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Study of Some Medicinal Plants for their Activity on Breast Cancer

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Abstract: *Medicinal plants have been used for centuries in traditional medicine systems. Mostly medicinal plants are used in the Ayurveda System. Recent scientific studies have shown that plant-based compounds can play an important role in cancer prevention and treatment. Breast cancer is one of the principal caused death among women and there is a pressing need to develop novel and effective anti-cancer agents. These plants contain a diverse range of bioactive phytochemicals – including flavonoids, alkaloids, terpenoids and polyphenols that inhibit cancer cell growth. Their effectiveness is reported as decreased toxicity in usage, along with safety and less recurrent resistances compared with hormonal targeting anti-cancer agents. Major drawbacks to antioxidant from plants based therapy and used in breast cancer are herein briefly discussed.*

Keywords: Medicinal plants, Natural products, Breast cancer, Therapy, Anti-cancer, Anti-oxidants.

I. INTRODUCTION

Breast Cancer is a disease where cells in the breast grow uncontrollably, typically forming a tumor in the lobules (milk-producing glands) or ducts (milk passages). As the most common cancer diagnosed in women worldwide, it can also affect men. Key symptoms include a new lump, breast thickening, or skin changes, with high survival rates if detected early through screenings.

The breast is composed of:

- Lobules: Milk-producing glands
- Ducts: Tubes carrying milk to the nipple
- Fatty tissue
- Blood vessels and lymphatic vessels
- Cancer usually begins in the ducts or lobules.

The most common form are invasive Ductal Carcinoma (starts in ducts) and Invasive Lobular Carcinoma (starts in lobules). Breast cancer is rarely seen in client under the age of 40. In the last 30 years, doctors have made great strides in early diagnosis and treatment of the disease and in reducing breast cancer deaths. The management of breast cancer has seen significant advancements in recent decades, with various approaches such as surgery, hormone therapy, chemotherapy, radiation therapy, and immunotherapy being employed to combat this condition. The management of breast cancer has seen significant advancements in recent decades, with various approaches such as surgery, hormone therapy, chemotherapy, radiation therapy, immunotherapy being employed to combat this condition. Nonetheless, the treatment faces substantial challenges in terms of its expense, adverse effects, and the systemic toxicity associated with existing chemotherapeutic agents, along with the development of drug resistance (Kingham et al., 2013).

Natural products and their structural analogues have historically made a major contribution to pharmacotherapy, especially for cancer and infectious diseases (Atanasov et al., 2021). The recognition of medicinal plants as effective and inexpensive sources of synthetic novel chemotherapeutic compounds increasing in the last decades and many researchers focus their research on this promising area (Omogbadegun, 2013). Herbal based and plant-derived products

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can be thus exploited with sustainable comparative and competitive advantages, especially in developing countries to reduce the exorbitant cost of breast cancer treatment. This study presents an overview of the input of phytotherapy in the treatment of breast cancer. For Example: in the area of cancer, over the time frame from 1981 to 2019, out of the 185 small molecules used for the treatments of cancer, 62 or 33.5% are natural compounds.

The disease is classified into invasive and non-invasive types. Invasive cancers spread into surrounding tissues, while non-invasive cancers remain localized. Modern treatment approaches include surgery, chemotherapy, radiotherapy, hormonal therapy, immunotherapy, and targeted therapy. However, these treatments often produce side effects such as nausea, hair loss, fatigue, and immune suppression. Because of these limitations, researchers are exploring medicinal plants as alternative or supportive therapies. Medicinal plants have been used in traditional medicine systems such as Ayurveda, Traditional Chinese Medicine, and Unani for centuries. Plant-derived compounds are important sources of anticancer drugs. Medicinal plants contain bioactive phytochemicals such as alkaloids, flavonoids, terpenoids, tannins, polyphenols, and glycosides. These compounds exhibit antioxidant, anti-inflammatory, cytotoxic, and anti-proliferative activities. Several plant-derived drugs including vincristine, vinblastine, paclitaxel, and camptothecin derivatives are widely used in chemotherapy. The medicinal plants used in breast cancer are curcuma longa (turmeric), Catharanthus roseus, Camellia sinesis (green tea), Withania somnifera (ashwagandha), Allium sativum (garlic), Moringa oleifera etc.

