

Alkaloids Derived from *Catharanthus Roseus* and their Pharmacological Actions – A Review

C. Sasikala^{1*}, R. Koushika², P. Jayashree³, V. D. Nandhini⁴, R. Malavika⁵, S. Deepa⁶

¹Associate Professor, Department of Microbiology, Dr. N.G.P. Arts and Science College, Coimbatore, India

^{2,3,4,5,6}M.Sc. Microbiology, Dr. N.G.P. Arts and Science College, Coimbatore, India

Abstract: Medicinal plants serve as a potent source of diverse pharmaceutical compounds, demonstrating significant pharmacological effects on human health. Rather than relying on chemical drugs with adverse side effects, exploring ancient remedies can lead to the development of novel drug formulations that are more efficacious, safer, and cost-effective. Although many traditional medicines have been used historically without a full understanding of their mechanisms, modern technology enables further validation and commercialization of their active compounds pending proper approvals. *Catharanthus roseus*, among 21,000 medicinal plants, holds importance in treating various ailments such as diabetes, mouth ulcers, and leukemia due to its rich array of alkaloids like reserpine and vincristine. vinblastine and vincristine exhibit anti-leukemic activity, while different plant parts yield varying alkaloid concentrations, with root bark being the richest source at nearly 1.79%. Numerous reports support its antimicrobial activity against pathogens like *Staphylococcus albus*, *Bacillus megatarium*, *Shigella*, and *Pseudomonas*, alongside documented antioxidant and anti-mutagenic effects. Further research is needed to explore its potential anti-tumor properties.

Keywords: *Catharanthus roseus*, vinblastine, vincristine, anti-cancer property.

1. Introduction

Traditional medicine has always made use of medicinal herbs. Information on ethnobotanical properties of medicinal plants and how indigenous societies use them is helpful for drug discovery, biodiversity preservation, community health care, and the preservation of traditional traditions. A dicotyledonous angiosperm, *Catharanthus roseus* is a significant medicinal plant in the Apocynaceae family. It produces two terpene indole alkaloids, vinblastine and vincristine, which are used to treat cancer. In 1910, Peckolt reported that an infusion of the leaves was used in Brazil to treat chronic wounds, prevent bleeding and scurvy, and as a mouthwash for toothaches. Related species have been employed in Europe to privately stop the flow of milk. It has been used to treat diabetic ulcers in the British West Indies, and it is said to be a useful oral hypoglycemic medication in the Philippines. In a more recent study, Chopra et al. found that the whole alkaloids have a notable and long-lasting hypotensive effect in addition to a modest antibacterial activity. Although the hypoglycemic and antibacterial properties have not been verified, ajmalicine, one of the

alkaloids extracted from this plant, has been shown to have a brief diuretic effect on arterial blood pressure. Commonly referred to as "Nayantara" or "Sadabahar," "Periwinkle" or *C. roseus* (Family Apocynaceae) is derived from the Greek term meaning "pure flower". Roseus, on the other hand, denotes red, rose, or rosy.



Fig. 1. *Catharanthus roseus*
(Source: google.com)

Scientific classification:

Family : Apocynaceae
Kingdom : Plantae
Division : Magnoliophyta
Class : Magnoliopsida
Order : Gentianales
Family : Apocynaceae
Genus : *Catharanthus*
Species : *C. roseus*

Vernacular names:

Tamil : Cutkattu malli, Cutukattu malli, Cutukattuppu
Telugu : Billaganneru
Gujarati : Barmasi
Bengali : Noyontara
English : Cayenne jasmine, Old maid, Periwinkle
Hindi : Sada bahar, Sadabahar
Kannada : Batla hoo, Bili kaasi kanigalu, Ganeshana hoo
Malayalam : Banappuvu, Nityakalyani, Savanari, Usamalar

*Corresponding author: sasikalac@drngpsc.ac.in

Marathi : Sadaphool, Sadaphul, Sadaphuli
 Sanskrit : Nityakalyani, Rasna, Sadampuspa, Sadapushpi

2. Chemical Constituents

Researchers exploring its medicinal potential found that it contains a group of alkaloids, which though highly toxic, show promise in cancer treatment. Plants produce various chemical compounds to perform vital biological functions and protect against predators. *Catharanthus roseus* contains carbohydrates, flavonoids, saponins, and alkaloids, with alkaloids being its most potent constituents. Over 400 alkaloids are found in the plant, utilized in pharmaceuticals, agrochemicals, and other industries. Alkaloids like actineoplastidemer, vinblastine, vincristine, vindesine, vindoline, tabersonine, ajmalicine, vinceine, vineamine, raubasin, reserpine, and catharanthine are distributed in different parts of the plant. Additionally, the flower of *C. roseus* contains the anthocyanin pigment rosinidin.

