

# Review on Medicinal and Herbal Plant Used In Anti-cancer Activity

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## Abstract

Cancer is one of the life-threatening diseases which creates major problem in both the developing and developed countries. Demand for new methods to prevent this disease is growing increasingly. Plants have always been a basis for the traditional medicine systems and they have provided continuous remedies to the mankind for thousands of years. Medicinal plants are considered as a repository of various bioactive compounds and used for long time due to its therapeutic properties. Plant derived product has benefits over synthetic medicine which increased the utilization of medicinal plants in the healthcare sector as several plants' derived compounds show potential role against cancer treatment. Plant based anticancer agents includes vincristine, taxol, vinblastin, stigmasterol, camptothecin, resveratrol, etc., are in clinical use all over the world. In the present review, an effort has been made to provide the information about the role of various medicinal plants against cancer.

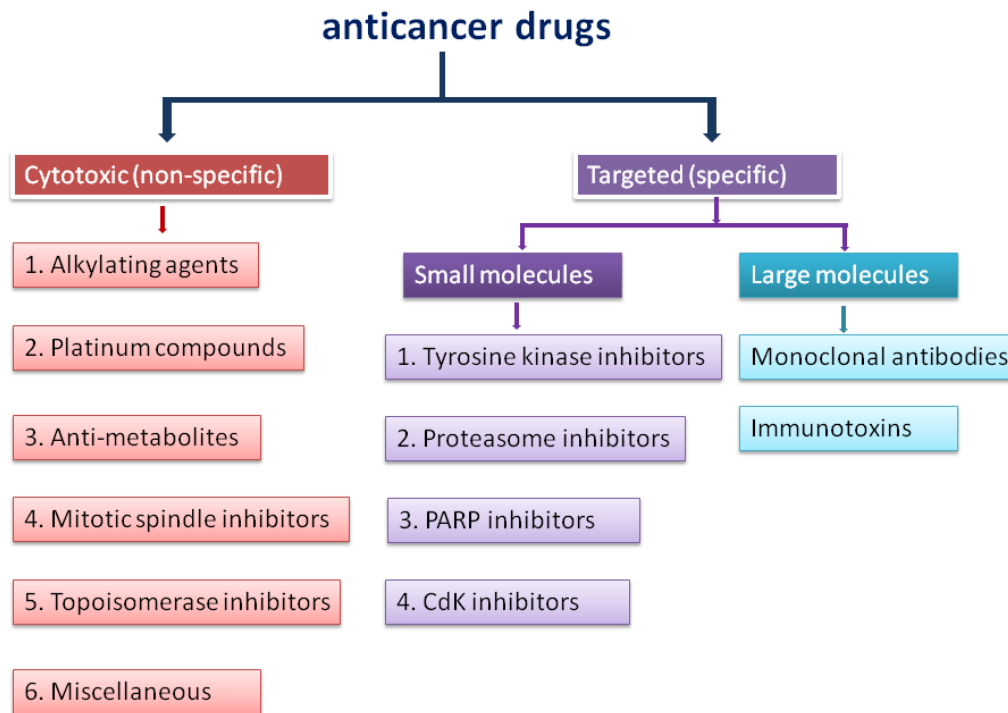
**Keywords:** Cancer; Anticancer agent; Medicinal plants; Bioactive compounds

## Introduction:

### Anti-Cancer Drugs :-

Anti-Cancer drugs are medicines formulated to treat wide range of cancer. Cancer is the uncontrolled growth of cells that interfere with the growth of healthy cells. The usual treatments of Cancer are surgery, chemotherapy (treatment with anticancer drugs), radiation, or some combination of these methods. Anti-Cancer drugs are targeted to control and treat various Cancer like, Breast cancer, Cervical cancer, Small cell lung cancer, Head and Neck cancer, Ovarian cancer, Hodgkin's and Non-Hodgkin's lymphoma, Osteosarcoma, Seminomas of testis, Myeloblastic leukemia, Lymphoblastic leukemia etc. The use and application of drugs synthesized or procured from natural or synthetic sources for cancer inhibition and cure is known as "chemotherapy" and the drugs are more commonly named as chemotherapeutic drugs.

