cannabinoids and their derivatives mitigate symptoms in cancer patients by suppressing nausea, vomiting, and pain, while concurrently enhancing appetite. These compounds have shown anti-tumor effects in cell culture and animal models by modifying crucial cell-signaling pathways.[26,27,28]

10) Daphne Mezereum

Daphne mezereum is a shrub frequently used in traditional medicine to relieve symptoms that resemble those of cancer. A hydroalcoholic extract of Daphne mezereum has shown potent antileukemic activity against lymphocytic leukemia in mice. Further fractionation tests performed on the extract resulted in the isolation and characterization of mezerein as a potent antileukemic compound.[29,30]

11) Gossypium Hirsutum

Gossypium hirustum, often called Gossypium herbaceum, is a plant species widely known as Gossypol or cottonseed oil. It is employed as a male contraceptive and for treating metastatic cancer of the endometrium or ovary. Moreover, it has practical uses in the administration of HIV. Research conducted both in living organisms (in vivo) and in laboratory settings (in vitro) has demonstrated that gossypol exhibits anticancer properties. This compound specifically inhibits many cytosolic and mitochondrial enzyme systems that play a vital role in the growth and spread of cancer cells. It effectively targets tumor cells found in melanoma, endometrial, colon, lung, prostate, breast, brain, and adrenocortical malignancies. At now, there is no officially prescribed amount of gossypol for the purpose of treating cancer. It is crucial to acknowledge that self-administering gossypol as a medication is hazardous because of its inherent toxicity.[31,32]

12) Nervilia Fordii

Nervelia fordii is a traditional medicinal ingredient used in China for therapeutic purposes. The anticancer properties of Nervilia fordii were assessed by testing petroleum ether and ethyl acetate extracts on mice models. Both extracts have exhibited substantial anticancer activities when administered to S-180 mice and H-22 mice models. Moreover, it has been discovered that they can extend the lives of mice afflicted with cancer. This study suggests that Nervilia fordii exhibits the potential to serve as a cancer-inhibiting agent. However, additional investigation is required to determine the precise active ingredient(s) present in the medication.[1,35]

13) Salvia Miltiorrhiza

The effect of Tanshinone-I, derived from the traditional herb Salvia miltiorrhizae, on the expression of intercellular adhesion molecule was investigated. The study revealed a potential anti-cancer effect of tanshinone-I on breast cancer cells, suggesting that tanshinone-I may be a powerful medicine for the treatment of breast cancer. Tanshinone II-A, obtained from

Salvia miltiorrhiza, induced apoptosis by the proteolytic cleavage of a crucial component involved in the process of programmed cell death.[1,36]

14) Terminalia Chebula

Terminalia chebula is a botanical species that possesses hydrolysable tannins, which have demonstrated antimutagenic properties in Salmonella typhimurium.Phenols, including chebulinic acid, tannic acid, and ellagic acid, has anticancer properties by inhibiting the growth of cancer cells. The chemicals are found in the fruits of Terminalia chebula. The powdered fruits and acetone extract derived from the bark of Terminalia chebula have exhibited notable antimutagenic and anticarcinogenic activities.[37]

15) Zingiber Officinale

The potential anticancer effects of Zingiber officinale ethanol extract were investigated using a model of skin carcinogenesis. The application of Zingiber officinale ethanol extract to the skin of mice prior to exposure to 12-0-tetradecanoylphorbol-13-acetate (TPA) effectively inhibited the activation of epidermal ODC, cyclo oxygenase, and lipoxygenase enzymes, as well as the expression of ODC mRNA. The extent of this suppression was dependent on the dosage of the extract. Topical administration of Zingiber officinale ethanol extract on mice before TPA treatment markedly decreased the incidence of epidermal edema and hyperplasia. Topical application of Zingiber officinale ethanol extract to mice, 30 minutes before to each injection of TPA, a carcinogenic agent that induces skin tumors, resulted in a noteworthy decrease in both the frequency and quantity of skin tumors.[39]

List of Anticancer plants

Sr. No.	Plant Name/Family	Habitat	Active Constituent	Class
1	*Agapanthus africanus* Agapanthace	S. Africa	Isoliquiritigenin	Chalcone
2	*Aglaila sylvestre* Meliaceae	India	Silvesterol	-
3	*Ailanthus Altissima* Simaraubaceae	China	Ailnthone, Ailantenol	Quassinoids
4	*Apium graveolens* Umbelliferae	N. America	Apigenin	Flavonoid
5	*Bleckeria vitensis* Apocynaceae	France	Ellipticine	Alkaloid
6	*Brucea antidysenterica* Simaraubaceae	Africa	Bruceantin	Quassinoid
7	*Bursera microphylla* Burseraceae	Mexico	Burseran	Lignan

