REVIEW ARTICLE

A Review on Anti-Breast Cancer Activity of Selected Medicinal Plants

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Abstract

To review and identify medicinal plants and bioactive substances with potential anti-breast cancer activity and provide a complete overview for future research. A comprehensive analysis of all scientific studies, phytochemical screening, ethnobotanical surveys, plant medicinal applications, and anti-breast cancer activities of medicinal plants was conducted. These data were gathered by searching for relevant articles in databases such as PubMed, Scopus, Google Scholar, and Web of Science. Relevant studies included those published in peer-reviewed journals and reports from respective conservation agencies. The reviewed medicinal plants and their bioactive components demonstrated promising anti-breast cancer activities, including antiproliferative, apoptotic, anti-angiogenic, and antioxidant activities. This study emphasizes the potential of medicinal plants and their bioactive chemicals for the treatment of breast cancer. This is a significant resource for future research and the development of effective plant-based medicines. Herbal medications are promising alternatives to traditional chemotherapy, with fewer side effects and greater tolerability. Further research is required to fully understand the anti-breast cancer capabilities of these medicinal plants and their bioactive components.

Key words: Breast cancer activity, breast cancer, medicinal plants, phytochemical constituents

INTRODUCTION

Breast cancer is a medical condition in which abnormal breast cells grow out of control and turn into tumors.[1] In 2022, 2.3 million women received a diagnosis of breast cancer worldwide, accounting for 670,000 deaths from the disease.[2] Breast cancer affects women globally, with 99% of cases occurring in women, whereas men only experience it in 0.5–1%. Factors such as aging, obesity, alcohol abuse, radiation exposure, family history, reproductive history, smoking, and post-menopausal hormone therapy increase the risk of breast cancer.[3,4] Breast cancer symptoms include breast thickening or lumping, changes in breast size, shape, appearance, skin abnormalities such as dimpling, redness, pitting, or pitting, and alterations in the nipple or surrounding skin due to abnormal or bloody nipple fluid.[5,6] According to the World Health Organization (WHO) estimates, in the absence of immediate action, the number of cancer-related deaths will increase by almost 80% by 2030, with most of these fatalities taking place in countries with low and moderate incomes.[7]

Breast chemoprevention uses pharmaceuticals or natural substances to block the progression of pre-malignant cells with DNA damage, preventing the initiation of invasive breast cancer. However, due to severe side effects, it has not significantly reduced morbidity or death rates. As there is no viable treatment for advanced illnesses, the cancer is highly resistant to chemotherapy.[8] The anti-tumor and anti-cancer effects of natural plant substances have shown promising results.[9,10] The WHO recommends traditional medicines due to their effectiveness and safety, but some people still opt for herbal drugs for various reasons, such as health promotion, disease prevention, exhaustion of conventional therapies, dissatisfaction with efficacy, significant side

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effects, belief in herbal products, personal involvement in decision-making, and cultural or spiritual preferences.[11] The National Cancer Institute has identified 3,000 medicinal herbs with consistent anticancer efficacy, based on their secondary metabolites, including isocatechins, catechins, lignans, coumarins, flavonoids, and flavones, from nearly 35,000 plant species.[12]

Hormonal issues often lead to cancer outcomes, which can be addressed by bioactive chemicals such as isoflavonoids and phytoestrogens. Plant flavonoids have been shown to have chemopreventive, estrogenic, and anti-estrogenic properties. Other medicinal compounds found in plants, such as taxol, camptothecin, vincristine, vinblastine, vinorelbine, vindesine, and vinflunine, have shown significant therapeutic value in various cancer treatments.[13,14]

Thus, this review aims to integrate information about medicinal herbs with anti-breast cancer activity. Figure 1 depicts a medicinal plant that contains various phytochemicals with anti-breast cancer activity. The phytochemicals present in various therapeutic plants that have anti-breast cancer properties are shown in Figure 2.

DESCRIPTION OF MEDICINAL HERBS WITH ANTI-BREAST CANCER PROPERTIES

Caesalpinia pulcherrima

Barbados pride or peacock flower, or *C. pulcherrima*, is a herb used to treat menoxenia, pyrexia, wheezing, and bronchitis. Its effects include antiviral, purgative, emmenagogue, tonic, stimulant, and cathartic. Out of the herb's 61 active ingredients, 29 have been linked to breast cancer. Gallic acid, catechin, rutin, elalic acid, quercetin, α-pinene, β-pinene, limonene, E-Verbenol, α-terpineol, α-copaene, and E-Caryophyllene are among the phytochemicals found in the flower that is used to cure breast cancer.[15] *C. pulcherrima* is shown in Figure 3.

