

CHAPTER 8

Medicinal Importance of *Catharanthus roseus* (L.) G. Don

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ABSTRACT

Catharanthus roseus (L.) G. Don, belonging to the family Apocynaceae, is a well-known medicinal plant valued for its diverse pharmacologically active compounds. Native to Madagascar but now cultivated globally, the plant exhibits a wide range of therapeutic properties due to its rich phytochemical profile, particularly alkaloids, flavonoids, terpenoids, and phenolic compounds. It is a source of over 400 alkaloids, including the anticancer agents like vincristine and vinblastine, as well as compounds with antidiabetic, antimicrobial, antihypertensive, and neuroprotective activities. This review summarizes the phytochemical diversity, pharmacological importance, and potential therapeutic applications of *Catharanthus roseus*, highlighting its relevance in the pharmaceutical and ethnomedicinal sectors.

Keywords: *Catharanthus*, ethnomedicine, pharmacological properties, secondary metabolites

INTRODUCTION

Catharanthus roseus (L.) G. Don is commonly known as Sadabahar, a large speckled medicinal plant of the Apocynaceae family (Ali et al. 2021; Gawade 2023). English names used for the plant include Cape Periwinkle, Rose

Periwinkle, Rosy Periwinkle, and Old Maid. It is a perennial plant that is native to Madagascar and Southern Asia, and has expanded throughout India's tropical and subtropical regions (Paarakh et al. 2019). It is an important medicinal plant of Apocynaceae containing abundant useful alkaloids, used in diabetes, blood pressure, asthma, constipation, cancer, and menstrual problems (Das and Sharangi 2017). It contains various important phytochemical substances like flavonoids, steroids, tannins, phenolic compounds, alkaloids, carbohydrates, quinones, terpenoids, saponins (Gawade 2023). *C. roseus* contains significant amount of volatile and phenolic compounds such as caffeoylquinic acids and flavonal glycosides which act as antioxidants against reactive oxygen species and play an important role in plant defence system. It contains more than 400 alkaloids of which have been categorized as antineoplastic agents for inhibiting or preventing the growth and spreading of tumours or malignant cells such as rhabdomyosarcoma, leukemia, neuroblastoma, malignant lymphomas, and Hodgkin's disease (Maqsood et al. 2018). Due to the presence of such bioactive compounds, the plant possesses various pharmacological uses in modern medicines for anticancer, antidiabetic, antimicrobial, antioxidant, anti-diarrheal, anthelmintic, hypotensive, wound healing, hypolipidemic, Alzheimer disease, antiallergic and cardioprotective effects (Gawade et al. 2023).

TAXONOMY (Lahare et al. 2020; Gawade et al. 2023; Paarakh et al. 2019; Figure 1)

Catharanthus roseus is an evergreen herbaceous plant or subshrub that grows between 32 to 100 cm in height. It is usually erect, with a somewhat woody base, and exudes white latex when cut. The stems are cylindrical, longitudinally ridged, or narrowly winged, and may appear green, red, or purple, often with a pubescent surface when young. The leaves are oppositely arranged, borne on short petioles. They are elliptic to obovate or oval to oblong, ranging from 3-10 cm in length and 1-4 cm in width. The leaves have a glossy, dark green surface with a paler midrib and veins. Their tips can be rounded to acute, often with a tiny point. Some leaves may be hairless, while others have fine pubescence. The inflorescence is racemose, either axillary or terminal in position. Flowers may be solitary or paired, and are shortly pedicellate. The flowers are tubular, swollen in the region of the anthers, and have a hairy corolla tube throat. They naturally appear in pale pink, white, or dark pink, with a purple, red, pale yellow, or white center. The corolla tube measures 2.5-3 cm, while the fully opened flower spans 4–5 cm in diameter, featuring five petal-like lobes. The androecium consists of five stamens that

are included within the corolla tube. The filaments are short and epipetalous, and the anthers form a cone-like structure above the stigma. The gynoecium is composed of two carpels, which are free at the base but united in the stylar



Figure 1: Vegetative parts of *C. roseus*

region. A single style extends from the ovary, ending in a dumbbell-shaped stigma. The fruit is a follicle, measuring 1.2- 4 cm in length and 0.2-0.4 cm in width. It is susceptible to splitting along the axial side upon maturity. The plant produces numerous small black seeds, approximately 1-2 mm in size, with a grooved surface on one side.

