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Catharanthus roseus: A Multipurpose Plant with their Morphology and Dosage Form

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Abstract: Catharanthus roseus (L.) G. Don, Frequently known as Madagascar periwinkle, is a medicinal plant of significant therapeutic importance. Belonging to the Apocynaceae family, it is well-known for producing valuable alkaloids such as vincristine and vinblastine, which are extensively used in cancer chemotherapy. Traditionally, the plant has been used to treat ailments such as diabetes, hypertension, and microbial infections. Pharmacologically, it exhibits anticancer, antidiabetic, antimicrobial, and antioxidant activities. The plant is characterized morphologically by its glossy green leaves, pink or white flowers, and slender stems. Various dosage forms including extracts, tablets, and injectable formulations have been developed from its active constituents. Despite its medicinal benefits, C. roseus may cause side effects such as nausea, hair loss, and myelosuppression, especially when used in high doses or for prolonged periods. The diverse chemical constituents and pharmacological potential of C. roseus make it a critical plant in both traditional and modern medicine.

Keyword: *Medicinal Plant, Plant Extract Process, Pharmacological Effect, Dosage Form , Traditional uses.*

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I. INTRODUCTION

Ethnobotanical understanding of medicinal plants and how indigenous societies use them helps with drug development, biodiversity, community health care, and the preservation of traditional culture. One important source of medicinal plants is Catharanthus roseus. Known by several names, including vinca rosea and Madagascar periwinkle, this perennial plant is indigenous to Madagascar and southern Asia and belongs to the Apocynaceae family. The periwinkle insignia is used by the Malaysian National Cancer Council to symbolize hope for cancer patients. [1] Since the dawn of civilization, plants have played a vital role in human society. Folk recipes are made using the entire plant or its many parts, such as the leaf, stem, bark, root, flower, seed, etc., as well as its secondary products, including gum, resins, and Latex[2]. The main constituent vincristine and vinblastine are derived from the plant's leaves and these are effective in treating diabetes, platelets related disease, and both malignant and non-malignant cancer. Ajmalicine, reserpine and serpentine are found in the roots beneficial as anti-hypertensive. It includes phytoconstituents, clinical pharmacology, ethnopharmacological activities, and economic importance to aid scientists and learners in appreciating the plant's essential values.[3] Fig.no.01.

Fig 1*(Catharanthus roseus)*

- *Different Types of Catharanthus roseus (Sadaphuli)*

Fig 2 (Pink Color)

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Fig 3 (White Color)

Fig 4 (Red Color)

Fig 5 (Violet Color)

II. MORPHOLOGY OF PLANT

- *Synonym:*
  periwinkle, Vinca, Sada Bahar, Sadaphuli

- *Biological source:*
  It is obtained by dried entire plant of Catharanthus roseus (L.) G. Don, belonging to the family Apocynaceae.[4]

- *Geographic Origin:*
  Originally from Madagascar, the plant is distributed throughout North and South America, particularly in South Africa, Australia, and India. In Europe and India, the plant is grown as a garden plant.

- *Description:*
  Leaves are simple, cauline, opposite, exstipulate, petiolate, elliptic ovate to oblong, 4 to 10 by 2 to 4 cm glabrous to pubescent, base acute or cuneate, apex obtusely apiculate and lateral nerves 10 to 12 pairs. Petiole is 1.0 to 1.5 cm long. [5]

