OVERVIEW ON CANCER: ROLE OF MEDICINAL PLANTS IN ITS TREATMENT

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1. INTRODUCTION

Cancer is a group of diseases characterized by the uncontrolled growth and spread of abnormal cells. If the spread is not controlled, it can result in death. Cancer is caused by external factors, such as tobacco, infectious organisms and an unhealthy diet and internal factors, such as inherited genetic mutations, hormones and immune conditions. These factors may act together or in sequence to cause cancer. Ten or more years often pass between exposure to external factors and detectable cancer. Treatments include surgery, radiation, chemotherapy, hormone therapy, immune therapy and targeted therapy (drugs that specifically interfere with cancer cell growth). Cancer is one of the most common leading causes of mortality worldwide. Cancer is an uncontrolled growth of cells resulting in lack of differentiation and ability to invade local tissues and metastasis which are proliferate individually throughout the body. During metastasis, cancer cells enter the blood stream and are carried to distant parts of the body where they form other similar growths. Synthetic drugs are available for the treatment of cancer but they are not free from adverse effects. Chemotherapy and radiation therapy are major clinical treatment used for the control of early stages of tumor but these methods has serious side effects. Nature has provides human a variety of useful sources mainly plants for discovery and development of drugs against dreadful diseases. Traditional herb as an effective system of treatment of cancer and many diseases. Drugs from medicinal plants are found to be comparatively less toxic and side effects.

The group of chemicals that cause cancer in human and animals are collectively referred to as carcinogens. Environmental pollution is associated with increased risk of cancer. Prevention of cancer and other related diseases can be pursued by avoiding exposure to recognized...
carcinogens, by favoring the intake of protective factors and by fortifying physiological defense mechanisms. Moreover, there is an increasing awareness that certain naturally occurring substances in plants and other source have protective effects against environmental carcinogens and also endogenous carcinogens. Hence research work related to the discovery, characterization and use of anticarcinogenic agents is receiving considerable attention. A large number of experimental reports have begun to appear in the scientific literature, wherein increasingly more natural anticarcinogens have been identified, isolated and found to possess significant cancer chemopreventive properties.\textsuperscript{[3]}

Cancer is major health problem in both developed and developing countries. Cancer after cardiovascular disease is the second leading cause of death. Cancer is the abnormal growth of cells in our bodies that can lead to death. Because of high death rate associated with cancer and because of serious side effects of chemotherapy and radiation therapy, many cancer patients seek alternative complementary methods of treatment. Plants have been used for treating diseases since time immemorial. More than 50% of modern drugs in clinical use are of natural products. In the present review, an attempt has been made to study the plants that have been used in the treatment of cancer.\textsuperscript{[4]}

![Fig. 1. Growth of cancer cell.](image)

2. AIM AND OBJECTIVE

AIM

This study is based on the overview on cancer & role of medicinal plants in its treatment.
OBJECTIVE
This study is carried to perform brief description about cancer and medicinal plants that have anticancer activity. Study reviewed the description of cancer and anticancer medicinal plants like Turmeric, Vinca, Wheat grass, Neem, Taxus and Aloe vera in treatment or/and chemoprevention of cancer.

3. FACTS ABOUT CANCER[6]

- Cancers figure among the leading causes of morbidity and mortality worldwide, with approximately 14 million new cases and 8.2 million cancer related deaths in 2012.
- The number of new cases is expected to rise by about 70% over the next 2 decades.
- Among men, the 5 most common sites of cancer diagnosed in 2012 were lung, prostate, colorectum, stomach, and liver cancer.
- Among women the 5 most common sites diagnosed were breast, colorectum, lung, cervix, and stomach cancer.
- Around one third of cancer deaths are due to the 5 leading behavioral and dietary risks: high body mass index, low fruit and vegetable intake, lack of physical activity, tobacco use, alcohol use.
- Tobacco use is the most important risk factor for cancer causing around 20% of global cancer deaths and around 70% of global lung cancer deaths.
- Cancer causing viral infections such as HBV/HCV and HPV are responsible for up to 20% of cancer deaths in low-and middle-income countries.
- More than 60% of world’s total new annual cases occur in Africa, Asia and Central and South America. These regions account for 70% of the world’s cancer deaths.
- It is expected that annual cancer cases will rise from 14 million in 2012 to 22 within the next 2 decades.

4. TYPES OF CANCER[7]

Table 1. Types of cancer.