8	*Campotheca acuminate* Nyssaceae	China	Campothecin	Alkaloid
9	*Catharanthus roseus* Apocynaceae	India,Africa	Vincristine, Vinblastine	Alkaloid
10	*Centaurea montata* Asteraceae	Europe	Montamine	Alkaloid
11	*Centaurea schischkinii* Asteraceae	----------	Schischkinnin	Alkaloid
12	*Cephalotaxus harringtonia* Cephalotaxaceae	Japan	Homoharringtonine	Alkaloid
13	*Cleistanthus collinus* Euphorbiaceae	India	Cleistanthin, Collinusin	Lignan
14	*Combretum caffrum* Combretaceae	S.Africa	Combrestatins	Stilbenes
15	*Croton lechleri* Euphorbiaceae	S.America	Taspine	Alkaloid
16	*Daphne mezereum* Thymelaeaceae	Asia, Europe	Mezerein	-------
17	*Diphylleia grayi* Berberidaceae	Japan	Diphyllin	Lignan
18	*Dysoxylum binectariferum* Meliaceae	India	Rohitukine	Alkaloid
19	*Erythroxylum pervillei* Erythroxylaceae	Madagascar	Pervilleine	Alkaloid
20	*Euphorbia semiperfoliata* Euphorbiaceae	Europe	Jatrophane	Terpenoid
21	*Fritillaria thunbergia* Liliaceae	China,Japan	Zhebeinone	Alkaloid
22	*Gunnera perpensa* Gunneraceae	Brazil	2-methyl-6(3-methyl 2-butenyl) benzo 1-4 quinone	Quinone
23	*Hypericum perforatum* Clusiaceae	Europe	Hypericin	Anthraquinone
24	*Hypoxis colchicifolia* Hypoxidaceae	S.Africa	Hypoxoside, Rooperol	Glycoside
25	*Indigofera tinctoria* Leguminosae	Asia	Indirubins	Indigoids
26	*Justicia procumbens* Acanthaceae	India	Justicidin A,B	Lignan
27	*Lantana camara* Verbenaceae	America	Verbascoside	Glucoside
28	*Larrea tridentate* Zygophyllaceae	Mexico	Terameprocol	Lignan
29	*Linium album* Linaceae	---------	Podophyllotoxin	Lignan
30	*Lonicera japonica* Caprifoliaceae	Japan	Luteolin	Flavanoid
31	*Paris polyphilla* Trilliaceae	China	Polyphyllin	---------

32	*Pestemon deustus* Serophulariaceae	U.S.A	Liriodendrin	Lignan
33	*Phaleria macrocarpa* Thymelaeaceae	Indonesia	Pinoresinol, Laricinesinol	Lignan
34	*Podophyllum emodii* Berberidaceae	India	Epipodophyllotoxin	Alkaloid
35	*Polygonum cuspidatum* Polygonaceae	Japan,China	Resveratrol	Flavanoid
36	*Pteris multifida* Pteridaceae	Japan	Pterokaurane	Terpenoid
37	*Pygeum africanum* Rosacea	Africa	Amygdalin	Glycoside
38	*Vitex rotundifolia* Verbenaceae	India, Korea	Casticin	Flavanoid
39	*Wikstroemia viridi* Thymelaeaceae	China	Wikstromol	Caumarin

6. CONCLUSION

Medicinal plants maintain the health and vitality of persons while also providing treatment for various illnesses, including cancer, without causing toxicity. Medicinal plants have provided valuable natural substances that have made a substantial contribution to the treatment of cancer. This review focuses on several medicinal plants that possess anti-cancer potential. The plants contain a chemical that has strong immunomodulatory and antioxidant properties, which contribute to its ability to fight against cancer. This article provides global information about foreign medicinal plants that possess anticancer effects. Moreover, it is imperative to utilize recently produced anti-cancer drugs derived from medicinal plants. The lack of this early warning system presents a major obstacle in dealing with the emergence of chemoresistance. An ideal approach would involve tailoring therapy to suit the unique needs of each individual right from the start. Nevertheless, it is unlikely that this will occur in the foreseeable future, despite notable progress in pharmacogenomics. Furthermore, acquiring a more thorough understanding of the mechanisms of resistance will empower the physician to adapt the treatment as needed. The utilization of medicinal plants has greatly improved the overall health and quality of life for individuals. It is necessary to screen the valuable data on plant extracts and their bioactive components that contribute to their anticancer properties. This review has revealed multiple plants that demonstrate anti-cancer effectiveness against different types of cancer.

