

Catharanthus roseus L. (*Periwinkle*): An Herb having Significant Phytochemical and Pharmacological Action with Benefits on Health

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Abstract

Catharanthus roseus is a perennial species of flowering plant in the Apocynaceae family. It is also referred to as bright eyes, Cape periwinkle, graveyard plant, Madagascar periwinkle, old maid, pink periwinkle, and rose periwinkle. Although it is native and endemic to Madagascar, it is now spread across the tropics as an attractive and medicinal plant. It is the source of the cancer-treatment medications vincristine and vinblastine. *Vinca rosea* was the name given to it while it belonged to the genus *Vinca*. Another distinctive feature of the plant is that it is a model for studying phytoplasmas and spiroplasmas, the tiniest bacteria on the planet, and it is a friendly experimental host for their upkeep. Botanical details about synonyms, colloquial names, cultivars, floral morphology, and reproduction contribute to our understanding of the plant, while periwinkle's ecology and location highlight how commonplace the organism is. Robust plant propagation, a valuable source of bioactive substances, plethora of horticulture uses are guaranteed by good agronomic techniques. Among the main *vinca* alkaloids used in medicine are vinpocetine, vinblastin, vincristine, vindesine, tabersonine, and vinorelbine. *Vinca rosea* flower juice is used to treat a variety of skin conditions, including dermatitis, eczema, and acne. We believe that it could be beneficial to researchers, scientists, ayurvedic doctors, pharmacognosists, botanists, and students working in the field of medicinal plant study. *Catharanthus roseus* has been studied for a variety of reasons, including its amazing ethno medicinal qualities. This study provides an outline of the biology and its different applications.

Keywords: Catharanthus roseus; Apocynaceae; Vincristine; Vinblastine

Introduction

There are eight species in the genus *Catharanthus*; seven of them are native to Madagascar, while one, *C. pusillus*, is native to India. *Catharanthus roseus*, often known as Madagascar periwinkle (MP), is a significant flower species in horticulture and one of the few plants with a lengthy history that is used as a pharmaceutical. Its origins can be found in tradition from Mesopotamia that dates back to 2600 BCE. This plant is still used extensively in herbal and traditional medicine today to treat a wide range of illnesses. Sometime in the mid-1950s, several compounds belonging to the alkaloid class were identified as having therapeutic effects [1,2]. Global health care has benefited greatly from the use of medicinal plants [3]. In addition to being the primary source of natural pharmaceuticals, MP is a model organism of choice for studying plant alkaloid metabolites because of its large range of terpenoid indole alkaloids (TIAs) and extensive range of pharmacological effects [4-7]. However, MP is potentially poisonous as are many plants of the dogbane family. Nowadays, MP comes in many different varieties and colors ranging from white, hot pink, and mauve to the original pink as a result of breeding experiments. There is a dearth of knowledge regarding the other characteristics of the species because reviews of MP that have already been published have largely focused on the herb's chemical and pharmacological components. The purpose of this review is to present current information on new cultivars that have been brought to the horticultural business along with insights into the agrotechnological, biological, ecological, and medicinal aspects of MP (especially anticancer chemicals).

Taxonomy

Description

Catharanthus roseus

Family: Apocynaceae

- Kingdom: Plantae
- Order: Gentianales
- Family Name: Apocynaceae
- Genus: Catharanthus
- Species: roseus
- Binomial name: Catharanthus roseus
- Botanical Name: *Vinca rosea* [8].

Vinca rosea was the old name of this species. With over 1500 species, this is a big family that is mostly found in tropical areas. Many of the most well-known tropical decorative plants are found in it, such as Mandevilla, Frangipani, Oleander, and Allamanda. Some are smaller, evergreen, or deciduous trees, shrubs, or climbers from other warm regions of the planet, while one or two are found in temperate climates (*Vinca*). Many are big trees with buttress roots found in rainforests. The majority of plants produce a milky latex sap that is frequently used for medicinal purposes or to make rubber.

Simple, undivided leaves surround the stem in circles in opposite directions.

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A calyx is made up of five pieces that can be linked together to form a tube or can be separated. The flowers are huge and spectacular and are usually seen in bunches. Usually, the base of them is a tube made up of five petals. Five stamens are connected to one another.

The two-part seed capsule might be found inside the blossom or outside of it. Seeds vary greatly; they can be big and woody (*Allamanda*) or little with a hairy tuft (*Nerium*).

Simple leaves, a milky sap, a five-part calyx, clusters of flowers, five big petals connected at the base, and five stamens are typical characteristics of members of this family. Most parts of many members of this plant family are poisonous. Each plant of this family (*Apocyanaceae*) possesses different medicinal behavior [9].

Origin and Distribution

Native to Madagascar. Widely naturalized in numerous areas. Especially in dry coastal regions. Grown commercially in Australia, Africa, India, and southern Europe for therapeutic purposes. Cultivated practically everywhere in the tropical and subtropical world as an ornamental plant [10].