<table>
<thead>
<tr>
<th>Type</th>
<th>Site of cancer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carcinomas</td>
<td>Cells that cover internal and external parts of the body such as lung, breast, and colon cancer.</td>
</tr>
<tr>
<td>Sarcoma</td>
<td>Bone, cartilage, fat, connective tissue, muscle and other supportive tissues.</td>
</tr>
<tr>
<td>Lymphomas</td>
<td>Lymph nodes and immune system tissues.</td>
</tr>
<tr>
<td>Leukemias</td>
<td>Bone marrow and often accumulate in the bloodstream.</td>
</tr>
<tr>
<td>Adenomas</td>
<td>Thyroid, the pituitary gland, the adrenal gland and other glandular tissues.</td>
</tr>
</tbody>
</table>
5. SIGN AND SYMPTOMS\textsuperscript{[8,9]}

You should know some of the general signs and symptoms of cancer. But remember, having any of these does not mean that you have cancer- many other things cause these sign and symptoms, too.

- Unexplained weight loss
- Fever
- Fatigue
- Pain
- Skin changes (Darker looking skin, yellowish skin and eyes, reddened skin, itching, excessive hair growth)
- Change in bowel habits or bladder function
- Sores that do not heal
- White patches inside the mouth or white spots on the tongue
- Unusual bleeding or discharge
- Thickening or lump in the breast or other parts of the body
- Indigestion or trouble swallowing
- Recent change in a wart or mole or any new skin change
- Nagging cough or hoarseness
- Breathlessness
- Unexplained vaginal bleeding
- Persist hearburn or indigestion
- Croaky voice or hoarseness
- Looser poo or pooing more often
- Persistent bloating
- Difficulty swallowing
- Mouth or tongue ulcer that won’t heal
- Heavy night sweats
- Unusual breast changes
- Blood in your poo
- Blood in your pee
- Other symptoms
6. DIAGNOSIS
If you have a symptom or your screening test result suggests cancer, the doctor must find out whether it is due to cancer or some other cause. The doctor may ask about your personal and family medical history and do a physical exam. The doctor also may order lab tests, scans, or other tests or procedures.

- **Lab Tests**
High or low levels of certain substances in your body can be a sign of cancer. So, lab tests of the blood, urine, or other body fluids that measure these substances can help doctors make a diagnosis. However, abnormal lab results are not a sure sign of cancer. Lab tests are an important tool, but doctors cannot rely on them alone to diagnose cancer.

- **Imaging Procedures**
Imaging procedures create pictures of areas inside your body that help the doctor see whether a tumor is present. These pictures can be made in several ways.

**CT scan**
An x-ray machine linked to a computer takes a series of detailed pictures of your organs. You may receive a dye or other contrast material to highlight areas inside the body. Contrast material helps make these pictures easier to read.

**Nuclear scan**
For this scan, you receive an injection of a small amount of radioactive material, which is sometimes called a tracer. It flows through your bloodstream and collects in certain bones or organs. A machine called a scanner detects and measures the radioactivity. The scanner creates pictures of bones or organs on a computer screen or on film. Your body gets rid of the radioactive substance quickly. This type of scan may also be called radionuclide scan.

**Ultrasound**
An ultrasound device sends out sound waves that people cannot hear. The waves bounce off tissues inside your body like an echo. A computer uses these echoes to create a picture of areas inside your body. This picture is called a sonogram.
MRI
A strong magnet linked to a computer is used to make detailed pictures of areas in your body. Your doctor can view these pictures on a monitor and print them on film.

PET scan
For this scan, you receive an injection of a tracer. Then, a machine makes 3-D pictures that show where the tracer collects in the body. These scans show how organs and tissues are working.

X-rays
X-rays use low doses of radiation to create pictures of the inside of your body.

- Biopsy
In most cases, doctors need to do a biopsy to make a diagnosis of cancer. A biopsy is a procedure in which the doctor removes a sample of tissue. A pathologist then looks at the tissue under a microscope to see if it is cancer. The sample may be removed in several ways.

With a needle
The doctor uses a needle to withdraw tissue or fluid.

With an endoscope
The doctor looks at areas inside the body using a thin, lighted tube called an endoscope. The scope is inserted through a natural opening, such as the mouth. Then, the doctor uses a special tool to remove tissue or cells through the tube.