**Classification Of Anticancer Drugs:<sup>2</sup>**

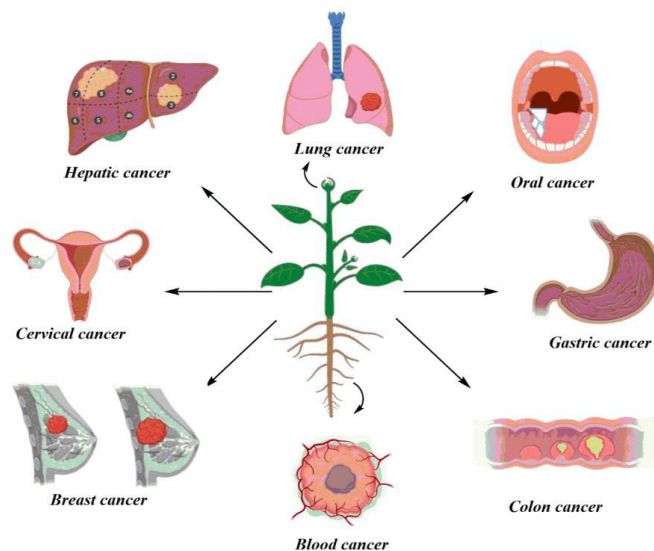


**Fig. 1 Classification of anticancer drug**

**Anti-Cancer Activity On Medicinal Plant:<sup>3</sup>**

The term “medicinal plant” include various types of plants used in herbalism ("herbology" or "herbal medicine"). It is the use of plants for medicinal purposes, and the study of such uses.

Cancer is an abnormal growth of cells in our bodies that can lead to death. It destroys the normal cells and creates an imbalance in the body. It is one of the most severe health problems in both developing and developed countries. It is very difficult to find the specific cause for cancer. However, tobacco use, alcohol consumption, environmental pollutant, infectious agents, custom habits and lifestyles are some commonly known reasons responsible for this disease.



**Fig. 2 Illustration of activity of plants against several types of cancers**

Environmental factor that contributes to the cancer deaths includes tobacco, obesity, radiation, infection, heredity, stress, environmental pollutants and lack of physical activity (lifestyle, economic and behavioral factors). Smoking causes 90% of lung cancer. It also causes kidney, stomach, pancreas, larynx, and bladder cancer. Tobacco is responsible for about one in five cancer death cases globally. Physical inactivity, obesity and diet are related to 30-35% of cancer deaths. Physical inactivity is believed to contribute to the cancer risk. More than half of the effect from diet is due to the over nutrition. Some specific foods are related to the specific type of cancers like high salt diet causes gastric cancer, aflatoxin B1 causes liver cancer and chewing betel nut causes oral cancer. Exposure to ionizing and non ionizing ultraviolet radiation causes cancer (up to 10%).

Source of ionizing radiations includes radon gas and medical imaging; this radiation is not particularly a strong mutagen. When radiation combines with other cancer causing agents then it is more potent like radon with the tobacco smoke. Prolonged ultraviolet ray exposure from sun light leads to skin cancer. Hereditary also causes cancer in some cases, less than 0.3% population carries genetic mutations that cause cancer. Examples of cancer due to hereditary include inherited mutation in BRCA1 and BRCA2 genes, hereditary non-polyposis colorectal cancer.

#### **Characteristics Of Medicinal Plants :<sup>4</sup>**

- **Synergic medicine-** The ingredients of plants all interact simultaneously, so their uses can complement or damage others or neutralize their possible negative effects.
- **Support of official medicine-** In the treatment of complex cases like cancer diseases the components of the plants proved to be very effective.
- **Preventive medicine-** It has been proven that the component of the plants also characterize by their ability to prevent the appearance of some diseases. This will help to reduce the use of the chemical remedies which will be used when the disease is already present i.e., reduce the side effect of synthetic treatment.

#### **Classification Of Medicinal Plants :<sup>5</sup>**

Classification of medicinal plants is organized in different ways depending on the criteria used. In general, medicinal plants are arranged according to their active principles in their storage organs of plants, particularly roots, leaves, flowers, seeds and other parts of plant. These principles are valuable to mankind in the treatment of diseases. Reports on the classification of many plant species yielding vegetable oils used in cosmetics and body and skin care preparations are sporadic or lacking.

