

## CHAPTER 17

# Medicinal Uses of *Catharanthus roseus* (L) from Apocynaceae Family

**Dhole N. A.**

*Department of Botany, Digambarrao Bindu Arts, Commerce and Science College, Bhokar Dist. Nanded 431801 Maharashtra, India*

*Corresponding author Email: [nageshdhole2019@gmail.com](mailto:nageshdhole2019@gmail.com)*

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### Abstract

Vinca Rosea, or *Catharanthus roseus*, is a prominent plant species in the Apocynaceae family that has long been used in Indian traditional medicine due to its many therapeutic uses and aesthetic qualities. *Catharanthus roseus*, scientific name, is a member of the Apocynaceae family and classed in Gentianales. *Catharanthus roseus*, also known as "Sadabahar," gets its name by the combination a pair of Greek words: Katharos, which means pure, and anthos, which means flower. The Greek word roseus means red in colour. *Catharanthus roseus* is an everlasting shrub with oval or oval leaves, shiny green hairless blooms, and two lobes. It reaches to a height of one metre and has white to deep pink, dark crimson, and petal-like leaflets. *Catharanthus roseus* is frequently referred to as the Madagascar periwinkle. It is renowned for its

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therapeutic qualities and has been thoroughly researched for its ability to heal a number of illnesses, including diabetes, degenerative diseases and various types of cancers. Furthermore, this adaptable herb is grown as an ornamental plant because of its vivid blossoms and capacity to flourish in a variety of temperatures (Mishra & Verma, 2017).



*Catharanthus roseus* (L)

About 400 alkaloids are found in plant material and are used as additives to foods, pesticides, agricultural products, flavour and perfume elements, and pharmaceuticals. The aerial parts of *Catharanthus roseus* often include the common alkaloids such as vinblastine, vincristine, while the roots typically contain vineamine, reserpine, and different derivatives of catharanthine. Peckolt described that the branches were immersed in water to be utilized in Brazil in 1910 to cure chronic injuries, control haemorrhage and scurvy, and ease mouth discomfort from toothaches. In Europe, associated varieties of *Catharanthus roseus* were historically used to commercially reduce milk flow. It has been used in the British for the treatment of ulcers caused by diabetes and is said to be an effective oral blood sugar lowering drug in the Philippines as well. In a recent study, Chopra *et al.* discovered that *Catharanthus roseus* alkaloids proved moderately antimicrobial and exhibited a significant and long-lasting hypotensive effect (Gajalakshmi *et al.*, 2013).

When opposed to synthetic medicines, natural resources, such as plant-based remedies, which contain a wide range of phytochemicals that show promise as conventional medication for the treatment of contagious and persistent medical conditions, have been regarded as safe, effective substitutes with fewer adverse effects. Kumar *et al.*, 2022 and associates documented 344 chemicals associated with pharmacological activities, including cytotoxicity, in relation to *Catharanthus roseus*. Furthermore, their research emphasizes the herb's ancient usage in treating and preventing various diseases. Many researchers reported that *Catharanthus roseus* has antimicrobial in nature; prevent oxidations, lipid lowering, memory-enhancing, antiulcer properties, hypoglycemic, hypotensive activities.

Apart from its biological properties, researchers have provided a thorough explanation of the various plant components' traditional use in treating a variety of illnesses. The report also discusses the very high prices of chemotherapy medications based on vincristine and vinblastine components because of their poor manufacturing yields (Chaturvedi *et al.*, 2022).