With surgery
Surgery may be excisional or incisional. In an excisional biopsy, the surgeon removes the entire tumor. Often some of the normal tissue around the tumor also is removed. In an incisional biopsy, the surgeon removes just part of the tumor.\cite{19}

7. FACTORS INFLUENCING CANCER
- Age
Cancer most commonly develops in older people; 78% of all cancer diagnoses are in people 55 years of age or older.\cite{1} Anyone can develop cancer. However, the risk of being diagnosed with cancer increases substantially with age. In economically developed countries, 78% of all
newly diagnosed cancer cases occur at age 55 and older compared to 58% in developing countries. The difference is largely due to variations in age structure of the populations. The populations of developing countries are younger and have a smaller proportion of older individuals in whom cancer most frequently occurs.\textsuperscript{[10]}

- **Obesity and Physical activity**
  Obesity and lack of physical activity are associated with increased risk at various cancer sites, including breast and endometrial cancer. In India, increases in the rates of obesity, central adiposity, and waist-hip ratio associated with urbanization are seen in every region and are highest among those with the highest levels of education and income. Energy balance, which includes maintaining ideal weight through physical exercise, has been associated with decreased risk of breast cancer. There are few large cross-sectional studies of energy balance in India. Among urban populations, energy intake has increased at the same time that energy expenditures have decreased, due in part to employment in industries reliant on mechanization. No comprehensive study of physical activity in India has been done, but small studies of selected populations suggest that levels of physical activity are inadequate to meet recommendations for prevention of chronic diseases.\textsuperscript{[11]}

- **Tobacco and Smoking**
  The consumption of tobacco is the leading cause of cancers in India. The regular use of tobacco via smoking, chewing, snuffing etc. in some areas of the country (India), which is responsible for 65% to 85% cancer incidences in men and women, respectively. The various cancers produced by the use of tobacco are of oral cavity, pharynx, esophagus, larynx, lungs and urinary bladder. Smoking is the most notorious factor for the causation of lung cancer. Approximately, 87 and 85% males and females have been found to have lung cancer due to tobacco smoking in the form of bidi and cigarette in India.\textsuperscript{[12]}

- **Alcohol consumption**
  Alcohol consumption has been considered as one of the major causes of colorectal cancer as per a recent monograph of WHO. Annually, about 9.4% new colorectal cancer cases are attributed to the consumption of alcohol, globally. An increased risk of 10% was observed with consumption of more than two drinks per day, which suggests a causative role of alcohol consumption in colorectal cancer. Relationship between alcohol consumption and high risk of oesophageal cancer was first known in 1910. However, chronic alcohol consumption has
been found to be a risk factor for the cancers of the upper respiratory and digestive tracts, including oral cavity, hypopharynx, larynx and esophagus as well as liver, pancreas, mouth and breast cancers. The mechanism of carcinogenesis due to alcohol consumption is not exactly known, however, it is thought that ethanol being a co-carcinogen might play a crucial role in the carcinogenesis.\(^{[12]}\)

**Radiation**

In the developed and developing countries, the radiations are also notorious carcinogens. About 10% cancer occurrence is due to radiation effect, both ionizing and non-ionizing. The major sources of radiations are radioactive compounds, ultraviolet (UV) and pulsed electromagnetic fields. The main series of cancers induced by exposure to the adequate doses of the carcinogenic radiations include thyroid, skin, leukemia, lymphoma, lung and breast carcinomas.\(^{[7]}\)

**Vegetarian diets**

A large percentage of Indians, particularly Hindus, practice vegetarianism and avoid meat and fish products in their diet. Vegetarian diets have been associated with decreased risk for prostate cancer. Case-control studies that compared non-vegetarian and vegetarian diets and alcohol and tobacco use in India have reported that vegetarians have a reduced risk of oral, oesophageal and breast cancers. Vegetarian’s diets rely on pulses (e.g. beans, chickpeas and lentils) as a source of protein and pulses have been significantly associated with reduction in cancer.\(^{[11]}\)

**Dietary fats and fiber**

Diets high in saturated fats have been associated with increased risk for cancer. Fat intake, especially saturated fat, is increasing in the middle class in India, although some rural residents traditionally have had a high intake of ghee (clarified butter, high content of saturated fat), as well. Studies have given equivocal results regarding the link between fat intake and the risk of cancer. Large epidemiological studies have identified a possible association between increased dietary fibre and a decreased risk for cancers of the colon and breast. No large studies on dietary fibre have been conducted in India, and rates of colon and breast are low compared to those in western societies. The Indian diet, which generally includes adequate levels of vegetables, fruits and fiber-rich grains, may provide some protection against increased risk for these cancers.\(^{[11]}\)
• **Spices and additives**