II. OBJECTIVES

The study of medicinal plants for their activity against breast cancer focuses on identifying natural, cost-effective, and less toxic alternatives or complementary agents to conventional chemotherapy.

Primary objectives:

- Evaluation of Antiproliferative Activity: To assess the ability of plant extracts to inhibit the growth and proliferation of breast cancer cell lines.
- Induction of apoptosis: to determine if the plants can induce programmed cell death in cancer cells by activating apoptotic pathways and altering Bcl-2 family proteins.

Secondary Objectives:

- To collect and authenticate medicinal plants traditionally used for anti-cancer or antioxidant properties.
- To prepare extracts using different solvents (aqueous, ethanol, methanol etc.)
- To perform phytochemical screening to identify active constituents (alkaloids, flavonoids, tannins etc.)
- To study the dose dependent response of extracts.
- To analyse results statistically and interpret the significance.

III. OVERVIEW OF BREAST CANCER

Breast cancer is the most prevalent cancer among women in India, with approximately 200,000 to 243,000+ new cases reported annually. A woman is diagnosed every 4 minutes and one dies every 8 minutes. Incidence is rising, driven by late diagnosis (60% at stage III\IV) and lifestyle factors, with high mortality rates (nearly 98,337 deaths in 2025.) Indian women are diagnosed ~10 years younger on average compared to Western counterparts, often in premenopausal life.

Stages of Breast Cancer

Stage 0

Cancer is non-invasive and localized.

Stage I

Small tumor with limited spread.

Stage II

Larger tumor or spread to nearby lymph nodes.

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Stage III

Advanced local spread.

Stage IV

Cancer spreads to distant organs (metastasis).

Case 1: Early-Stage Breast Cancer

A 45-year-old woman detected a small lump in her left breast during self-examination. Mammography and biopsy confirmed Stage I invasive ductal carcinoma. She underwent lumpectomy followed by radiotherapy. Early diagnosis helped achieve complete recovery.

Outcome

Successful treatment

No metastasis

Improved survival rate

Case 2: HER2-Positive Breast Cancer

A 52-year-old female presented with breast swelling and nipple discharge. Testing revealed HER2-positive breast cancer. She received chemotherapy combined with targeted therapy (trastuzumab).

Outcome

Tumor size reduced significantly

Better response due to targeted therapy

Regular follow-up required

Case 3: Triple-Negative Breast Cancer

A 39-year-old woman was diagnosed with triple-negative breast cancer, an aggressive form of the disease. Since hormonal therapy was ineffective, chemotherapy and immunotherapy were used.

Outcome

Partial tumor regression

Higher recurrence risk

Continuous monitoring necessary

Case 4: Use of Medicinal Plants as Supportive Therapy

A breast cancer patient undergoing chemotherapy experienced severe fatigue and oxidative stress. Under medical supervision, turmeric extract containing curcumin was used as supportive therapy along with standard treatment.

Outcome

- Reduced inflammation
- Improved antioxidant status
- Better quality of life

IV. CAUSES AND RISK FACTORS

The exact cause of breast cancer remains unknown, but several risk factors contribute to its development. Genetic mutations such as BRCA1 and BRCA2 significantly increase the risk. Hormonal imbalance, obesity, smoking, alcohol consumption, radiation exposure, aging, and family history also play important roles. Lifestyle factors are important contributors. Lack of physical activity and unhealthy diet increase the risk of breast cancer. Women who experience early menstruation or late menopause are exposed to estrogen for a longer duration, increasing susceptibility. Environmental pollutants and exposure to harmful chemicals can also contribute to cancer development by damaging DNA and promoting oxidative stress.

Genetic Factors

BRCA1 and BRCA2 gene mutations

Family history of breast cancer

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Hormonal Factors
Early menstruation
Late menopause
Hormone replacement therapy
Lifestyle Factors
Obesity
Smoking
Alcohol consumption
Physical inactivity
Environmental Factors
Radiation exposure
Pollution and chemicals

V. SYMPTOMS AND DIAGNOSIS

Symptoms:

- Lump in the breast or underarm
- Change in breast size or shape
- Nipple discharge
- Breast pain
- Skin dimpling
- Redness or swelling
- Inverted nipple

Diagnosis:
Clinical examination:
Physical examination of breast tissue.