The medicinal importance of *Catharanthus roseus* in the treatment of cancer is examined in the present article. The purpose of this review is to provide a thorough examination of a variety of research, clarifying the several processes that underlie *Catharanthus roseus* anticancer properties. In contrast to other studies, this one covers important topics related to different alkaloids, including methods to improve their synthesis and biologically important systems to enable their targeted distribution. This review also explores the effects of alkaloids on several signalling pathways that are implicated in cancer. Given that cancer is one of the top causes of death globally, it is important for the general population to comprehend *Catharanthus roseus* in relation to cancer care. Vinblastine and Vincristine, two significant alkaloids derived from *Catharanthus roseus*, have shown encouraging results against a range of cancers, including leukaemia and lymphoma. Vinblastine disrupts the cell cycle by stopping microtubules from forming during cell division. Vincristine, which inhibits the development of cancer cells by disrupting microtubule assembling, which prevents chromosomal separation during cell division (Faraoni & Graziani, 2018).

These two alkaloids have an impact on several genes responsible for the signalling paths, that stops the spread of cancerous cells and causes controlled cell apoptosis. The next section contains a detailed discussion of the numerous genes and cellular pathways with their unique roles. Despite being one of the most widely used chemotherapeutic drugs for treating tumours, vinca alkaloids have adverse effects that many doctors are quite concerned about. Investigators have investigated a number of medication delivery techniques in an effort to lessen the toxicity of these substances and enhance their therapeutic effects (Lee *et al.*, 2015).

Researchers invented a vinblastine way of administration using chitosan and nanomaterials as the medication carrier. A set of rats with a solid tumor implants, were given the vinblastine containing ingredients intramuscularly. Creatine kinase values significantly decreased, according to serum examination, and were almost identical to those in untreated animals (AL-Ahmari *et al.*, 2021).

Researchers and colleagues investigated the therapeutic potential of vinblastine encapsulated in polymers made of nanoparticles that were directed against that tumour cells overexpress. Over the course

of forty hours, a steady discharge was accomplished. The cancer cell lines showed rapid cellular absorption of nanoparticles which containing drug molecules (Cannav`a *et al.*, 2022).

As vinblastine, which carriers in order to dextran folate coated iron oxide nanoparticles. Effective internalization was shown in in-vitro experiments using cell line, which might be explained by connections between its folate receptor as well as the nano-carrier that delivers folic acid. Since the examined cell lines showed no signs of severe cytotoxicity, its carrier was considered safe with respect to of cytotoxicity. This decreased survival of cells suggested the effectiveness of cancer inhibitors. A liposome containing composition was created by numerous authors that efficiently deliver vincristine compounds to tumor cells. The mixture was unusual because it had a hydrophobic material of some kind that was incorporated into the cell membranes of the liposomes. When the liposomes detected ultrasonic vibrations, the liposomes ruptured, and vinblastines were expelled (Lin *et al.*, 2019).

In order to create a nanogel, Jeswani and associates synthesized bound vincristine sulphate and incorporated it into a thermosensitive gel matrix. Since the unconjugated drug exhibited comparable activity, linking the drug with a small carrier's method had no effect on its cytotoxicity, according to in-vitro studies conducted on the MCF-7 cell line. Furthermore, this formulation had less haemolytic effects in comparison to vincristine sulphate given lacking a carrier system, underscoring its potential for successful treatment of breast cancer (Jeswani *et al.*, 2021).

Huang *et al.* created a magnetic triggered vinblastine delivery method by using particle tiny pumps to create chitosan microparticles that included nanoparticles based on magnetic particles of iron oxide. When the particles were magnetized provoked, they showed full drug elimination in about 80-130 minutes, allowing for controlled release of the drug (Huang *et al.*, 2019).

Amiri *et al.* examined the cytotoxic and tumour fighting properties of a PEG-modified vinblastine method of administration on a TC-1 cell type and a lung tumor model in rats, respectively. Compared to the drug's unattached version, experimental findings showed increased cytotoxicity and mitotic inhibition, indicating persistent vinblastine outflow. Different portions of this plant have been historically used for a variety of therapeutic reasons in different areas of India. The whole plant or roots traditionally used to treat diabetes in various region Tamil Nadu, India. It may be boiled in warm water for use by mouth or ground into a powder and combined with cow's milk (Amiri *et al.*, 2018).