Diet in India developed over thousands of years and is based on a mix of religious and secular beliefs. Among the most studied in recent years is turmeric, an ingredient in the common Indian curry and a spice that has been shown to be a potent antioxidant and anti-inflammatory agent with additional promise as a chemo-preventive agent. In a study in human blood cancer cell lines, turmeric suppressed and destroyed blood cancer cells. Turmeric has been shown to suppress tumour initiation, promotion and metastasis in experimental studies. Turmeric also has been found to inhibit the growth of 19 clinical strains of Helicobacter pylori, a carcinogenic bacterium linked to the increased risk of adenocarcinoma of the stomach and colorectal adenomas. Amrita Bindu, a dietary supplement that is a salt-spice-herbal mixture, was found to protect rats against cancer induced by N-methyl-N-nitrosoguanidine, a potent carcinogenic nitro-samine. Studies on spices and food additives have been conducted in vitro and in animal studies. Because of intriguing findings from these studies, there is a need to investigate these dietary factors in human studies. 

• **Micronutrients**

Micronutrients play a significant role in maintaining health and preventing disease, including cancer, through a wide range of mechanisms: anti-oxidation, anti-proliferation and repair of DNA damage. Direct and indirect relationships between micronutrients and health have been described in experimental, epidemiological and clinical trials. Vitamin deficiencies, specifically of vitamins A, C and E may contribute to the high prevalence of oral cancers in India. A study carried out in rural India found that the presence of lesions was associated in patients with oral pre-cancerous lesions with low plasma levels of vitamins E and β-carotene. A study of Kuchias (a tribal population in Kerala, India, who consume a diet high in micronutrients and have a low prevalence of CHD and other chronic diseases of aging, including cancer) found that levels of serum vitamins A and E were inversely related to levels of lipid peroxides and CHD risk factors. Micronutrient deficiencies of iodine, iron and vitamin A are highly prevalent in Indian children. Among 6-14 year-old, goiter, caused by iodine deficiency and related to thyroid cancer, has a prevalence rate of 0.33 to 2.4%.}

[11]
8. LEADING SITES OF NEW CANCER CASES 2015 ESTIMATES[1]

Table 2. Estimated new cancer cases 2015.

<table>
<thead>
<tr>
<th>Estimated New Cases*</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate</td>
<td>26%</td>
<td>Breast</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>14%</td>
<td>Lung &amp; bronchus</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>8%</td>
<td>Colon &amp; rectum</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>7%</td>
<td>Uterine corpus</td>
</tr>
<tr>
<td>Melanoma of the skin</td>
<td>5%</td>
<td>Thyroid</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>5%</td>
<td>Non-Hodgkin lymphoma</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>5%</td>
<td>Melanoma of the skin</td>
</tr>
<tr>
<td>Oral cavity &amp; pharynx</td>
<td>4%</td>
<td>Pancreas</td>
</tr>
<tr>
<td>Leukemia</td>
<td>4%</td>
<td>Leukemia</td>
</tr>
<tr>
<td>Liver &amp; interhepatic bile duct</td>
<td>3%</td>
<td>Kidney &amp; renal pelvis</td>
</tr>
<tr>
<td>All sites</td>
<td>100%</td>
<td>All sites</td>
</tr>
</tbody>
</table>

*Excludes basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder.

9. LEADING SITES OF NEW CANCER DEATHS 2015 ESTIMATES[1]

Table 3. Estimated new cancer deaths 2015.

<table>
<thead>
<tr>
<th>Estimated Deaths</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung &amp; bronchus</td>
<td>28%</td>
<td>Lung &amp; bronchus</td>
</tr>
<tr>
<td>Prostate</td>
<td>9%</td>
<td>Breast</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>8%</td>
<td>Colon &amp; rectum</td>
</tr>
<tr>
<td>Pancreas</td>
<td>7%</td>
<td>Pancreas</td>
</tr>
<tr>
<td>Liver &amp; interhepatic bile duct</td>
<td>5%</td>
<td>Ovary</td>
</tr>
<tr>
<td>Leukemia</td>
<td>5%</td>
<td>Leukemia</td>
</tr>
<tr>
<td>Esophagus</td>
<td>4%</td>
<td>Uterine corpus</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>4%</td>
<td>Non-Hodgkin lymphoma</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>4%</td>
<td>Liver &amp; interhepatic bile duct</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>3%</td>
<td>Brain &amp; other nervous system</td>
</tr>
<tr>
<td>All sites</td>
<td>100%</td>
<td>All sites</td>
</tr>
</tbody>
</table>

Fig. 2. Estimated New Cases Male 2015.
Fig. 3. Estimated New Cases Female 2015.