#### **Based on part used :-**

1. Root: Dasamula
2. Stem: Tinosporacordifolia, Acoruscalamus
3. Bark: Saracaasoca
4. Leaf: Indigoferatinctoria, Lawsoniainermis, Aloe vera
5. Flower: Biophytumsensitivityum, Mimusopselenji
6. Fruit: Solanum species
7. Seed: Daturastramonium
8. Whole plant: Boerhaaviadiffusa, Phyllanthusneruri

**Based on habit :-**

1. Grasses: Cynodondactylon
2. Sedges: Cyperusrotundus
3. Herbs :Vernoniacineria
4. Shrubs: Solanum species
5. Climbers: Asparagus racemosus
6. Trees: Azadirachtaindica

**Based on habitat :-**

- 1.Tropical: Andrographispaniculata
- 2.Sub-tropical: Menthaarvensis
- 3.Temperate: Atropa belladonna

**Based on therapeutic value :-**

1. Anti-malarial : Cinchona officinalis, Artemisia annua
2. Anti-cancer :Catharanthusroseus, Taxusbaccata
3. Anti-ulcer :Azadirachtaindica, Glycyrrhizaglabra
4. Anti-diabetic :Catharanthusroseus, Momordicacharantia
5. Anti-cholesterol : Allium sativum
6. Anti-inflammatory : Curcuma domestica, Desmodiumgangeticum
7. Anti-viral : Acacia catechu
8. Anti-bacterial :Plumbagoindica
9. Anti-fungal : Allium sativum
10. Anti-diarrhoeal :Psidiumgujava, Curcuma domestica
11. Hypotensive : Coleus forskohlii, Aliumsativum
12. Tranquilizing :Rauvolfiaserpentina
13. Anaesthetic :Erythroxylum coca
14. Diuretic :Phyllanthusniruri, Centellaasiatica
15. Astringent : Piper betle, Abrusprecatorius
16. Anthelmentic :Quisqualisindica, Punicagranatum
17. Cardi tonic : Digitalis sp., Thevetia sp.

**Based on Ayurvedic formulation in which used :**

**a) The ten roots of the Dasamoola( Dasamoolam )**

1. Desmodiumgangeticum (Orila)
2. Urarialagopoides (Cheriaorila)
3. Solanumjacquinii (Kantakari)
4. Solanumindicum (Cheruchunda)
5. Tribulusterrestris (Njerinjil)
6. Aeglemarmelos (Koovalam)
7. Oroxylumindicum (Palakapayyani)
8. Gmelinaarborea (Kumizhu)
9. Steriospermumsuaveolens (Pathiri)

10. Premnaspinosus (Munja)

**b) The ten flowers of the Dasapushpa( Dasapushpam )**

1. Biophytumsensitivum (Mukkutti)
2. Ipomea maxima (Thiruthali)
3. Ecliptaprostrata (Kayyuniyam)
4. Vernoniacineria (Poovamkurunnil)
5. Evolvulusalsinoides (Vishnukranthi)
6. Cynodondactylon (Karuka)
7. Emelia sonchifolia (Muyalcheviyan)
8. Curculigoorchioides (Nilappana)
9. Cardiospermumhalicacabum (Uzhinja)
10. Aervalanata (Cherula)

**c) The four trees of the Nalpamara( Nalpamaram )**

1. Ficusracemosa (Athi)
2. Ficusmicrocarpa (Ithi)
3. Ficusrelegiosa (Arayal)
4. Ficusbenghalensis (Peral)

**d) The three fruits of the Triphala( Triphalam )**

1. Phyllanthusemblica (Nellikka)
2. Terminaliabellerica (Thannikka)
3. Terminaliachebula (Kadukka)

**Drug profile:**

**1. Ginseng (panax ginseng) :- 25**

**Common names:** Asian ginseng, Korean ginseng, Chinese ginseng. Chinese ginseng.

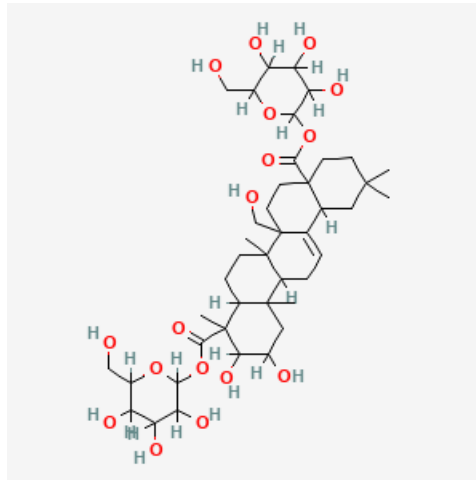
**Family:** Araliaceae



**Fig.3Panax ginseng**

**Molecular formula :** C<sub>42</sub>H<sub>66</sub>O<sub>17</sub>

**Chemical structure :**



**Dosing :** Ginseng root is standardized according to ginsenosides content, and can be chewed or taken as a powder, liquid extract, decoction, or infusion.