Morphology

The plant *Catharanthus roseus* is a herbaceous or sub-herbaceous evergreen. This herbaceous plant, which is endemic to Madagascar, can reach heights of 80cm to 1m and produces pink, purple, or white flowers all year long [11]. The leaves are grouped in opposite pairs and are oval to oblong, 2.5–9.0cm long and 1–3.5cm broad. They are glossy, green, hairless, and have a light midrib and a short, 1–1.8cm long petiole. Two common cultivars of *C. roseus* are called after their bloom colors: one produces the pink flower "Rosea" (4), while the other produces the white flower "Alba." The blooms have five petal-like lobes on a corolla that is 2–5cm in diameter and ranges in color from white to dark pink with a dark red center. The basal tube is around 2.5–3cm long. The fruit consists of two follicles that are roughly 2–4cm long and 3mm wide.

In subtropical climates, the plant can reach a height of approximately one meter. According to the leaves of this plant are oval to oblong in shape, 2.5 - 9.0cm long and 1.0 - 3.5cm broad. They are glossy green, hairless, and have a light midrib and a short petiole that is approximately 1.0 - 1.8cm long. The leaves are placed in opposing pairs.

Geographical distribution

Madagascar, an island in the Indian Ocean, is the native home of *Catharanthus roseus*. It is now a well-liked decorative plant in many tropical and subtropical areas of the world. For therapeutic use, it is commercially grown in Southern Europe, Africa, Australia, India, China, Spain, and the United States. Major markets for the medications made from this plant include the United States, Hungary, West Germany, Italy, the Netherlands, and the United Kingdom [12]. These days, it is widespread throughout the world's tropical and subtropical climates, including the southern United States.

Cultivation and collection

Vinca rosea plants need both dry and moist soil to survive droughts. It depicts the seed during growth. In the nursery, fresh seed is used in February and March. The resulting plant seedlings are transferred into the soil when they reach a height of 5 to 8cm and a distance of 45cm multiplied by 30cm after two months. Gather the entire plant and make a first cut above 10cm in the stem above the field. During organization,

the stem, leaves, and seeds are separated and dried. Gathered the roots, which are then packed, dried, and cleaned by filling [13]

Chemical constituents of vinca rosea

Vinblastine: Vinblastine is a medication sold under various brands, including Velban. It is utilized locally in conjunction with certain medications. This department treats a wide range of cancers, such as seminoma, malignant melanoma, bladder cancer, brain cancer, Hodgkin's malignant neoplastic disease, and non-small cell respiratory organ cancer. It is injected into a vein to be administered [14].

Vincristine: In chemotherapy, vincristine is also known as leurocristine and is marketed under the brand name Oncovin, among others. It ought to be utilized in the treatment of several cancer kinds. These comprise, among other things, small-cell lung cancer, neuroblastoma, Hodgkin's disease, acute lymphocytic leukemia, and acute myeloid leukemia. IV administration is used to administer it. Additionally, they are employed as immune suppressants [15].

Vindesine: Vindesine, a chemical substance of the antagonistic mitotic genus *Vinca*, is used in therapeutic. It should be used to treat a variety of cancers, such as those that are subtypes of malignant neoplastic diseases, numerous skin cancers, lymphomas, carcinomas, and neoplastic diseases. It's overseen by the blood vessel.

Tabersonine: *Vinca rosea*, a medicinal plant, contains terpenes called indole alkaloids, which are known as tabersonine. The enzyme tabersonine 16-hydroxylase (T16H), also known as form16-hydroxytabersonine, hydroxylates these at position sixteen. The first intermediate that results in type is vindoline; vinblastine biosynthesis requires both of these precursors [16].

Traditional use

Periwinkle has numerous folkloric and traditional uses that have been tried and taught by people's beliefs. The paste made from the leaves works wonders for healing wounds and relieving the agony associated with wasp stings. It has the ability to halt bleeding, hastening the healing process. Periwinkle is also reported by many to be helpful in relieving fatigue, headaches, and depression [17].