Fig. 4. Estimated Deaths Male 2015.

Fig. 5. Estimated Deaths Female 2015\textsuperscript{[1]}
10. THE MECHANISM ON CANCER THERAPY\textsuperscript{[13]}

- Inhibiting cancer cell proliferation directly by stimulating macrophage phagocytosis, enhancing natural killer cell activity.
- Promoting apoptosis of cancer cells by increasing production of interferon-I, interleukin-2, immunoglobulin and complement in blood serum.
- Enforcing the necrosis of tumor and inhibiting its translocation and spread by blocking the blood source of tumor tissue.
- Enhancing the number of leukocytes and platelets by stimulating the haemopoietic function.
- Promoting the reverse transformation from tumor cells into normal cells.
- Promoting metabolism and preventing carcinogenesis of normal cells.
- Stimulating appetite, improving quality of sleep, relieving pain, thus benefiting patient’s health.

11. CARCINOGENESIS, CARCINOGENS AND ANTICARCINOGENS

Carcinogenesis is a complex multi-stage process induced by various types of carcinogens that ultimately lead to the development of cancer. The common consensus among cancer researchers is that carcinogenesis, the process of malignant growth of normal cells, proceeds through a series of steps involving spontaneous changes in genetic material – DNA which is prone to damage by environmental agents especially radiation and chemical mutagens. Many intrinsic and extrinsic factors, interacting with one another, influence this process of carcinogenesis. Carcinogenesis includes three main phases: initiation, promotion and progression.

**Initiation**

Initiation is an irreversible process, which begins when the cells in normal tissues are exposed to a carcinogen. The carcinogen exposure causes damage to their genomic DNA that remains un-repaired. It also involves the uptake of the given carcinogenic agent followed by its transportation and distribution to the organs where its metabolism occurs. The reactive metabolite of the carcinogenic agent interacts with the cellular DNA followed by subsequent alteration in the DNA molecule thereby fixing genotoxic damage to produce mutation.
Promotion

As the name indicates it is expansion of the damaged cells to form an actively proliferating multi-cellular pre-malignant tumor cell population.

Progression

The third step is called ‘progression’ which is an irreversible process in which malignant cells grow and invade into the surrounding normal tissues or organs. Molecular mechanisms of tumor progression are not fully understood, but mutations and chromosomal aberrations are thought to be involved.

The substances which can induce carcinogenesis are known as carcinogens. These include, physical agents like ultra violet (UV) and X-rays cause the deletion of nucleotide. These agents produce a variety of lesions in DNA including strand break base damage and dimerisation of bases. Many diverse environmental, industrial, dietary and natural chemicals are capable of inducing mutation and genotoxic effects. Endogenous carcinogens are a group of cancer-causing compounds produced in vivo from harmless precursors. There is evidence that mutation in somatic cells causes’ cancer, genetic disorders and many other degenerative disorders including arthritis and connective tissue disorders, hepatic disorders, neurodegenerative disorders, cardiovascular disorders, diabetes, chronic inflammation, ageing etc. The carcinogenic effects of genotoxic chemicals are additive, cumulative and sometimes irreversible.

An anticarcinogenic agent can prevent the transformation of a pro-carcinogenic compound into carcinogen, inactivate the carcinogen or otherwise prevent the reaction between mutagen and DNA. Another kind of anticarcinogens may induce, repress or inactivate directly or indirectly the enzymes of the DNA repair recombination and replication pathways.

Mechanism of anticarcinogenesis

The major mechanisms of anticarcinogenesis can be broadly described as under:

1. Chemical or enzymatic inactivation.
2. Prevention of formation of active species.
3. Scavenging.
4. Antioxidant or free radical scavenging.
1. Chemical or enzymatic inactivation
Many carcinogens, which are reactive, acting not only on DNA but also on proteins and enzymes, can be directly inactivated by a range of different chemicals. Anticarcinogenic properties have been associated with both inhibitors and inducers of cytochrome P-450 enzymes such as indole-3-carbinol. Inducers of phase-II metabolic enzymes such as glutathione transferase tend to inhibit a wide range of target carcinogens. e.g. isothiocyanates such as benzyl isothiocyanate and antioxidants such as 2, 3-tert butyl-4-hydroxy-anisole (BHA).