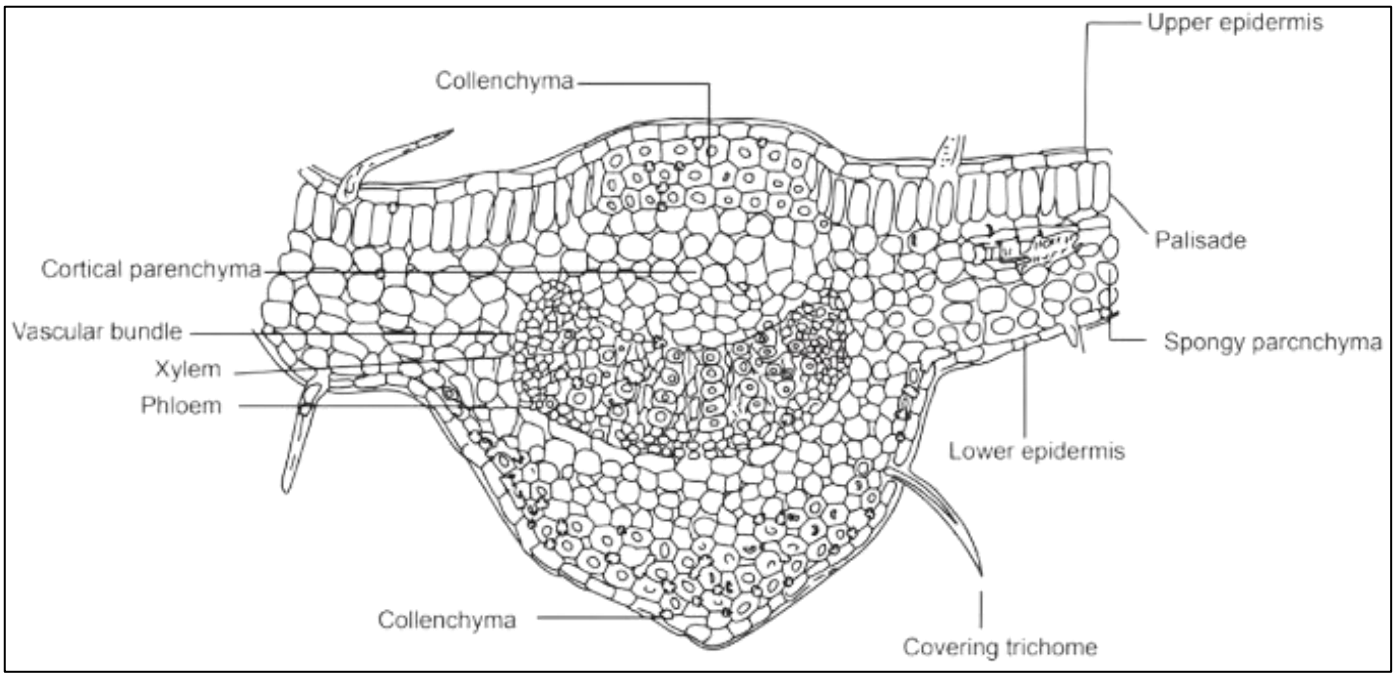

Fig 6 (T.S of Vinca Leaf)

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➢ *Scientific Classification:*

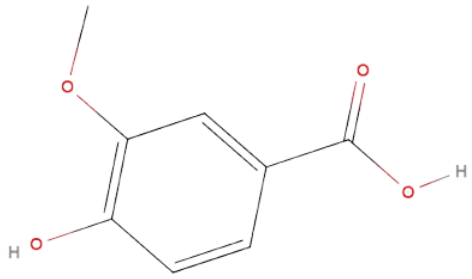
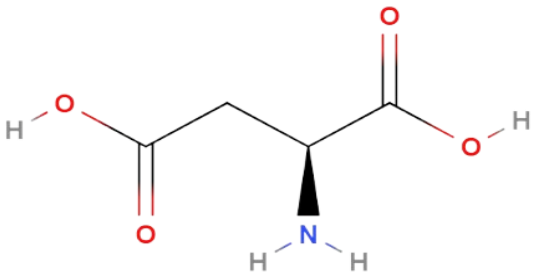
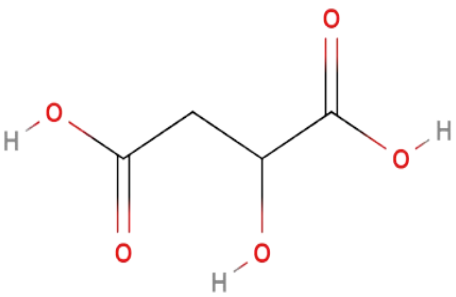
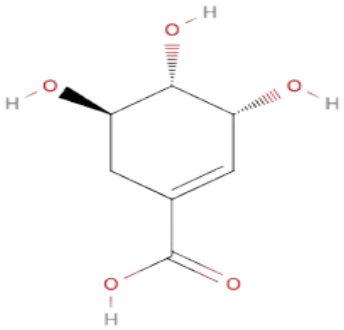
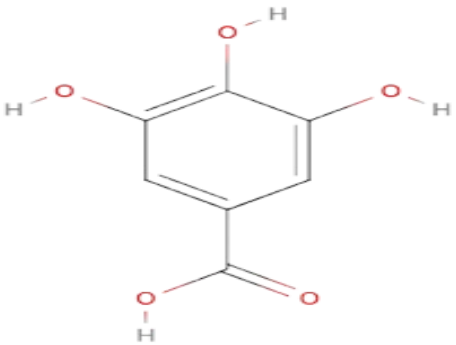
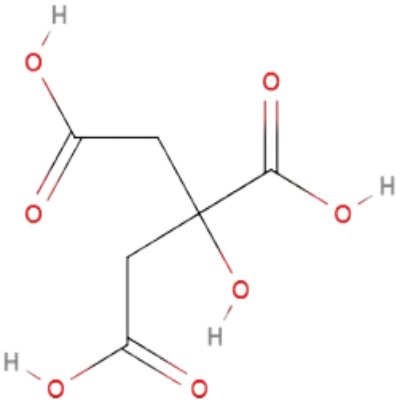
Table 2 Scientific Classification

Kingdom	Plantae
Division	Magnoliophyte
Class	Magnoliopsida
Order	Gentianales
Species	C. roseus
Family	Apocynaceae
Genus	Catharanthus