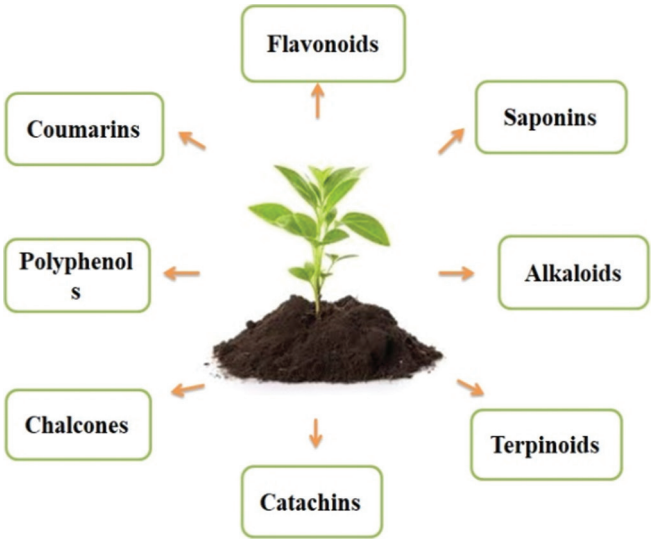

Figure 1: Types of phytochemicals from plants

Glycyrrhiza glabra

Liquorice, or *G. glabra*, is a major species in the genus *Glycyrrhiza* that has medicinal qualities.[16,17] The growth of MDA-MB-231 tumor cells is inhibited by its ethanolic root extract, contingent on dosage.[18] The presence of triterpenoid saponin glycyrrhizin in the root extract is linked to its sweet flavor. The most abundant and primary phytochemical (10–25%) in the root extract is glycyrrhizin.[16]

Strong antioxidant properties have been discovered in liquorice, which is abundant in phenolic compounds such as methylated isoflavones, chalcones, coumarins, and flavonoids.[17,18] These substances are ascribed to the fruit's extracted polysaccharides, chalcones, and saponins.[19] These substances have promise for the development of novel anticancer drugs because they may possess strong antioxidant qualities that inhibit the growth of cancer. Glabridin, one of the flavonoids in licorice, can aid in the battle against cancer by starting the mitochondrial apoptotic pathway and caspase cascade, which kills cancer cells.[20] *G. glabra* is shown in Figure 4.

Securidaca longipedunculata

The plant *S. longipedunculata* Fresen, also known as a violet tree in Northern Nigeria, is considered the mother of all remedies and is used by traditional medicine practitioners in African nations to treat various illnesses, including cancer.[21] The phytochemical screening of *S. longipedunculata* root bark extract revealed flavonoids, cardiac glycosides, phenols, alkaloids, saponins, and reducing sugar as compounds with anti-oxidant and anti-cancer properties.[22] *S. longipedunculata* is shown in Figure 5.

Perilla frutescens

A member of the *Labiaceae* family, *P. frutescens* is a perennial plant shown in Figure 6. China, Korea, Japan, Vietnam, and other countries widely grow this popular traditional herb. It comes from the same origins as food and medicine.[23] We can further classify it as a medicinal plant into *Perilla* plant material, *Perilla* leaves, and *Perilla* branches.[23,24] *P. frutescens* contains various active compounds including tocopherols, phytosterols, fatty acids, terpenoids,[25] polyphenols, flavonoids,[26] anthocyanins, coumarins, carotenoids, neolignans,[27] glucosides, peptides, and related compounds. We used *Perilla* seed species for the triterpenoid camelliol C.[28] Researchers found that additional pentacyclic triterpenes, such as ursolic acidic