**Origin:** Northeast Asia

**Characteristics and chemical composition of ginseng**

**Panax ginseng root (radix)** Ginseng has an aromatic smell and a sweet, mild taste at first, then slightly bitter. The root is spindle-shaped, usually less than 2.5 cm in diameter, and less than 2.5 cm in diameter, and is more or less branched depending on the age of the plant.

According to the European Pharmacopoeia, the part used is the root of *Panax ginseng* C. A. Meyer, cut and dried (white ginseng) or steamed and dried (called red ginseng because of its red-brown colour).



**Fig.4 Panax ginseng root (radix)**

**Cultivation of Ginseng**

Ginseng has fairly stringent environmental requirements. It requires at least 70 percent shade. The soil must have enough base nutrients (15-20 percent base saturation) to meet its needs, but not so much that the soil pH exceeds 6 (liming is out of the question unless pH is too low). The soil must be moist, but

well-drained. To achieve this, the organic matter content has to be pretty high. Heavy clays and very sandy soils are poor for ginseng. Ginseng does not compete well with other plants, so vegetation control is necessary.

**2. Paclitaxel (Taxol) :-26**

**Synonyms :**paclitaxel , Taxol , Taxol A

**Class: -** Antineoplastic Agents - Antimitotic Agents - Antimicrotubule Agent



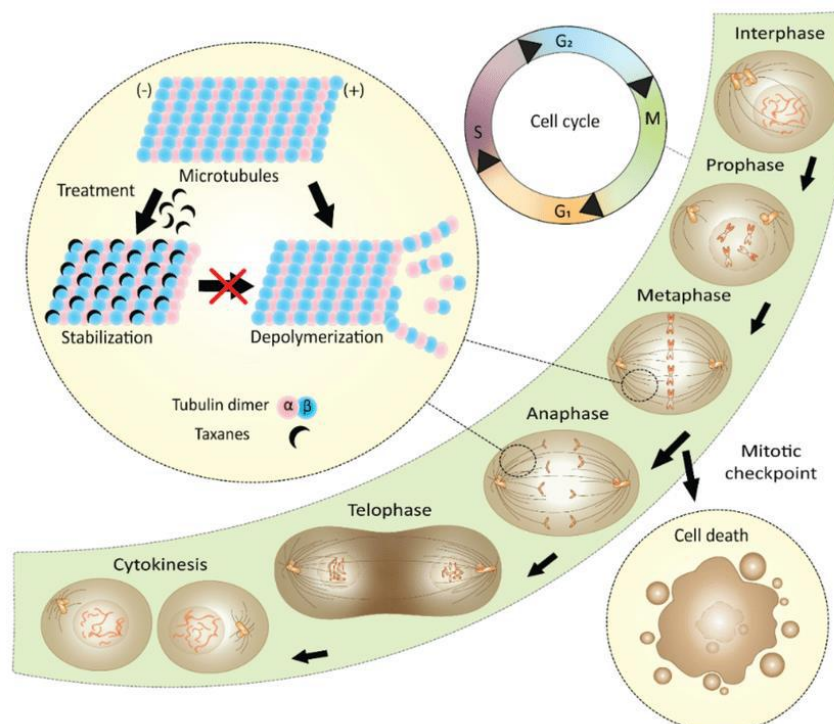
**Fig.5 paclitaxel plant**

**Molecular Formula :**C<sub>47</sub>H<sub>51</sub>NO<sub>14</sub>

**Brands :**Abraxane, Onxol, formerly available as Taxol

**Route of administration :**Intravenous (Iv)

**Mechanism of action :**<sup>27</sup>



### Anti-Cancer Activity On Herbal Plant :<sup>6</sup>

The word “**herb**” has been derived from the Latin word, “herba” and an old French word “herbe”. Now a days, herb refers to any part of the plant like fruit, seed, stem, bark, flower, leaf, stigma or a root, as well as a non-woody plant. Earlier, the term “herb” was only applied to non-woody plants, including those that come from trees and shrubs. These medicinal plants are also used as food, flavonoid, medicine or perfume and also in certain spiritual activities.

Cancer is a leading cause of mortality, and it strikes more than one-third of the world’s population and it’s the cause of more than 20% of all deaths. Among the causes for cancer are tobacco ,viralinfection, chemicals, radiation, environmental factors, and dietary factors. Surgery, chemotherapy and radiotherapy are the main conventional cancer treatment often supplemented by other complementary and alternative therapies in China.Plants has been used as an age old remedy of cancer history of use in the treatment of cancer.