Imaging technique:

- Mammography
- Ultrasound
- MRI scan

Laboratoty Tests:

- Hormone receptor testing
- HER2 testing
- Genetic testing

VI. CONVENTIONAL TREATMENTS

1. Surgery
Surgery is one of the primary treatments for breast cancer. It involves removal of the tumor or affected breast tissue.
Types of Surgery
a) Lumpectomy
Removal of the tumor and a small amount of surrounding tissue.
Also called breast-conserving surgery.
Usually followed by radiotherapy.

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b) Mastectomy
Complete removal of one or both breasts.
Recommended for large tumors or multiple tumor sites.

c) Sentinel Lymph Node Biopsy
Removal of a few lymph nodes to check cancer spread.

d) Axillary Lymph Node Dissection
Removal of several lymph nodes from the armpit area.

2. Chemotherapy
Chemotherapy uses anticancer drugs to kill rapidly dividing cancer cells. It may be given before surgery (neoadjuvant therapy) or after surgery (adjuvant therapy).

Common Chemotherapy Drugs

- Doxorubicin
- Cyclophosphamide
- Paclitaxel
- Docetaxel
- Fluorouracil

3. Radiotherapy
Radiotherapy uses high-energy radiation to destroy cancer cells and shrink tumors.
Types
External Beam Radiation Therapy
Most commonly used method where radiation is directed from outside the body.
Internal Radiation Therapy (Brachytherapy)
Radioactive material is placed near the tumor.

4. Hormonal Therapy
Hormonal therapy is used for hormone receptor-positive breast cancer.
Common Drugs

- Tamoxifen
- Letrozole
- Anastrozole
- Exemestane

5. Targeted Therapy
Targeted therapy specifically attacks cancer-related proteins with less damage to normal cells.
HER2-Targeted Therapy
Used in HER2-positive breast cancer.
Common Drugs

- Trastuzumab
- Pertuzumab
- Lapatinib

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6. Immunotherapy

Immunotherapy stimulates the immune system to recognize and destroy cancer cells.

Common Immunotherapy Drugs

- Pembrolizumab
- Atezolizumab

VII. ROLE OF MEDICINAL PLANTS

Medicinal plants play a significant role in breast cancer management by providing bioactive compounds that can inhibit tumor growth, induce programmed cell death(apoptosis), and reduce the side effects of conventional therapies. While many are used in traditional medicine, scientific research focuses on their ability to target specific cancer pathways with potentially lower toxicity than synthetic drugs.

Medicinal plants play an important role in the prevention and treatment of breast cancer because they contain bioactive compounds with anticancer properties. For centuries, medicinal plants have been used in traditional systems of medicine such as Ayurveda, Traditional Chinese Medicine, and Unani medicine. Modern scientific research has confirmed that many plant-derived compounds possess antioxidant, anti-inflammatory, anti-proliferative, and apoptosis-inducing activities against breast cancer cells.

Medicinal plants are considered promising alternatives or supportive therapies because they are natural, relatively safe, cost-effective, and capable of targeting multiple pathways involved in cancer progression.

Major Medicinal Plants Used in Breast Cancer

1. Curcuma longa (Turmeric)

Figure no.1- Turmeric

Scientific Name: Curcuma longa

Family: Zingiberaceae (Ginger family)

Active Compound

Curcumin

Role in Breast Cancer

Curcumin exhibits strong anticancer activity by:

- Inducing apoptosis
- Inhibiting angiogenesis
- Blocking tumor growth
- Suppressing metastasis

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- Reducing inflammation

Curcumin also inhibits signaling pathways such as NF-kB involved in cancer progression.

Research Findings

Studies on MCF-7 breast cancer cells showed reduced cell proliferation after curcumin treatment.

2. Catharanthus roseus (Madagascar Periwinkle)

Figure no. 2- Catharanthus roseus

Scientific Name: Catharanthus roseus
Family: Apocynaceae
Active Compounds

- Vincristine
- Vinblastine

Role in Breast Cancer

These alkaloids inhibit microtubule formation during cell division, preventing cancer cell multiplication.

Importance

Vincristine and vinblastine are widely used chemotherapy drugs derived from plants.