2. Prevention of formation of active species
Many genotoxic mutagens or carcinogens require metabolic activation or bio-activation to an electrophilic form (the active species) that can react with the DNA. Although these processes commonly occur in the liver, there is increasing evidence for metabolic activation by other tissues also, especially for the GIT. N-nitro compounds are often formed in the stomach through a reaction form nitrite and secondary or tertiary amines.

3. Scavenging
A number of anticarcinogens are able to scavenge dietary carcinogens through binding or adsorption. In general, the carcinogen remains intact during this process but is unable to react with DNA. Chlorophyllin and some dietary fibers appear to act in this way.

4. Antioxidant and free radical scavenging
Free radicals can damage DNA and cause mutagenicity and cytotoxicity and thus play a key role in carcinogenesis. It is believed that reactive oxygen species (ROS) can induce mutations and inhibit DNA repair process, that result in the inactivation of certain tumor suppressor genes, leading to cancer. This appears to be the most commonly operative anticarcinogenesis mechanism of medicinal plant constituents. A wide range of anticarcinogenic agents from medicinal plants have excellent antioxidant or free radical scavenging activity e. g. carotenoids, flavonoids and phenolic compounds. These agents can directly scavenge most oxidative and nitrosative free radicals generated during carcinogenesis process thus reduce oxidative stress and prevent carcinogen-toxicity to the vital organs like liver, heart, kidney and brain. These agents can also mediate anticarcinogenesis by augmenting the endogenous both non-enzymatic (glutathione) and enzymatic (glutathione S-transferase, glutathione reductase, superoxide dismutase, catalase) antioxidant defense mechanisms prevalent in the body thereby ameliorating the oxidative impact generated due to carcinogenesis. [3]
Natural anticarcinogenic agents

Extensive research in the last few decades on the detection and characterization of anticarcinogenic compounds from edible, non-edible, and medicinal plants and marine organisms has demonstrated a great diversity. Several authors have suggested that natural antimutagens may belong to any of the following major class of compounds. Major emphasis has been laid on the flavonoids, phenolics, carotenoids, coumarins, anthraquinones, tannins, terpenoids, saponins, and several others all of which are secondary plant metabolites. More than 500 compounds belonging to at least 25 chemical classes have been recognized as possessing anticarcinogenic effects.

The major classes of antimutagenic compounds are.

- Vitamins
- Flavonoids
- Phenolic compounds
- Anthraquinones
- Carotenoids
- Diterpenoids
- Coumarins
- Tannins
- Saponins
- Miscellaneous compounds.[3]

12. PLANT AS A SOURCE OF ANTI-CANCER COMPOUNDS

Plant derived compounds, which are the important source of clinically useful anti-cancer drug, has shown to have potential for treatment or prevention of cancer in humans. In the treatment of cancer, plant has a long history, more than 3000 plant species have been reported by Hartwell which are used in treatment of cancer.[14]

Plants as well as plant derived compounds have played significant role in the development of a number of clinically used anti-cancer agents. These include vinblastine, vincristine, the camptothecin derivatives, topotecan and irinotecan, etoposide, derived from epipodophyllotoxin, and paclitaxel. Quite a lot of promising new agents are in clinical development based on selective activity against cancer-related molecular targets, including flavopiridol and combretastatin A4 phosphate, and some agents which failed in earlier clinical
studies are stimulating renewed interest. Also there are some of the semi synthetic plant
derivatives which are clinically used as potential anti cancer agents. The traditional and the
preliminary scientific work on these plant products are giving promising results, further
research in the same is to be continued to derive potent anti cancer agents from medicinal
plants.\[15\]

Chemotherapy, being a major treatment modality used for the control of advanced stages of
malignancies and as a prophylactic against possible metastasis, exhibits severe toxicity on
normal tissues. Plants have been used for treating various diseases of human beings and
animals since time immemorial. They maintain the health and vitality of individuals and also
cure diseases, including cancer without causing toxicity. More than 50% of all modern drugs
in clinical use are of natural products, many of which have the ability to control cancer
cells.\[4\]