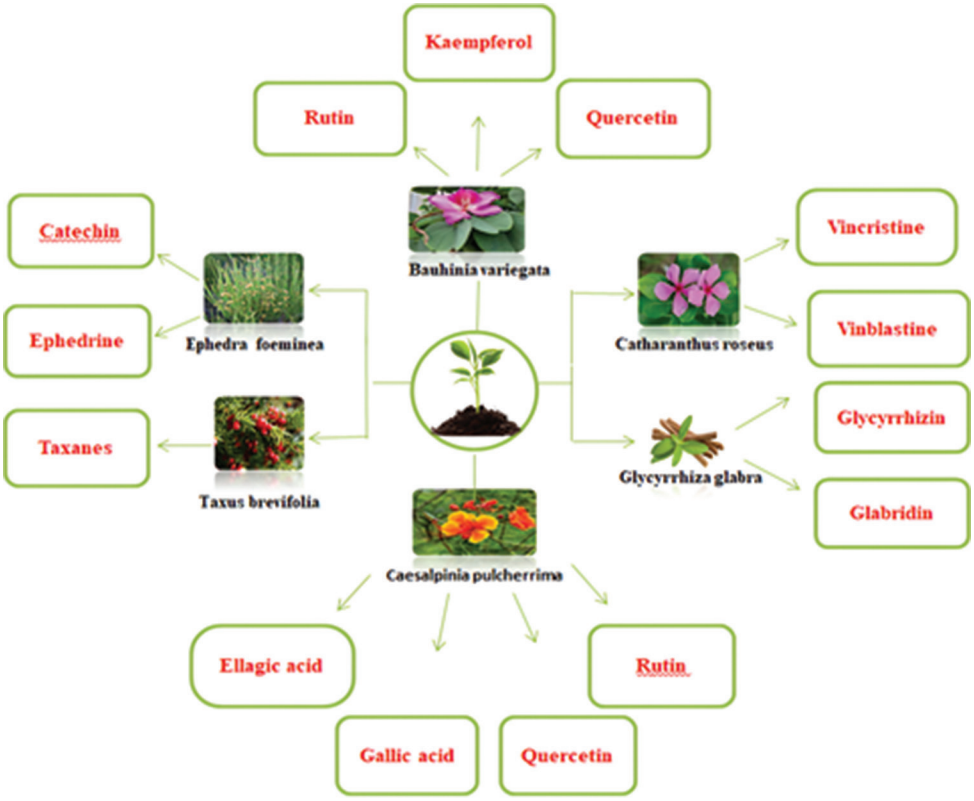

Figure 2: Phytochemicals present in various plants with anti-breast cancer properties

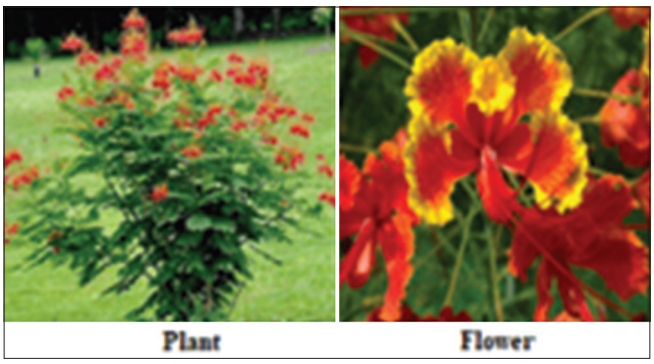

Figure 3: *Caesalpinia pulcherrima*

Figure 4: *Glycyrrhiza glabra*

Figure 5: *Securidaca longipedunculata*

Figure 6: *Perilla frutescens*

substances, oleanolic acid, corosolic acid, and marlinic acid, possess anti-tumor effects. Two common polyphenols, caffeic acid and Ros A, are antibacterial,[29] anxiety relievers, anti-depressive, liver-protective,[30] and have anticancer properties.

Catharanthus roseus

C. roseus, another name for Vincarosea, shown in Figure 7 is an evergreen herb belonging to the *Apocynaceae* dogbane family. Since ancient times, it has been used to cure a wide

range of illnesses, such as rheumatism, diabetes, cancer, menstruation problems, dyspepsia, and indigestion. The plant possesses a broad range of pharmacological properties and is abundant in bioactive chemicals. It is frequently cultivated for its anticancer alkaloids, which include vincristine and vinblastine, two of the more than 130 varieties used to treat cancer. Amalicine, reserpine, and serpentine are among the 70 chemical compounds found in the plant's leaves.[31]