Pharmacological benefits of Catharanthus roseus

Anti-cancer property

Vinblastine and vincristine, two anticancer alkaloids, are derived from the stem and leaves of *Catharanthus roseus*. [18] Different quantities of the methanolic crude extracts of *Catharanthus* were found to have strong anticancer activities against a variety of cell types in an in vitro research. [19] Numerous other indole alkaloids that have been identified from *C. roseus* have been found to have potent cytotoxic effects on various cancer cell lines. The human promyelocytic leukemia HL-60 cell line was found to be inhibited by the recently identified monoterpenoid indole alkaloid catharoseumine, with an IC₅₀ of 6.28 μM. [20] Furthermore, against the human breast cancer cell line MDA-MB-231, five previously identified compounds (vinamidine, lessine, catharine, cycloleurosine, and leurosidine) and three recently discovered dimeric indole alkaloids (140,150-didehydrocyclovinblastine, 17-deacetycyclovinblastine, and 17-deacetyvinamidine) all showed in vitro inhibition of cell viability with an IC₅₀ range of 0.73–10.67 μM [21]. The compounds vinblastine sulfate has been used to treat both acute and chronic leukaemia, as well as lymphosarcoma, choriocarcinoma, neuroblastoma, carcinoma of the breast and lungs, and other organs. Using vinblastine oxidized in the form of vincristine sulphate. medication that successfully halts mitosis in the metaphase

for reticulum cell sarcoma, lymphocytic leukemia, Hodgkin's disease, Wilkins' tumor, and acute leukemia in children [22].

Anti-oxidant property

The primary source of anti-oxidant properties in pink and white flowers is their roots, which contain phenolic extracts derived from various tests, including hydroxyl radical-scavenging activity, peroxide radical-scavenging activity, DPPH radical-scavenging, and nitric oxide radical inhibition method [23].

Anti-diabetic property

The plant *C. roseus* has a long history of use in the treatment of diabetes in various regions of the world. Blood glucose levels in both healthy and diabetic rabbits were shown to drop in a dose-dependent way following treatment with *C. roseus* leaf juice [24]. Vindoline, vindolidine, vindolicine, and vindolinine were the four alkaloids found in the dichloromethane extract of *Catharanthus* leaves. In pancreatic TC6 or myoblast C2C12 cells, all four alkaloids markedly improved glucose absorption; vindolicine exhibited the strongest action. Moreover, vindolidine, vindolinine, and vindolicine demonstrated substantial inhibitory activity against protein tyrosine phosphatase-1B (PTP-1B), indicating their potential as therapeutic agents for Type-2 diabetes [25]. It has been demonstrated that the leaves of *C. roseus* (L.) G. Don contains the hypoglycemic and antidiabetic qualities of vindoline, vindolidine, vindolicine, and vindolinine. These specialists claimed that these compounds enhanced pancreatic glucose absorption or that vindolicine, the compound with the best action in myoblast cells,

Apart from that, a notable degree of protein tyrosine inhibitory effect was shown by vindolidine, vindolicine, and vindolinine. Due to their ability to inhibit phosphatase-1B, these compounds may find application in the management of diabetes. Furthermore, vindolicine exhibited the highest antioxidant characteristics in the 1,1-diphenyl-2-picrylhydrazyl tests and the oxygen radical absorption capability, demonstrating that this compound also reduced the oxidative damage that H₂O₂-induced in pancreatic cells. Consequently, vindolicine may be applied as an antidiabetic in the future [26].

Anti-helmentic property

A class of antiparasitic medications known as anti-helminthics are used to eradicate parasitic worms. Chronic illness can result from helminth infection; ethanolic extract exhibits strong anthelmintic action [27]. It has an impact on both people and animals. It was discovered that *vinca rosea* has been utilized as an anti-helminthic medication since ancient times [28].

Anti-diarrheal property

The Wistar rats placed in the extract-treated groups experienced less severe diarrhea than the control rats, and the extracts significantly reduced the quantity and weight of wet poo pellets. In addition, additional doses of 200 and 500mg/kg of extract inhibited the gastrointestinal passage of charcoal powder and prevented castor oil-induced diarrhea.

The traditional use of *C. roseus* for the management and treatment of diarrhea is supported by these data [29]. The antidiarrheal activities of the plant's ethanolic leaf extracts were evaluated in Wistar rats by pre-treating the extract and using castor oil as an experimental diarrhoea-inducing agent. The potential of ethanolic extracts to stop diarrhea

C. roseus prevented castor oil-induced diarrhea in a dose-dependent manner [30].

Hypotensive property

The leaf extract, which has 150 beneficial alkaloids and other chemicals with pharmacological activity, has a hypotensive quality.

In experimental animals, leaf extracts (hydroalcoholic or dichloromethane methanol) have been shown to produce hypoglycemic and hypotensive effects [31].

Phytoremediation property

Pollutants are eliminated from environmental components using phytoremediation. According, lead and cadmium have an effect on *Catharanthus roseus*. They concluded that the harmful effects of lead and cadmium on *C. roseus* are greatest during germination, and that as the plant reaches maturity, its resistance to these heavy metals increases gradually. Examined *Catharanthus roseus*'s capacity for phytoremediation in relation to chromium. *C. roseus* has been demonstrated to be beneficial in the reclamation and remediation of chromium-contaminated soil and land since it can absorb up to 38% of the Cr present in primary and secondary sludge-amended soil through roots and accumulate it to about 22% in leaves. Employed *Catharanthus roseus* for phytoremediation of lead and nickel. Plant pathology uses *Catharanthus roseus* as a phytoplasma experiment host. This is due to the fact that it is highly susceptible to infection by the vast majority of phytoplasmas and frequently exhibits highly recognizable signs including phyllody and noticeably smaller leaves.