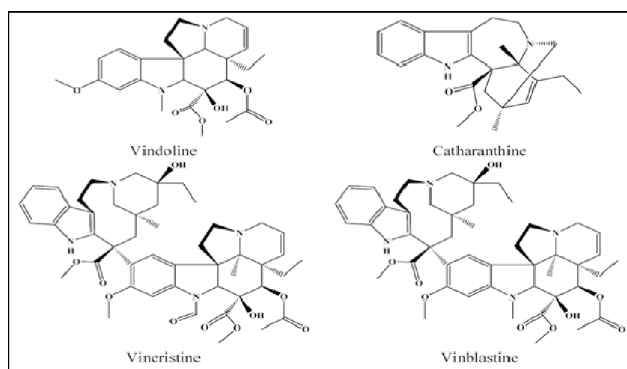


Fig. 2. Chemical constituents
 (Source: google.com)

3. Pharmacological Actions

A. Anticancer Activity

The alkaloids Vinblastine and Vincristine, derived from the stem and leaf of *Catharanthus roseus*, exhibit anticancer properties, inhibiting the growth of various human tumors. Vinblastine is utilized experimentally for neoplasm treatment, including Hodgkin's disease and choriocarcinoma, while Vincristine is used for leukemia in children. Methanolic crude extracts of *Catharanthus* demonstrated significant anticancer activity against various cell types, especially multidrug-resistant tumors, *in vitro*. Vinblastine is commercially available as velban, and vincristine as oncovin.

B. Antidiabetic Activity

Regarding its antidiabetic activity, ethanolic extracts from the leaves and flowers of *C. roseus* have shown a dose-dependent reduction in blood sugar levels comparable to standard drugs. The hypoglycemic effect of alkaloids extracted from *C. roseus* has been pharmacologically studied, leading to the development of a remedy marketed as Vinculin for diabetes treatment, due to its ability to increase glucose utilization in the liver. This effect has resulted in a significant reduction in blood glucose levels, with the aqueous extract demonstrating a 20% decrease in diabetic rats compared to the dichloromethane and

methanol extracts, which lowered levels by 49-58%.

C. Antimicrobial Activity

Various parts of the plant were examined for antibacterial properties, with the leaf extract demonstrating notably higher effectiveness. Testing against microorganisms such as *Pseudomonas aeruginosa* NCIM2036, *Salmonella typhimurium* NCIM2501, and *Staphylococcus aureus* NCIM5021 revealed the potential of these extracts as prophylactic agents for treating various diseases.

D. Antioxidant Activity

The antioxidant potential of ethanolic extracts from the roots of two varieties of *C. roseus*, rosea (pink flower) and alba (white flower), was assessed using various assays, including Hydroxyl radical scavenging, Superoxide radical scavenging, DPPH radical scavenging, and nitric oxide radical inhibition. Results demonstrated that the ethanolic extract from both periwinkle varieties exhibited significant scavenging effects across all assays in a concentration-dependent manner. Notably, *C. roseus* showed higher antioxidant activity compared to *C. alba*.

E. Anthelmintic Activity

The ethanolic extract of *C. roseus*, at a concentration of 250 mg/ml, demonstrated notable anti-helminthic activity, as assessed using *Pherithema postuma* as an experimental model, with *Piperazine citrate* serving as the standard reference.

F. Antiulcer Property

The alkaloids vincamine and vindoline, found in the plant, exhibit anti-ulcer properties. Specifically, vincamine, present in the leaves, demonstrates cerebrovasodilatory and neuroprotective effects. The leaves of the plant demonstrated antiulcer activity against experimentally induced gastric damage in rats.

G. Hypotensive Property

Leaf extract from the plant induced notable hypotensive effects. With a rich composition of 150 beneficial alkaloids and other pharmacologically active compounds, the leaves exhibited significant antihyperglycemic and hypotensive activity in laboratory animals, as evidenced by studies using hydroalcoholic or dichloromethane-methanol extracts.

H. Anti Diarrheal Property

In Wistar rats, the ethanolic leaf extracts of the plant were evaluated for their anti-diarrheal activity using castor oil as an experimental diarrhea-inducing agent, along with pretreatment of the extract. The anti-diarrheal effect of the ethanolic extracts of *C. roseus* demonstrated dose-dependent inhibition of castor oil-induced diarrhea.

I. Wound Healing Property

Rats treated with 100 mg/kg/day of *Catharanthus roseus* ethanol extract exhibited a notable increase in the wound contraction rate, a significant decrease in the epithelization period, and a marked increase in dry weight and hydroxyproline content of the granulation tissue compared to the controls.

These findings, including enhanced wound contraction, increased tensile strength, and higher hydroxyproline content, endorse the utilization of *C. roseus* in wound healing management.

J. Antilipidemic Effect

The study observed a significant reduction in serum levels of total cholesterol, triglycerides, LDL-c, VLDLc, and improvements in the histology of the aorta, liver, and kidney following administration of the leaf juice of *C. roseus*. These effects are likely attributed to the antioxidant properties of flavonoids and possibly to a vinpocetine-like compound present in the leaf juice of *Catharanthus roseus*.

4. Conclusion

Catharanthus roseus, commonly known as Madagascar periwinkle, is a resilient tropical plant cherished for its vibrant rosy or white blossoms. Native to Madagascar, this small perennial herbaceous evergreen is favored for its heat tolerance, reaching one to two feet in height and boasting glossy, dark green leaves (1-2 inches long). Even in hot weather, it blooms profusely, with wild varieties showcasing pale pink flowers accented by a purple "eye" at their centers, while cultivated varieties span a spectrum from white to pink to purple.

This plant holds significant medicinal value owing to its rich alkaloid content. Every part, including the leaves, roots, shoots, and stems, contains over 200 alkaloids utilized for therapeutic purposes across various ailments. Of notable mention are the key alkaloids vinblastine and vincristine, derived from the leaves, renowned for their anti-cancer and antidiabetic properties. Additionally, rubacine, sourced from the roots, serves as a hypotensive and antiarrhythmic agent. This review aims to delve deeper into the remarkable attributes of this botanical treasure.

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