REFERENCES

1. Pravinkumar Darji, Jayendrakumar Patel, Binit Patel, Arpan Chudasama, Praneeth Ivan Joel FNU, Seshadri Nalla. A comprehensive review on anticancer natural drugs. World journal of pharmacy and pharmaceutical sciences, 2024; 13(4): 717-734. DOI: 10.20959/wjpps20244-27049.
2. Sharma P, Majee C. A review on Anticancer Natural drugs. International journal of pharmtech research, 2015; 8(7): 131-141.
3. Darji P, Patel J, Patel B, Chudasama A, Joel P, Nalla S. Recent method to improve stability profile, pharmacokinetic and pharmacodynamic properties in anticancer drugs. *World journal of pharmaceutical and life sciences*, 2024; 10(3): 216-229.
4. Kharb M., Jat R.K. and Gupta A., A review on medicinal plants used as a source of anticancer agents,Int. J. Drug Res. Tech., 2012; (2): 177-183.
5. Kaur R., Singh J., Singh G., kaur H., Anticancer plants:A Review, J. Nat. Prod. Plant Resour., 2011; 1(4): 131-136
6. Prakash O., Kumar A., Kumar P., Ajeet., Anticancer Potential of Plants and Natural Products,American J. Ph.cological Sci., 2013; 1: 104-115.
7. Wamidh H.T., Anticancer and Antimicrobial Potential of Plant-Derived Natural Products,Phytochemicals – Bioactivities and Impact on Health., Dec., 2011; 142-158.
8. Bhutani K.K. and Gohil V M., Natural product drug discovery research in India:Status & appraisal,Ind. J. Exp. Bio., 2010; 48: 199-207.
9. Dholwani K.K., Saluja A.K., Gupta A.R., Shah D.R., A Review on Plant – derived natural products &their analogs with antitumor activity, Ind. J. Pharmacol., Apr. 2008; 40(2): 49-58.
10. Merina N., Chandra K.J. and Kotoky Jibon., Medicinal plants with potential anticancer activity: A Review, IRJP, 2012’ 3(6): 26-30.
11. Mi Ja Chung., Cha-Kwon Chung., Yoonhwa Jeong., Seung-Shi Ham., Anticancer activity of subfractions containing pure compounds of Chaga mushroom (Inonotus obliquus) extract in human cancer cells and in Balbc/c mice bearing Sarcoma-180 cells, Nutr Res Pract., 2010; 4: 177–182.
12. Srinivas K. and Afolayan. A.J., Anticancer drug design based on plant-derived natural products, Current Science, 2007; 92: 906-8.
13. Prayag Raval, Seshadri Nalla, Arpan Chudasama. Recent advancement on oral biologics. World journal of pharmacy and pharmaceutical sciences, 2024; 13(4): 687-716. DOI: 10.20959/wjpps20244-27035.

14. Chorawala M.R., Oza P.M. and Shah G.B., Mechanisms of Anticancer Drugs Resistance: An Overview, International Journal of Pharmaceutical Sciences and Drug Research., 2012; 4(1): 1-09.
15. Ghosh A., Das B., Roy A., Mandal B., and Chandra G., Antibacterial activity of some medicinal plant extracts, Journal of Natural Medicines, 2008; 62: 259–262.
16. Grayer R. and Harborne J., A survey of antifungal compounds from plants, Phytochemistry, 1994; 37: 19-42.
17. Z., Michael S., Eran Ben-A., and Bashar S., Greco-Arab and Islamic Herbal-Derived Anticancer Modalities: From Tradition to Molecular Mechanisms, Evidence-Based complementary and Alternative Medicine, 2012; 13.
18. Wen T., Jinjian L., Mingqing H., Yingbo Li., Meiwan C., Guosheng W., Jian G., Zhangfeng Z.,Zengtao X., Yuanye D., Jiajie G., Xiuping C., and Yitao W., Anti-cancer natural products isolated from chinese medicinal herbs, Chin Med., 2011; 6: 27.
19. Prema R., Sekar S.D., Chandra Sekhar K B., Review On: Herbs As Anticancer Agents, Int. J. Pharma & Ind. Res., 2011; 1: 105.
20. Scharfenberg K., Wagner R. and Wagner K.G., The cytotoxic effect of adjoin, a natural product from garlic, investigated with different cell lines, Cancer Letters, 1990; 53(3): 103.
21. Thomson M. and Ali M., Garlic (Allium sativum): a review of its potential use as an anti-cancer agent.,Current Cancer Drug Targets, 2003; 3(1): 67.
22. Geethangili M., Rao Y.K., Fang S.H. and Tzeng Y.M., Cytotoxic constituents from Andrographis paniculata induce cell cycle arrest in jurkat cells, Phytotherapy Research., 2008; 22(10): 1336.
23. Kumar R.A., Sridevi K., Kumar V.N., Nanduri S and Rajagopal S., Anticancer and immunostimulatory compounds from Andrographis paniculata, Journal of Ethnopharmacology., 2004; 92(2-3): 291.
24. Muriel J.M., Herbs or Natural Products That Decrease Cancer Growth, Oncology Nursing Forum, 2004; 31(4): 75.
25. Khwaja TA., Dias CB., Pentecost S., Recent studies on the anticancer activities of mistletoe (Viscum album) and its alkaloids, Oncology, 1986; 43: 42-50.
26. Lee Y.J., Kang S.J., Kim B.M., Kim Y.J., Woo H.D. and Chung H.W., Cytotoxicity of honeybee (Apismellifera) venom in normal human lymphocytes and HL-60 cells, Chemical Biology Interaction, 2007; 169(3): 189.