Extensive research at Sandoz laboratories in Switzerland in the 1960s and 1970s led to the development of etoposide and teniposide as clinically effective agents which are used in the treatment of lymphomas, bronchial and testicular cancer. These plants may promote host resistance against infection by re-stabilizing body equilibrium and conditioning the body tissues.



**Fig.6 vinca herbal plant**



**Fig.7 turmeric herbal plant**



Several reports describe that the anticancer activity of medicinal plants is due to the presence of antioxidants present in them. In fact, the medicinal plants are easily available, cheaper and possess no toxicity as compared to the modern (allopathic) drugs. The development of novel plant-derived natural products and their analogs for anticancer activity details efforts to synthesize new derivatives based on bioactivity- and mechanism of action-directed isolation and characterization coupled with rational drug design-based modification. Oncogenes are regulators of cellular communication with the outside environment. They are derived through the mutation of proto-oncogenes. Mutated oncogenes are stimulated by exposure to chemical, environment or viral carcinogens, which leads to cell changes and they produce proteins which are either wrongly expressed within their normal cell or expressed in inappropriate tissue which leads to cellular proliferation and there by result in cancer formation.

### Drug Profile:

#### 1. Turmeric: <sup>28</sup>



fig.8 turmeric

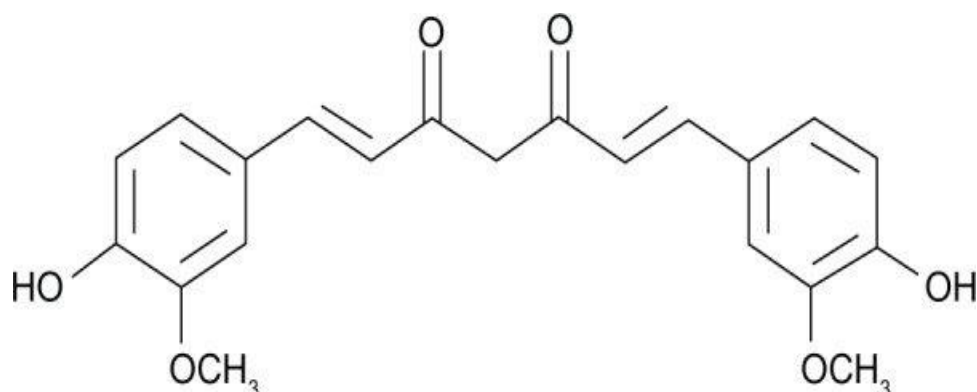
**Synonyms :** Saffron Indian; haldi (Hindi); Curcuma; Rhizoma cur-cumae.

**Biological Source :** Turmeric is the dried rhizome of *Curcuma longa* Linn. (syn. *C. domestica* Valetton), belonging to family Zingiberaceae.

**Geographical Source :** The plant is a native to southern Asia and is cultivated extensively in temperate regions. It is grown on a larger scale in India, China, East Indies, Pakistan, and Malaya.

**Chemical Formula :** C<sub>21</sub>H<sub>20</sub>O<sub>6</sub>

**Chemical structure :**



**Molar mass:** 368.38 g/mol

**IUPAC NAME :** (1E,6E)-1,7-bis (4-hydroxy- 3-methoxyphenyl) -1,6- heptadiene-3,5-dione

**Melting point:** 183 °C

**Boiling point:** 591.4 °C

**Cultivation :**

Turmeric plant is a perennial herb, 60–90 cm high with a short stem and tufted leaves; the rhizomes, which are short and thick, constitute the turmeric of commerce. The crop requires a hot and moist climate, a liberal water supply and a well-drained soil. It thrives on any soil-loamy or alluvial, but the soil should be loose and friable. The field should be well prepared by ploughing and turning over to a depth of about 30 cm and liberally manured with farmyard and green manures. Sets or fingers of the previous crop with one or two buds are planted 7 cm deep at distance of 30–37 cm from April to August. The crop is ready for harvesting in about 9–10 months when the lower leaves turn yellow. The rhizomes are carefully dug up with hard picks, washed, and dried.

**Chemical Constituents :**

Turmeric contains yellow colouring matter called as curcuminoids (5%) and essential oil (6%). The chief constituent of the colouring matter is curcumin I (60%) in addition with small quantities of curcumin III, curcumin II and dihydrocurcumin. The volatile oil contains mono- and sesquiterpenes like zingiberene (25%),  $\alpha$ -phellandrene, sabinene, turmerone, arturmerone, borneol, and cineole. Choleric action of the essential oil is attributed to  $\beta$ -tolylmethylcarbinol.