Bauhinia variegata

The flowering plant species *B. variegata* belongs to the *Fabaceae* family of legumes. We commonly refer to it as the orchid tree. The orchid tree possesses excellent anticancer and antioxidant properties. Researchers have examined its potential to prevent breast cancer.[32] Numerous phytochemical compounds in *B. variegata* exhibit anti-cancer properties, particularly against breast cancer.[33] Several compounds found in *B. variegata* have potent anti-tumor properties.[34] These include three particular flavonoids that can stop the growth of cancer cells and trigger apoptosis: quercetin, kaempferol, and rutin.[35] The plant *B. variegata* contains phytosterols, terpenoids, and phenolic acids that have been shown to be useful in promoting the death of cancer cells and lowering oxidative stress. Certain acids, such as gallic and ellagic acids, have been shown to be cytotoxic to cancer cells, resulting in cell death and halting growth.[36] Terpenoids such as beta-sitosterol and phytosterols such as stigmasterol in *B. variegata* have been found to be cytotoxic to cancer cells, causing apoptosis and stopping cell proliferation.[37] Furthermore, it has been demonstrated that the stem and root extracts inhibit the development of human breast cancer cells, with IC_{50} values ranging from 12.10 to 14.20 µg/mL. *B. variegata* is shown in Figure 8.

Ephedra foeminea

Non-flowering seed plants in the genus *Ephedra* are found throughout dry and semi-arid climates, especially in North Africa, Asia, America, and Europe.[38] The ecological, commercial, and medicinal qualities of these plants make them valuable. According to a report, *E. foeminea* is used in herbal treatments for breast cancer in 68% of Palestinian women.[39] According to earlier studies that examined *E. foeminea's* phytochemical composition, it included 0.68% phenolic compounds, 0.01% alkaloids, and 0.06% flavonoids.[40]

Ephedrine is not a chemotype of *E. foeminea*, in contrast to other *Ephedra* species.[41] Because it does not contain ephedrine, its pharmacological characteristics are different from those of other species. 18 distinct flavonoids, phenolics, 32 terpenes, organic acids, vitamins, and citric acid are all present in *E. foeminea's* aqueous extract.[42,43] *E. foeminea* is shown in Figure 9.

Taxus brevifolia

The North American plant *T. Brevifolia* is shown in Figure 10. Sometimes referred to as Pacific yew or mountain mahogany, it grows along the coast from Alaska to California. Taxanes and diterpene alkaloids, such as Paclitaxel, Docetaxel, and 10-deacetylbaccatin III, which are important active principles in the taxane family, are its primary chemical constituents.[44]