3. Camellia sinensis (Green Tea)

Figure no. 3- Green tea leaves

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Scientific Name: Camellia sinensis
Family: Theaceae
Active Compound
Epigallocatechin gallate (EGCG)
Role in Breast Cancer

- Green tea polyphenols:
- Act as antioxidants
- Reduce oxidative stress
- Suppress tumor growth
- Induce apoptosis
- Prevent DNA damage

Additional Benefits
Green tea may improve overall immunity and reduce inflammation.

4. Withania somnifera (Ashwagandha)

Figure No.4- Ashwagandha

Scientific Name: Withania somnifera
Family: Solanaceae
Active Compound
Withaferin A
Role in Breast Cancer
Ashwagandha:
Induces apoptosis
Enhances immune function
Reduces oxidative stress
Improves chemotherapy effectiveness
It is also known for anti-stress and anti-inflammatory properties.

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5. Allium sativum (Garlic)

Figure no.5- Garlic

Scientific Name: Allium sativum
Family: Amaryllidaceae
Active Compound
Allicin
Role in Breast Cancer
Garlic compounds:
Prevent tumor formation
Inhibit metastasis
Enhance immune response
Protect cells from oxidative damage
Research studies demonstrated cytotoxic effects of garlic extracts on breast cancer cells.

6. Moringa oleifera

Figure no.6- Moringa oleifera

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Scientific Name: Moringa oleifera
Family: Moringaceae
Active Compounds

- Quercetin
- Kaempferol
- Chlorogenic acid

Role in Breast Cancer

- Moringa extracts:
- Suppress cancer cell growth
- Induce apoptosis
- Reduce inflammation
- Provide antioxidant protection

VIII. PHYTOCHEMICALS AND THEIR ROLE

Phytochemicals are naturally occurring bioactive compounds present in medicinal plants, fruits, vegetables, grains, herbs, and spices. These compounds are not essential nutrients like vitamins or minerals, but they possess important biological activities that help protect against diseases including cancer.
Medicinal plants contain phytochemicals with:

- Antioxidant activity
- Anti-inflammatory effects
- Apoptotic activity
- Anti-proliferative properties

1. Alkaloids

Alkaloids are nitrogen-containing compounds with strong pharmacological activities.
Role in Breast Cancer

- Inhibit cell division
- Prevent tumor growth
- Interfere with microtubule formation
- Induce apoptosis

2. Flavonoids

Flavonoids are polyphenolic compounds found in fruits, vegetables, and medicinal plants.
Role in Breast Cancer

- Antioxidant activity
- Reduction of oxidative stress
- Inhibition of cancer cell proliferation
- Prevention of DNA damage
- Suppression of inflammation
- Flavonoids also improve immune response.

3. Polyphenols

Polyphenols are powerful antioxidants that protect cells from oxidative damage.
Role in Breast Cancer

- Induce apoptosis

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- Block tumor growth
- Inhibit angiogenesis
- Prevent metastasis

Curcumin is one of the most extensively studied polyphenols in breast cancer therapy.

4. Terpenoids

Terpenoids are aromatic compounds present in many medicinal plants.

Role in Breast Cancer

- Inhibit tumor growth
- Induce apoptosis
- Suppress inflammation
- Prevent angiogenesis

Paclitaxel (Taxol), a plant-derived drug, is widely used in breast cancer treatment.

5. Tannins

Tannins are polyphenolic compounds with antioxidant properties.

Role in Breast Cancer

- Neutralize free radicals
- Reduce inflammation
- Prevent cancer cell proliferation

6. Saponins

Saponins are glycosides known for their cytotoxic effects.

Role in Breast Cancer

- Induce apoptosis
- Enhance immune response
- Inhibit metastasis

IX. MECHANISM OF ACTION

The anticancer activity of medicinal plants mainly occurs through the following mechanisms:

1. Induction of Apoptosis (Programmed Cell Death)

Apoptosis is a natural process that removes damaged or abnormal cells. Cancer cells avoid apoptosis, leading to uncontrolled growth. Many medicinal plants activate apoptotic pathways in breast cancer cells.

Mechanism

Activation of caspase enzymes
Increase in pro-apoptotic proteins (Bax)
Decrease in anti-apoptotic proteins (Bcl-2)
Release of cytochrome-c from mitochondria

Example Plants

Turmeric (*Curcuma longa*)
Green tea (*Camellia sinensis*)
Neem (*Azadirachta indica*)

Result

Cancer cells undergo self-destruction without affecting normal cells significantly.