13. LIST OF ANTICANCER PLANTS

Table 4. List of Anticancer Plant.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Plant name</th>
<th>Family</th>
<th>Chemical responsible for anticancer activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Turmeric</td>
<td>Zingiberaceae</td>
<td>Curcumin</td>
</tr>
<tr>
<td>2.</td>
<td>Vinca</td>
<td>Apocynaceae</td>
<td>Vinblastine, Vincristine, Vinorelbine, and Vindesine</td>
</tr>
<tr>
<td>3.</td>
<td>Wheat grass</td>
<td>Grasses</td>
<td>Chlorophyll, Selenium and Lactrile</td>
</tr>
<tr>
<td>4.</td>
<td>Neem</td>
<td>Meliaceae</td>
<td>Flavonoids (Rutin and Quercetin)</td>
</tr>
<tr>
<td>5.</td>
<td>Taxus</td>
<td>Taxaceae</td>
<td>Paclitaxel, Taxol</td>
</tr>
<tr>
<td>6.</td>
<td>Aloe vera</td>
<td>Xanthorrhoeaceae</td>
<td>Aloemodin, Emodin</td>
</tr>
</tbody>
</table>

14. TURMERIC

Fig. 6. Turmeric.
Provides anti-Tumor support Curcumin is undergoing clinical trial as an alternative for cancer treatment. Curcumin extract could be beneficial in many kinds of cancer such as breast cancer, colon cancer, skin cancer as well as prostate cancer.\[16\] Based on its distinct chemical properties, curcumin interacts with numerous extracellular and intracellular molecules that are actively involved in cancer initiation and progression, thereby inhibiting cancer progression. Increasing evidence suggests that deregulated inflammatory pathways play a pivotal role in a multitude of chronic diseases, including cancer. The mechanism by which chronic inflammation drives cancer initiation and progression is via increased production of pro-inflammatory mediators, such as cytokines, chemokines, reactive oxygen species (ROS), overexpression of oncogenes, cyclooxygenase (COX-2), matrix metalloproteinase (MMPs), intracellular signaling pathway mediators, transcription factors such as nuclear factor κB (NF-κB), signal transducer and activator of transcription 3 (STAT3), protein kinase B (AKT), and activator protein 1 (AP1) that drive tumor cell proliferation, transformation, invasion, metastasis, angiogenesis, chemo resistance and radio resistance.\[20\]

15. VINCA

Vinca alkaloids belong to an important class of anti-cancer drugs. The mechanism of action of Vinca alkaloids is that they inhibit the cell proliferation by affecting the microtubular dynamics during mitosis and this causes a characteristic block during mitosis leading to apoptosis. Vinca alkaloids include Vinblastine (VLB) and Vincristine (VCR), Vinorelbine (VRLB) and Vindesine (VDS) are obtained from the Madagascar periwinkle, Catharanthus roseus G. Don. (Apocynaceae).\[5\]
The main mechanisms of Vinca alkaloid cytotoxicity is due to their interactions with tubulin and disruption of microtubule function, particularly of microtubules comprising the mitotic spindle apparatus, directly causing metaphase arrest. However, they can do many other biochemical activities that may or may not be related to their effects on microtubules. Many of the effects that do not include microtubule interruption happen only after treatment of cells with clinically irrelevant doses of the vinca alkaloids. Nevertheless, the vinca alkaloids and other antimicrotubule agents also have an effect on both non-malignant and malignant cells in the non-mitotic cell cycle, because microtubules are involved in many non-mitotic functions.\textsuperscript{[26]}

16. WHEATGRASS

![Wheatgrass](image)

Fig. 8. Wheatgrass.

Many dietary compounds have been suggested to contribute to the prevention of cancer, there is a strong likelihood that wheatgrass extract, which contains chlorophyll, an antioxidant, may affect cancer prevention. Additionally, selenium and lactrile present in wheatgrass have anti-cancer properties. Selenium builds a strong immune system, and can decrease the risk of cancer. Wheatgrass contains at least 13 vitamins (several of which are antioxidants) including B12, abscisic acid, superoxide dismutase (SOD), cytochrome oxidase, mucopolysaccharide. SOD converts two superoxide anions into a hydrogen peroxide molecule, which has an extra oxygen molecule to kill cancer cells.