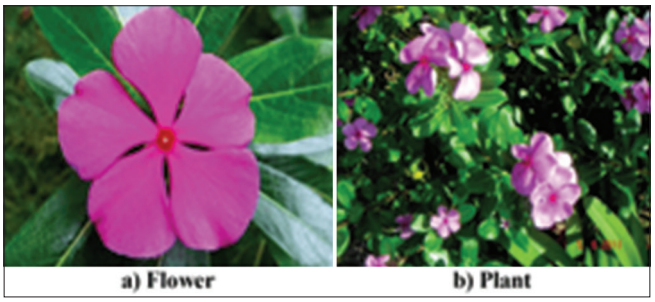

Figure 7: *Catharanthus roseus*

Figure 8: *Bauhinia variegata*

Figure 9: *Ephedra foeminea*

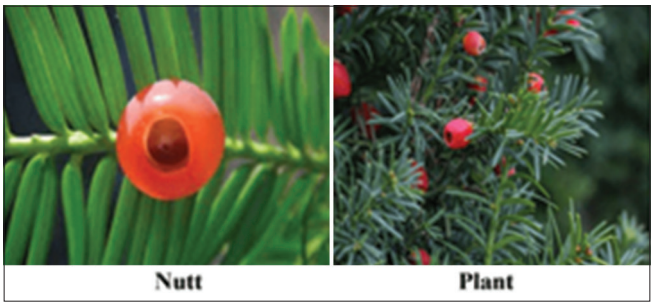

Figure 10: *Taxus brevifolia*

Table 1: Various medicinal plants and their phytochemical constituents

S. No.	Plant name	Local name	Family	Phytochemical constituents
1.	*Caesalpinia pulcherrima*	Peacock flower	Fabaceae	Myricetin, flavonoids, homoflavonoids, β-Sitosterol, gallic acid, quercetin, rutin, lupeol, and elagic acid.[15]
2.	*Glycyrrhiza glabra*	Liquorice	Fabaceae	Glycyrrhizin, chalcones, coumarins, flavonoids, isoflavones, and methylated isoflavones.[17,18]
3.	*Securidaca longipedunculata*	Violet tree	Polygalaceae	Flavonoids, cardiac glycosides, phenols, alkaloids, saponins, and reducing sugar.[21]
4.	*Perilla frutescens*	Beefsteak plant	Lamiaceae	Fatty acids, phenylpropane, terpenoids, polyphenols,[25] flavonoids,[26] anthocyanins, carotenoids, neolignans.[27]
5.	*Catharanthus roseus*	Madagascar periwinkle	Apocynaceae	Vincristine and vinblastine[31]
6.	*Bauhinia variegata*	Orchid tree	Fabaceae	Quercetin, kaempferol, and rutin[35]
7.	*Ephedra foeminea*	Joint-pine, Brigham tea	Ephedraceae	Kaempferol, quercetin, catechin, limonene, stearic acid, vitamins, and citric acid[41]
8.	*Taxus brevifolia*	pacific yew	Taxaceae	Taxanes and paclitaxel[45]
9.	*Withania somnifera*	Indian Ginseng, Ashwagandha	Solanaceae	Withanolides, alkaloids, sitoindosides, and withaferin[48]
10.	*Andrographis paniculata*	Kalmegh	Acanthaceae	Andrographolide[49]
11.	*Cytisus villosus*	Hairybroom	Leguminosae	Epigallocatechin, quercetin derivatives, and kaempferol derivatives[50]
12.	*Hemidesmus indicus*	Sarasaparilla	Apocynaceae	Two-hydroxy-4-methoxybenzoic acid, three-hydroxy-4-methoxybenzaldehyde, and two-hydroxy-4-methoxybenzaldehyde[51]
13.	*Acacia victoriae*	Bardi bush	Fabaceae	Saponins (avicins and Fo35)[52]
14.	*Vachellia tortilis*	Umbrella thron acacia	Fabaceae	Gallic acid, and epicatechingalloyled[53]
15.	*Annona muricata*	Raviola, Soursop, Sauersak	Annonaceae	Annonacin,[54] alkaloids, and flavonoids
16.	*Rhoicissus tridentata*	Bushman's grape	Vitaceae	Alkaloids, terpenoids, flavonoids, and gallic acid.[55]
17.	*Cannabis sativa*	Marihuana, and marijuana	Cannabaceae	Cannabinoids, tetrahydrocannabinol (THC), and cannabidiol (CBD).[56,57]
18.	*Linum usitatissimum*	Flax	Linaceae	Gallic acid, phenylpropanoids, and Linseed carotenoids.[58]

Paclitaxel was extracted from Yew tree bark extracts in 1964 and 1965.[45] Initially, the drug was sold under the name "Taxol." In 1984, the FDA approved paclitaxel for use in chemotherapy and as a treatment for ovarian and breast cancer in 1992.[46] The USDA released paclitaxel, which was derived from *T. brevifolia*, in 1992. It has been demonstrated to have anticancer and antiangiogenic qualities in a variety of cancer cell lines, including those from the liver, prostate, lung, pancreas, and breast.[47] Various medicinal plants and their phytochemical constituents are presented in Table 1.

This article provides an overview of several plants along with information on their phytochemical composition. According to existing research on plants, all of these herbal plants contain phytochemical constituents such as myricetin, vincristine and vinblastine, glycyrrhizin, chalcones, tetrahydrocannabinol, saponins (avicins and Fo35), quercetin, gallic acid, and withanolides. Which have already had their anticancer and antioxidant properties demonstrated. For this reason, it is expected that these plant materials will be useful in the treatment of breast cancer.

CONCLUSION

This study investigates the potential of medicinal plants and their phytochemical components to prevent breast cancer. Conventional cancer treatments such as radiation therapy and chemotherapy have negative health effects, necessitating the use of complementary and alternative medicine. Medicinal plants contain novel anti-cancer agents, and traditional practitioners in countries such as Malaysia also use them.

A large number of secondary metabolites found in medicinal plants may be beneficial in treating breast cancer-causing chemicals by inhibiting their action. Therefore, this review lists various plants with anticancer properties and discusses each plant's ability to prevent breast cancer. Researchers will use this information as a starting point for further research on these plants with anti-breast cancer action.

SUMMARY

This review explores the potential of medicinal plants and bioactive substances in treating breast cancer. Breast cancer is a prevalent disease affecting millions of women worldwide. At present, chemotherapy is the most common treatment, but it has side effects. Thus, this review highlights the potential of herbal plants with bioactive compounds as potential anti-breast cancer treatments. This information could help beginners identify herbs with anti-breast cancer activity, paving the way for future research.

AUTHORS CONTRIBUTION

Both authors have made an equal contribution.

AVAILABILITY OF DATA ACCESS

The datasets of this study are available from the corresponding author on reasonable request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

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