TRADITIONAL USES

C. roseus has been widely used in traditional medicine across various countries for treating a range of ailments. In northern India, a home remedy involves boiling the plant's dried leaves in water and administering the extract orally to manage diabetes. Similarly, in Tamil Nadu, people of Kancheepuram prepare a powder from the whole plant, mix it with cow's milk, and consume it to control diabetes (Pham et al. 2020). In Kenya, this plant has been incorporated into cancer treatment therapies, while in Venda, southern Africa, the dried root is used to prevent urogenital infections (Pham et al. 2020; Gawade et al. 2023). Additionally, in some regions of Africa, the roots are used to treat gonorrhea, and in Zimbabwe, the plant is taken to alleviate stomach aches. In India, the juice of the leaves is applied to bee or wasp stings to reduce pain and swelling (De Wet et al. 2011; Semenya and Potgieter 2013). Historically, *C. roseus* has been used as a folk remedy for diabetes in Europe for centuries (Aziz et al. 2016). In Hawaii, the plant was boiled to make a poultice that helped stop bleeding, while in China, it served as an astringent, diuretic, and cough remedy (Nejat et al. 2015; Nisar et al. 2016). In Central and South America, it was used as a homemade cold remedy to ease lung congestion and inflammation. In the Caribbean, a flower extract solution was traditionally used for eye infections and irritation. The plant was also considered magical in Europe, where people believed it could ward off evil spirits, hence its French nickname, "violet of the sorcerers." (Aslam et al. 2010; Nejat et al. 2015). Western researchers first became interested in *C. roseus* in the 1950s after learning that Jamaicans drank tea made from the plant to treat diabetes (Aslam et al. 2010). In the Philippines, a decoction of leaves is consumed to treat diabetes and stomach cramps, while a root decoction is used for intestinal parasitism (Laxman 2024). An infusion of leaves is given for menorrhagia, and crude extracts of the leaves and roots exhibit anticancer properties (Sharma et al. 2024). In Madagascar, the bitter and astringent leaves are used as an emetic, while the roots function as purgatives, vermifuges, depuratives, and hemostatics and are also used to relieve toothaches (Nejat et al. 2015). In Mauritius, the juice of the leaves is taken to alleviate indigestion and dyspepsia. In the West Indies and Nigeria, the plant is a well-known diabetes

remedy (Nammi et al. 2003). In Cuba and Jamaica, the flower extract is used as an eye wash for infants, while in the Bahamas, a decoction of the flowers is consumed to relieve asthma, tuberculosis, and flatulence (Laxman 2024). In Malaysia, *C. roseus* is used to treat diabetes, hypertension, insomnia, and cancer (Das and Sharangi 2017). Beyond these uses, the plant is known for its effectiveness in wound healing, pain relief from wasp stings, and its ability to stop bleeding. Additionally, it is believed to provide relief from depression, headaches, and fatigue (Nayak and Kumar 2023).