**Uses :**

- Turmeric is used as aromatic
- Anti-inflammatory
- Stomachic
- Uretic
- Anodyne for billiary calculus
- Stimulant
- Tonic
- blood purifier
- antiperiodic, alterative, spice,
- colouring agent for ointments and a common household remedy for cold and cough.

**Adulteration:**

The genuine drug is adulterated with the rhizomes of *Acoruscalamus*.

**Chemical Tests :**

1. Turmeric powder on treatment with concentrated sulphuric acid forms red colour.
2. On addition of alkali solution to Turmeric powder red to violet colour is produced.
3. With acetic anhydride and concentrated sulphuric acid Turmeric gives violet colour. Under UV light this colour is seen as an intense red fluorescence.

**Discussion:**

Cancer is becoming a high profile disease in developed and developing worlds. In 2007 the WHO published that in 2005, 7.6 million people died from cancer related diseases with the majority of these people living in low-income countries . In the United States cancer is the cause of 1 in 4 deaths and in 2010 it was estimated there were over 1.5 million new cases of cancer. Cancer Research UK said in 2012 14.1 million adults were diagnosed with cancer and 8.2 million people were killed by cancer globally . Therefore, the demand for a cure and the prevention of cancer is extremely high.

Increasing demand for plant-derived drugs is putting pressure on high-value medicinal plants and risking their biodiversity. Increasing populations, urbanization and deforestation are contributing to species endangerment in developing countries. To aid conservation of these species germplasm conservation, cryopreservation, tissue cultures and plant part substitution strategies need to be in place. Mass cultivation of medicinal plant species and utilizing raw by-products in industries may also help with conservation .

Plant-derived anticancer agents are effective inhibitors of cancer cells lines, making them in high demand. Exploitation of these agents needs to be managed to keep up with demands and be sustainable.

**Summary:**

Globally cancer is a disease which severely effects the human population. There is a constant demand for new therapies to treat and prevent this life-threatening disease. Scientific and research interest is drawing its attention towards naturally-derived compounds as they are considered to have less toxic side effects compared to current treatments such as chemotherapy.

"Cancer" is the term we give to a large group of diseases that vary in type and location but have one thing in common: abnormal cells growing out of control. It continues multiplying uncontrollably and the result of this accumulation of abnormal cells is a mass of cells called a "cancer".

The Plant Kingdom produces naturally occurring secondary metabolites which are being investigated for their anticancer activities leading to the development of new clinical drugs. Vinca Alkaloids, Taxans, podophyllotoxin, Camptothecins have been clinically used as Plant derived anticancer agents. With the success of these compounds that have been developed into staple drugs for cancer treatment new technologies are emerging to develop the area further. New technologies include nanoparticles for Nano-medicines which aim to enhance anticancer activities of plant-derived drugs by controlling the release of the compound and investigating new methods for administration.

**Conclusion:**

□ Chemically-derived drugs have been developed and other cancer treatments pre-exist . However, current methods such as chemotherapy have their limitations due to their toxic effects on non-targeted

tissues furthering human health problems. Therefore, there is a demand for alternative treatments with naturally-derived anticancer agents with plants being the desired source.

□ Every year, cancer takes the life of millions of people. Various therapies are available for the cancer treatment but they have several limitations such as kidney damage, gastro-intestinal disorder, etc., due to which an alternative solution to this problem is required. Plant derived compounds possessing anti-cancerous activities have received huge amount of scientific attention. They play vital role in the cancer prevention and treatment.

□ Pharmaceutical research has been done in countries like Germany, USA, Japan, France and China to improve the quality of herbal medicine for the cancer treatment. Plants are the major source of secondary metabolites and an important source of pharmaceutical drugs. Herbal drug treatment is an ideal choice as it is comparatively cheaper and may be highly recommended to the poor and rural people for the effective treatment of cancer.

□ Anticancer agents discovered from medicinal plants have played an important role in cancer treatment. It is documented that medicinal herbs have rich anticancer potential due to their immunomodulatory and antioxidant properties, and on the forefront whenever we talk about anticancer remedies, they are a significant source of synthetic and/or herbal origin. Bioactive compounds significantly influenced the cancer research on various aspects.

□ Secondary metabolites from medicinal plants inhibit the DNA damage, arrest the cell cycle, inhibit the tumor cell angiogenesis and induce apoptosis thus prevent the cancer. Researchers must pay attention to the scientific rigor of studies of herbal drugs in the future to improve the status.

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