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2. Cell Cycle Arrest

Cancer cells divide rapidly due to loss of cell cycle control. Certain phytochemicals stop the cell cycle at specific phases.

Mechanism

Inhibition of cyclins and cyclin-dependent kinases (CDKs)

Arrest at G0/G1, S, or G2/M phase

Example Plants

Garlic (*Allium sativum*)

Ginger (*Zingiber officinale*)

Result

Prevents multiplication of breast cancer cells.

3. Antioxidant Activity

Oxidative stress caused by free radicals contributes to DNA damage and cancer development. Antioxidants neutralize these free radicals.

Mechanism

Scavenging reactive oxygen species (ROS)

Enhancing antioxidant enzymes such as:

Superoxide dismutase (SOD)

Catalase

Glutathione peroxidase

Example Plants

Green tea

Amla (*Phyllanthus emblica*)

Tulsi (*Ocimum sanctum*)

Result

Protection of healthy cells and prevention of cancer progression.

4. Anti-inflammatory Activity

Chronic inflammation promotes tumor growth and metastasis.

Mechanism

Inhibition of inflammatory mediators:

TNF-α

IL-6

COX-2

NF-κB pathway

Example Plants

Turmeric

Boswellia (*Boswellia serrata*)

Result

Reduction in tumor-promoting inflammation.

5. Inhibition of Angiogenesis

Tumors require new blood vessels to obtain oxygen and nutrients.

Mechanism

Suppression of VEGF (Vascular Endothelial Growth Factor)

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Inhibition of endothelial cell proliferation

Example Plants

Grape seed extract

Curcumin from turmeric

Result

Cuts off blood supply to tumors, limiting tumor growth.

6. Inhibition of Metastasis

Metastasis is the spread of cancer to other organs.

Mechanism

Inhibition of matrix metalloproteinases (MMPs)

Reduction in cell migration and invasion

Example Plants

Resveratrol-containing plants

Green tea catechins

Result

Prevents spread of breast cancer cells.

7. Hormonal Modulation

Some breast cancers are estrogen-dependent.

Mechanism

Phytoestrogens compete with estrogen receptors

Modulation of estrogen synthesis

Example Plants

Soybean (*Glycine max*)

Flaxseed (*Linum usitatissimum*)

Result

Reduction in hormone-dependent tumor growth.

X. ADVANTAGES OF MEDICINAL PLANTS IN BREAST CANCER

Medicinal plants offer several advantages in the prevention and treatment of breast cancer. Due to the presence of bioactive phytochemicals, these plants exhibit anticancer activity with relatively lower toxicity compared to conventional therapies.

- Natural source of anticancer compounds
- Lower toxicity
- Multiple mechanism of action
- Antioxidant activity
- Cost effective treatment
- Enhancement of immune system
- Reduction of chemotherapy side effects
- Prevention metastasis
- Synergistic effect with conventional therapy
- Availability of plant derived anticancer drugs
- Improved quality of life

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XI. LIMITATION OF MEDICINAL PLANTS IN BREAST CANCER

- Lack of Standardization
- Poor Bioavailability
- Limited Clinical Trials
- Slow Therapeutic Action
- Possible Toxicity and Side Effects
- Drug Interactions
- Difficulty in Dosage Determination
- Variability in Plant Composition
- Lack of Regulatory Approval
- Insufficient Mechanistic Understanding
- Risk of Contamination
- Not Effective for All Types of Breast Cancer

XII. FUTURE PROSPECT

Future research should focus on clinical trials, nanotechnology-based drug delivery systems, isolation of novel phytochemicals, and combination therapies. Advanced molecular studies may help identify new plant-derived compounds for breast cancer treatment.

- Advanced delivery systems
- Targeted therapy for aggressive types
- Combination therapies
- Clinical standardization
- Personalised medicine

XIII. CONCLUSION

In conclusion, medicinal plants represent a promising source of anticancer agents for breast cancer management. Their natural origin, multiple mechanisms of action, and relatively lower toxicity make them valuable candidates for future drug development and supportive cancer therapy. Further studies involving advanced drug delivery systems, molecular investigations, and clinical trials are essential to establish their safety, efficacy, and therapeutic potential in breast cancer treatment.

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