Wound healing property

Rats with the ability to heal wounds are given ethanol extracts at a dose of 100mg/kg each day. An increase in dry weight and hydroxyproline is indicative of a decrease in the epithelization time with a high rate of wound contraction. Together with hydroxyproline, there is an increase in tensile strength that aids in the control of wound healing.

Microbial activity

Catharanthus roseus is an important medicinal plant for novel therapeutics, as most bacterial illnesses are becoming resistant to many of the antibacterial antibiotics that are currently on the market. Phytes possess natural resources that have been beneficial in offering potent chemotherapy medications a broad spectrum of action. The antibacterial activity of crude extracts from different sections of *Catharanthus roseus* against different kinds of bacteria and its therapeutic importance. After each plant component is extracted with the appropriate solvent, an agar well diffusion assay is used to assess each part's antibacterial activity against a total of six bacterial stains. Furthermore, the minimum inhibitory concentration or concentrations for the active crude extracts were determined. The microorganism under investigation, the extraction technique, the plant part used for extraction, the state of the plant part (fresh or dried), and the extraction solvent all had a major effect on the pattern of inhibition, according to the data. Testing the plant's leaf extracts' antimicrobial activity against microorganisms such as *Salmonella typhimurium* NCIM 2501, *Pseudomonas aeruginosa* NCIM 2036, and *Staphylococcus aureus* NCIM 5021 revealed that the extract could be used as a preventive measure in the treatment of a variety of illnesses [32].

Anti-ulcer

The plant's alkaloids, vincamine and vindoline, showed signs of

having anti-ulcer qualities. The leaves of the *C. roseus* plant have been found to have anti-ulcer effects in test animals with ulcers.

Vincamine's neuroprotective and cerebral-vasodilatory properties are widely recognized [33].

Bio-pesticidal property

The effectiveness of *Catharanthus roseus* solvent extracts against the larvae of the gramme pod borer *Helicoverpa armigera* was evaluated biologically. It was found that *C. roseus* leaf extract fractions in ethyl acetate worked well as a biopesticides [34].

Cytotoxic activity

The anticancer benefits of the *Vinca rosea* stem and leaves are derived from the alkaloids vinblastin and vincristine, which have growth-inhibitory effects on cancers in animals. Vinblastin, vincristine, and its derivatives, such as deacetyl-vinblastin amide, mostly obstruct cancer cell division. They have generally been proven to be successful in treating both malignant and non-malignant platelets as well as platelets linked to disorders. A *vinca rosea* alkaloid has been found to prevent the formation of new blood vessels, hence encouraging the growth of tumors. While vincristine leukemia is treated with vinblastin, hooking's disease and choriocarcinoma are treated with vinblastin in children [35].

Alzheimer disease

Vinca rosea contains alkaloids called vinpocetine, which have a range of effects to enhance memory and brain function [36]. These actions are often advantageous in cases of Alzheimer's disease. In clinical trials for dementia and stroke, vinpocetine was administered at a well-tolerated dose of up to 60 mg per day, with no discernible side effects [37].

Some side effects of *Vinca rosea*

During its application, this plant exhibits several negative consequences. We are aware that the VLB has strong vesicants, gastrointestinal toxicity, extravasation damage, and bone marrow suppression. It is not recommended that this medication be taken by a patient who has bacterial illnesses. Breastfeeding is not an option for mothers due of the possibility of it secreting into breast milk. Studies on animals have shown vinblastine to be poisonous and mutagenic. It is also carcinogenic, thus women should not use it while they are pregnant. Ingestion of Madagascar periwinkles can pose a risk. It produces carcinogens and is mentioned in various legal documents, including the Louisiana State Act 159 (*Vinca rosea*) [38-42].

Conclusion

These days, there is an increasing demand for natural products and medications derived from plants worldwide. *Catharanthus roseus* is a wonderful herb because of its many uses. It is a popular ornamental plant in the horticultural sector, a model plant for phytopathology and biotechnology research, and a natural source of chemicals that are used in popular anticancer drugs sold all over the world.

Catharanthus roseus has shown stronger cytotoxic, antioxidant, anticancer, and antidiabetic properties. Ethanol extracts of leaves and flowers exhibit the highest diabetic wound healing effectiveness. Alkaloids, or phytochemicals, are a class of compounds that have been found in abundance. They have been shown to have anti-bacterial, anti-malarial, anti-cancer, and anti-diabetic properties. *Catharanthus roseus* aq. Through apoptosis, the extract can operate as an anticancer agent and potentially show antioxidant properties.

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