27. Kupchan S.M. and Baxter R.L., Mezerein: anti leukemic principle isolated from Daphne mezereum, Life Science, 1975; 187(4177): 652.
28. Zhen H.S., Study of anticancer effect in vivo of active fraction from Nervillia fordii, Zhong, Yao Cai, 2007; 30(9): 1095.
29. Nizamutdinova I.T., Lee G.W., Lee J.S., Cho M.K., Son K. H. and Jeon S.J., Tanshinone - I suppresses growth and invasion of human breast cancer cells, MDA- MB- 231, through regulation of adhesion molecules, Carcinogenesis., 2008; 29(10): 1885.
30. Yoon Y., Kim Y., Jeon W.K., Park H.J. and Sun H.J., Tanshinone IIA isolated from Salvia miltiorrhiza B. induced apoptosis in HL60 human premyelocytic leukemia cell line, Journal of Ethno pharmacology, 1999; 68(1): 121.
31. Saleem M., Hushum M., Harkonen P., Pihlaja K., Inhibition of cancer cell growth by crude extract and phenolics of Terminalia chebula fruit, Journal of Ethno pharmacology, 2002; 81: 327.
32. Katiyar S.K., Agarwal R. and Mukhtar H., Inhibition of tumor promotion in SENCAR mouse skin by ethanol extract of Zingiber officinale rhizome, Cancer Research., 1996; 56(5): 1023.
33. Mingji. P., Cancer treatment with Fu Zheng Pei Ben Principal, Fujjan Science and Technology Publishing House., Fuzhou, 1992; 10-12.
34. Binit Patel, Archita Patel, Dilip Ghava, Rikeeta Padiya, Pravinkumar Darji, Development and validation of stability indicating rp-hplc method for estimation of cyclandelate in bulk drug and capsule dosage form. Journal of medical pharmaceutical and allied sciences, 2023; 12 - I 6: 6247 – 6253. Doi:https://doi.org/10.55522/jmpas.V12I6.5943.
35. Pravinkumar Darji, Jayendrakumar Patel, Binit Patel, Shalin Parikh, Praneeth Ivan Joel FNU. Overview on osmotic drug delivery system. International journal of pharmaceutical research and applications, 2024; 9(1): 86-100. DOI: 10.35629/7781-090186100.
36. Schnall S., Macdonald J.S. Mitomycin therapy in gastric cancer. Oncology, 1993; 50((Suppl. 1)): 70–77. doi: 10.1159/000227249. [PubMed] [CrossRef] [Google Scholar]
37. Muggia F.M., Kelley S.L. Teniposide in adult solid tumors: A historical perspective. Semin. Oncol, 1992; 19: 43–50. [PubMed] [Google Scholar]
38. Barata P.C., Sartor A.O. Metastatic castration-sensitive prostate cancer: Abiraterone, docetaxel, or… Cancer, 2019; 125: 1777–1788. doi: 10.1002/cncr.32039. [PubMed] [CrossRef] [Google Scholar]

39. Pravinkumar Darji, Jayendrakumar Patel, Binit Patel, Shalin Parikh, Praneeth Ivan Joel FNU. Comprehensive review on oral biologics. World journal of pharmaceutical research, 2024; 13(3): 1217-1249. DOI:10.20959/wjpr20243-31160.
40. Voigtlaender M., Schneider-Merck T., Trepel M. Lapatinib. Recent Results Cancer Res., 2018; 211: 19–44. doi: 10.1007/978-3-319-91442-8_2. [PubMed] [CrossRef] [Google Scholar]
41. Ostendorf B.N., le Coutre P., Kim T.D., Quintás-Cardama A. Nilotinib. Recent Results Cancer Res., 2014; 201: 67–80. doi: 10.1007/978-3-642-54490-3_3. [PubMed] [CrossRef] [Google Scholar]