In Kenya, the *Catharanthus roseus* whole plant is cooked and used topically or taken orally to cure cancers of the throat, intestines, and oesophagus. It is often used in conjunction with the entire parts of plant of *Sesbania sesban* (Fernandes *et al.*, 2018).

Additionally, in certain parts of South Africa and in different places of Zimbabwe, the plant's roots are used to treat a variety of ailments, such as gonorrhoea, stomach problems, and urogenital infections, using particular preparation techniques and dosage methods. Furthermore, the whole plant is cooked with water and consumed orally in Vietnam to treat cancer, diabetes, high blood pressure, and diarrhea (Tiong *et al.*, 2015).

Having a 5000-year history, traditional Chinese medical practices continue to be an essential part of medical care in rural areas of China and are also widely accepted and used in contemporary metropolitan environments. Centuries of investigation, testing, and improvement have led to the development of this integrated approach to medical services, which offers a thorough system of evaluation, medication, and therapy that incorporates the thoughts, body, and mentality. Chinese officials made significant attempts at the beginning of the twenty-first century to increase the applicability of these medical procedures in contemporary settings. These initiatives seek to use of plant potential advantages for health and socioeconomic expansion, guaranteeing its ongoing applicability and involvement in the welfare of people in a variety of contexts. A vital component of ancient Chinese cultural practices and medical theories is Chinese botanical medicine. According to standard procedure, a herbal psychotherapist would usually recommend a mixture of more than ten herbs, each with unique qualities, works, and flavours, based on the particular condition that has to be treated. *Catharanthus roseus* is known for its ability to treat a variety of illnesses in the field of conventional Chinese herbal remedies (Wang *et al.*, 2012).

According to reports, the medicinal qualities of *Catharanthus roseus* preparations in different solvent types have long been accepted in Chinese traditional medicine techniques. These extracts have been used to treat swelling that affects the uvea, the conjunctive, or other components of the eye, as shown by decreased vision, distress, a feeling of a foreign body in the eye, irritation, and the fear of light. This plant is used as an astringent in conventional Chinese medicine because it tightens or contracts tissues, usually via precipitation of peptides (Romm *et al.*, 2010).

According to reports, *Catharanthus roseus* increases the kidneys' output of urine, which increases the body's removal of electrolytes as well as water. This is achieved by blocking receptors that are connected in the reintroduction of sodium ions from renal tubules, which raises the quantity of dissolved particles in the tubules and prevents water preservation. Because of its calming qualities, this adaptable plant is often used as a cough treatment to relieve respiratory problems. It is accepted in Ancient Chinese Medicines as a successful treatment for coughing and associated respiratory conditions due to high therapeutic adaptability (Arora *et al.*, 2010).

Globally, cancer is steadily taking the lead as the leading cause of mortality. Cancer accounted for 7.6 million of the 58 million cancer deaths worldwide in 2019, or 13% of all fatalities. Even though medication for cancer has advanced significantly, certain therapies still have unfavourable negative effects and high costs. Therefore, herb like *Catharanthus roseus* may be effective against certain types of cancers. *Catharanthus roseus* contains the polyphenolic compounds vinblastine and vincristine, which are well known for their anti-cancer effects. In addition to having improved therapeutic advantages, vindesine and vinorelbine belong to the same family of substances which together make up a significant class of anticancer medications with roots in ancient Chinese medicine (Efferth *et al.*, 2007).

The beneficial effects of 24 plant extracts, including *Catharanthus roseus*, that are often used in Conventional Chinese Medicine was investigated by Wang *et al.* In vitro tests were used to evaluate these traditional herbs' impact on vascular development, a characteristic that distinguishes malignancies. The

anti-cancer properties of water-soluble extracts were investigated. Vessel quantification and replication levels in the different models' embryos and aortic endothelial cells of cattle origin were among the parameters utilised to evaluate the anti-vascular qualities. The water-based extracts component from the traditional plant *Catharanthus roseus* showed substantial suppression of vasculature at a dose of 1g/ml. This demonstrates the herb's medicinal potential and emphasizes its importance in ancient Chinese medicine for the cure of cancer (Saman *et al.*, 2020).