Wheatgrass juice may also inhibit hematological toxicity related to chemotherapy in breast cancer patients. It is also observed that people undergoing chemotherapy, who are on wheatgrass, have sailed through this treatment and have not required hospital admission, while side effects such as nausea, vomiting and mouth ulcers have been virtually non-existent.
In another study, in vitro cytotoxic and antiproliferation activities of two extracts—the wheatgrass and the mixture of fibers, were tested and demonstrated anti-leukemia potential with less or no toxic effects towards the healthy immune system. Wheatgrass and fiber methanol extracts have successfully exhibited to be cytotoxic towards HL60 cell lines without causing toxicity towards normal human PBMC. Thus, these health products can be a potential alternative supplement for cancer patients.[17]

17. NEEM

Azadirachta indica (neem tree) has been used successfully to reduce tumors by herbalists from centuries. Recent studies indicated that an ethanolic extract of neem has been shown to cause cell death of prostate cancer cells (PC-3) by inducing apoptosis as evidenced by a dose-dependent increase in DNA fragmentation and a decrease in cell viability. Different studies indicate its use against buccal carcinogenesis, skin carcinogenesis, prostate cancer, mammary carcinogenesis, gastric carcinogenesis, Ehrlich carcinoma and B16 melanoma. A. indica (Neem) has also revealed a chemo preventive capability by regressing the hepat-carcinogenesie induced by DEN/AAF carcinogens.[15]

The biological activity of Neem leaves was due to its rich content of flavonoids. Flavanoids have been reported to possess both antioxidant activity and anti-inflammatory activities via scavenging free radicals and inhibition of lipid peroxidation. Antitumor activity of flavonoids, isolated from several sources other neem, has been reported. That compounds have been shown to have anti-proliferative effects on human squamous cell carcinoma.[21]
18. TAXUS

![Taxus Image]

**Fig.10. Taxus.**

Taxol, Docetaxol are the active constituents of Taxus which belong to Taxaceae. These drugs are given to treat breast cancer, after combination anthracycline and cytoxan therapy. Taxol is also used to treat ovarian cancer, lung cancer, head and neck cancer, bladder cancer.\(^{[18]}\)

A cyclodecane isolated from the bark of the Pacific yew tree, Taxus brevifolia. It stabilizes microtubules in their polymerized form leading to cell death. ABI-007 (Abraxane) is the latest attempt to improve upon paclitaxel, one of the leading chemotherapy treatments.\(^{[5]}\)

Use of an inhibitor against an activating mutation of signaling molecule in combination with a standard chemotherapeutic agent such as Paclitaxel showed synergistic activity in mutant human endometrial cancer cell lines. A study performed to evaluate the cytotoxic effects of Paclitaxel in combination with Etoposide in Osteosarcoma cells to thermochemotherapy showed that the apoptosis inducing capacity of the drug combination was stronger than the effect of drugs when used individually.\(^{[22]}\)

Taxol is an important anticancer drug used widely in the clinical field. Taxol is a diterpenoids, which was first extracted in the bark of yew (Taxus brevifolia). It can kill tumor cells by enhancing the assembly of microtubules and inhibiting their depolymerisation. This compound is the world’s first billion dollar anticancer drug and it is used to treat breast, lung, ovarian cancer and other human tissue proliferating disease.\(^{[23]}\)
19. ALOE VERA

Aloe vera contains aloemodin, which activates the macrophages to fight cancer. Aloe vera also contains acemannan, which enhances activity of the immune cells against cancer. Aloe vera is found to inhibit metastases.\[13\]

There is early evidence that oral Aloe may reduce the risk of developing lung cancer.\[24\] The role of Aloe in carcinogenicity has not been evaluated well. The chronic abuse of anthranoid-containing laxatives has been hypothesized to play a role in colo-rectal cancer; however, no causal relationship between anthranoid laxative abuse and colorectal cancer has been demonstrated and. Aloe vera juice enables the body to heal itself from cancer and also from the damage caused by radio and chemotherapy that destroys healthy immune cells crucial for the recovery. Aloe vera emodin, an anthraquinone, has the ability to suppress or inhibit the growth of malignant cancer cells making it to have anti-neoplastic properties.\[25\]

20. CONCLUSION

Cancer after cardiovascular disease is the second leading cause of death. Cancer is the abnormal growth of cells in our bodies that can lead to death. For treatment of cancer there are very synthetic compounds are present but they have many adverse effect as compared to medicinal plants that have anticancer activity. Medicinal plants that have anticancer activity has role in treatment as well as chemopreventive purpose for cancer. Some medicinal plant like turmeric, vinca, taxus, neem, aloe vera, broccoli, etc that have chemical constituents as curcumin, vincristine, vinblastine, taxol and various anticancer classes of constituents like vitamins, flavonoids, phenolic compounds, anthraquinones, carotenoids, diterpenoids,
coumarins, tannins, saponins and other miscellaneous compounds have their important role in treatment and/or in prevention of cancer.

21. REFERENCES