BIOACTIVE COMPOUNDS

Catharanthus roseus is known for its rich phytochemical composition, exhibiting a diverse range of bioactive compounds with significant medicinal potential. Its extracts contain alkaloids, flavonoids, fatty acids, sterols, and phenolic compounds that contribute to various pharmacological activities. Among the notable compounds identified are Ethylcyclopentenolone, Pyranone, Indole, Guanosine, Quinic acid, Mome inositol, Hexacosane, Hexatriacontane, Squalene, Campesterol, gamma-Sitosterol, and alpha-Amyrin. Additional compounds include 1,3,5-Triazine-2,4,6-Triamine, Catechol, 5-Hydroxymethylfurfural, Methyl Myristate, Linoleic Acid Methyl Ester, Ethyl Oleate, and Ajmalicine. Importantly, both polar and non-polar extracts share several common constituents such as Guanosine, Methyl Palmitate, Squalene, Campesterol, and gamma-Sitosterol, reflecting a conserved phytochemical profile (Samiyarsih et al. 2020; et al. 2022; Kaur 2023). The plant is especially valued for its alkaloid content, with over 400 different alkaloids reported. Key alkaloids like vincristine and vinblastine are well-known for their anticancer properties and are widely used in chemotherapy. Others, such as catharanthine, vindoline, lochnerine, and leurosine sulfate, help regulate blood sugar, while reserpine and serpentine are effective tranquilizers (Rowinsky 2003; Lahare et al. 2020). The plant's alkaloids are distributed throughout different parts: the aerial portions are rich in vincristine, vinblastine, vindesine, and tabersonine, while roots and basal stems contain ajmalicine, vineamine, raubasin, and reserpine. Additionally, the anthocyanin pigment rosindin is found in the flowers (Aslam et al. 2010; Malhotra et al. 2024). Besides alkaloids, *C. roseus* is rich in terpenoid indole alkaloids (TIAs), which are used for pharmaceutical applications. Other secondary metabolites such as flavonoids, steroids, glycosides, tannins, phenols, and saponins also contribute to the plant's therapeutic value (Rajashekara et al. 2022). Flavonoids act as antimicrobial agents; phenols serve in antiseptic formulations; glycosides assist in lowering blood pressure;

and saponins are known for managing cholesterol and menopausal symptoms. Altogether, the presence of these compounds highlights *Catharanthus roseus* as a potent medicinal plant with applications in antimicrobial, anti-inflammatory, antioxidant, anticancer, and cardiovascular treatments (Chaturvedi et al. 2022; Gawade et al. 2023).

PHARMACOLOGICAL IMPORTANCE

C. roseus has been extensively studied for its diverse pharmacological properties, attributed to its rich array of bioactive compounds, particularly indole alkaloids.

Anticancer Activity

C. roseus has alkaloids like vincristine and vinblastine, which are integral in chemotherapy for cancers such as leukemia, lymphoma, and neuroblastoma. These compounds disrupt mitotic spindle formation, effectively halting cancer cell division (Pham et al. 2020).

Antidiabetic and Antioxidant Effects

Alkaloids like vindoline, vindolicine, and vindolinine have shown significant antidiabetic properties by enhancing glucose uptake in pancreatic and muscle cells and inhibiting protein tyrosine phosphatase-1B, a negative regulator of insulin signaling. These compounds also exhibit strong antioxidant activities, mitigating oxidative stress associated with diabetes (Almagro et al. 2015; Goboza et al. 2020).

Antimicrobial and Antiviral Properties

Compounds such as yohimbine from *C. roseus* have demonstrated antimicrobial activities, including antibacterial, antifungal, and antiviral effects. Yohimbine has shown efficacy against herpes simplex virus type 1 and *Candida albicans*, suggesting potential for treating various infections (Almagro et al. 2015; Pham et al. 2020).

Cardiovascular and Neuroprotective Benefits

Alkaloids like ajmalicine and reserpine contribute to cardiovascular health by exhibiting antihypertensive effects. Compounds such as vinpocetine and vincamine have been associated with neuroprotective and vasodilatory properties, indicating potential benefits in managing neurological disorders (Khan et al. 2024).

Wound Healing and Anti-inflammatory Activities

Methanolic extracts of *C. roseus* leaves have been found to promote wound healing and exhibit anti-inflammatory properties. These effects are attributed to the plant's rich content of flavonoids and phenolic compounds, which aid in tissue repair and reduce inflammation (Rajashekara et al. 2022).

CONCLUSION

Catharanthus roseus is a potent medicinal herb with significant pharmacological activities. Its rich repository of bioactive alkaloids, such as vincristine, vinblastine, ajmalicine, and catharanthine, has made it invaluable in the treatment of cancer, diabetes, hypertension, and microbial infections. The plant's secondary metabolites contribute to its antioxidant, anti-inflammatory, and wound-healing properties, supporting its widespread use in traditional medicine. Ongoing research continues to unveil new therapeutic potentials, validating its significance in modern pharmacognosy.

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