According to ethnomedical reports, *Catharanthus roseus* is used for treating bone marrow-originating cancers which interfere with the typical manufacturing of the platelets and red blood cells by altering white blood cells fabrication and causing juvenile white blood cells to proliferate abnormally. Additionally, it is currently used to treat lymphatic vessels cancers, specifically those that affect lymphocytes cells. These cancers usually start in lymphatic systems but can also spread to other immune-related organs. In addition to malignancies, Chinese therapy has used portions of *Catharanthus roseus* to treat lymphoma and excessive arterial stiffness against artery walls. Furthermore, when made as a decoction using its dried all aerial parts and taken orally, this plant is used in classical Chinese medicine to balance the period of menstruation. According to indigenous Chinese medicine, dried out whole plant can be taken orally to treat chronic disorders of metabolism with elevated glucose levels caused by a lack of insulin produced by the pancreas itself or the body's incapacity to use insulin efficiently, as well as diseases that impact the makeup or function of the liver. Such as a condition called chronic fatty liver disease, and leading to complications of hepatitis (Aslam *et al.*, 2010).

Additionally, in ancient Chinese medicine, this kind of plant is used to treat various signs of diseases including menstruation cramping, malaria, heat burns, and chronic skin irritations. Childhood obesity, a lack of activity, poor nutrition, and ageing are risk factors that are common to both diabetic complications and cancer. These risk factors lead to elevated insulin levels, oxidative damages, prolonged inflammation, and irregular pathways in cells. Diabetes of type 2 is characterised by increased resistance to insulin, which may raise insulin and cause high levels of insulin, which encourages the development of tumours and cell division. Diabetes-related long-term inflammation and high pro-inflammatory cytokine concentrations may provide a milieu that encourages tumour growth. The presence of diabetes affects the effectiveness and tolerance of therapies, which may make cancer therapy more difficult. Diabetes-related hyperglycemia may promote tumour development and lessen the impact of radiotherapy and surgery. Certain diabetes medications may influence the course of cancer or interfere with cancer treatments (Abudawood, 2019).

Because of its therapeutic qualities, *Catharanthus roseus* is useful in the treatment of diabetic complications and cancers. Vinblastine and vincristine, two powerful anticancer drugs used in treatment for a variety of malignancies, are among its naturally active constituents. Furthermore, *Catharanthus roseus* extract have severe hypoglycemic properties that improve blood glucose levels and tolerance to insulin, and glucose absorption by focusing on many pathways linked to complications of diabetes and tumours (Tiong *et al.*, 2013).

An important medicinal plant known for its many alkaloid molecules, *Catharanthus roseus*, is being thoroughly studied for potential therapeutic use in a range of illnesses, especially cancer. Alkaloids from *Catharanthus roseus*, such as vinblastine and vincristine, exhibit remarkable efficacy in treating a variety of tumours, which is why cancer care is paying close attention to this area. With the use of biomedical informatics, *Catharanthus roseus* promise in cancer treatment may be more successfully realized. Using combining information, medication expansion, predictive modelling, medical advice, and targeted therapy, physiological informatics enables a comprehensive understanding of the bioactive compounds found in plants and how they impact cancer pathways. Furthermore, techniques like as biology of systems, pharmacological modelling, data visualization, and genome sequencing provide important insights into molecular mechanisms and potential targets for creating novel and customized cancer treatments derived from *Catharanthus roseus*. Therefore, applying recent medical information technology to the study and deployment of *Catharanthus roseus* in cancer treatment has potential for developing efficient and customized cancer treatments, which will benefit to improve patient overall health.

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