III. CHEMICAL CONSTITUENTS

Scientist all over the globe has carried out extensive research work on the phytochemical constituents of the C. roseus. Till now there are two benzoic acid, four phenylpropanoids, eighteen flavonoids, six anthocyanins, six organic acids and nineteen animo acids are reported. It contains gallic acid, vanillic acid, ferulic acid, Mauritianin, citric acid, pyruvic acid, malic acid, fumaric acid, shikimic acid, aspartic acid, asparagine, glutamine, serine, thionine, glycine, valine, proline, alanine, leucine, tryptophan, phenylalanine, cysteine, lysine, histidine, tyrosine.[6]

Table 3 Chemical Constituents

	
Vanillic Acid	Aspartic Acid
	
Malic Acid	Shikimic Acid
	
Gallic Acid	Citric Acid

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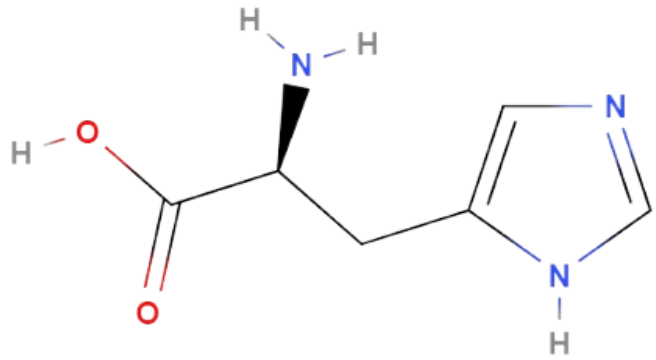
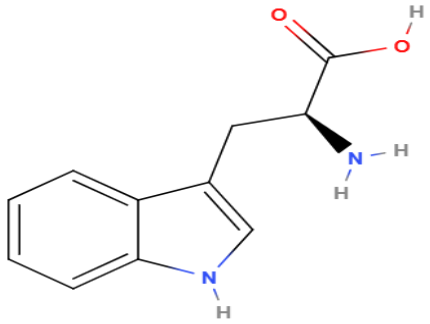


Phenylalanine Histidine



Tryptophan

➢ *Chemical Constituent Present in Plant Parts:*

Table 4 Chemical Constituent Present in Plant Parts

Plant Part	Name of Alkaloid Present
Flower	Vindoline, Lochnerine, Tricin, Catharanthine
Stem	Leurosine, Lochnerine, Vindoline
Leaf	Ibogaine, Yohimbine, Raubasine, Vinblastine, Vincristine,
Root	Ajmalacine, Serpentine, Lochnerine,Reserpine, Alstonine, Tabersonine, Horhammericine, Lochnericine, Echitoveni

➢ *Vincristine:*

One common vinca alkaloids used to treat sarcomas, lymphomas, neuroblastomas, and leukemia is vincristine. It is well known that vincristine can cause lung damage when used with other chemotherapy medications. Thirty percent of 27 patients experienced significant pulmonary toxicity when vincristine was combined with bleomycin, doxorubicin, cyclophosphamide, procarbazine, prednisone, and gemcitabine. This was believed to be the result of a bleomycin-gemcitabine interaction. Vincristine, additionally referred to as leurocristine, is a chemotherapeutic medication that is sold under several brand names, including Oncovin. It ought to be taken into account when treating numerous types of cancer. Only veins should receive vincristine injections. However, it might seep into adjacent tissue, resulting in serious pain or damage. At the administration site, your physician or nurse will keep an eye on this reaction. If you experience any of the following symptoms—pain, itching, swelling, blistering, or blisters in the area where the medicine was injected—call your doctor immediately. Vincristine should only be given under a doctor's supervision who is experienced in administering chemotherapy drugs. Fig.no. 07

➢ *Vinblastine:*

One of the antineoplastic vinca alkaloids is vinblastine. Vindoline and catharanthine are the two multiringed units that make up the vinca alkaloids, and they have the same structural makeup. Vinca alkaloids have been useful in medicine since their anticancer activity was discovered in 1959. Periwinkle extract was first investigated for its hypoglycemic properties, but it was later found to have antileukemic effects in vitro and to induce marrow suppression in rats. Vinblastine suppresses the immune system. It is believed that the cell cycle phase is distinct from vinca alkaloids. Intramuscular, subcutaneous, or intrathecal administration of vinblastine is not permitted.Either the injection site of an intravenous infusion that is already flowing or the vein itself can receive the solution. The injection of vinblastine sulfate takes roughly a minute to finish. The structural differences between vinblastine and vincristine include that the former has a methyl group attached to the core indole moiety's nitrogen, whilst the latter has an aldehydic role attached to the same nitrogen. The anticancer activity and toxicity of these medications differed significantly as a result of this structural heterogeneity. Fig.no. 08

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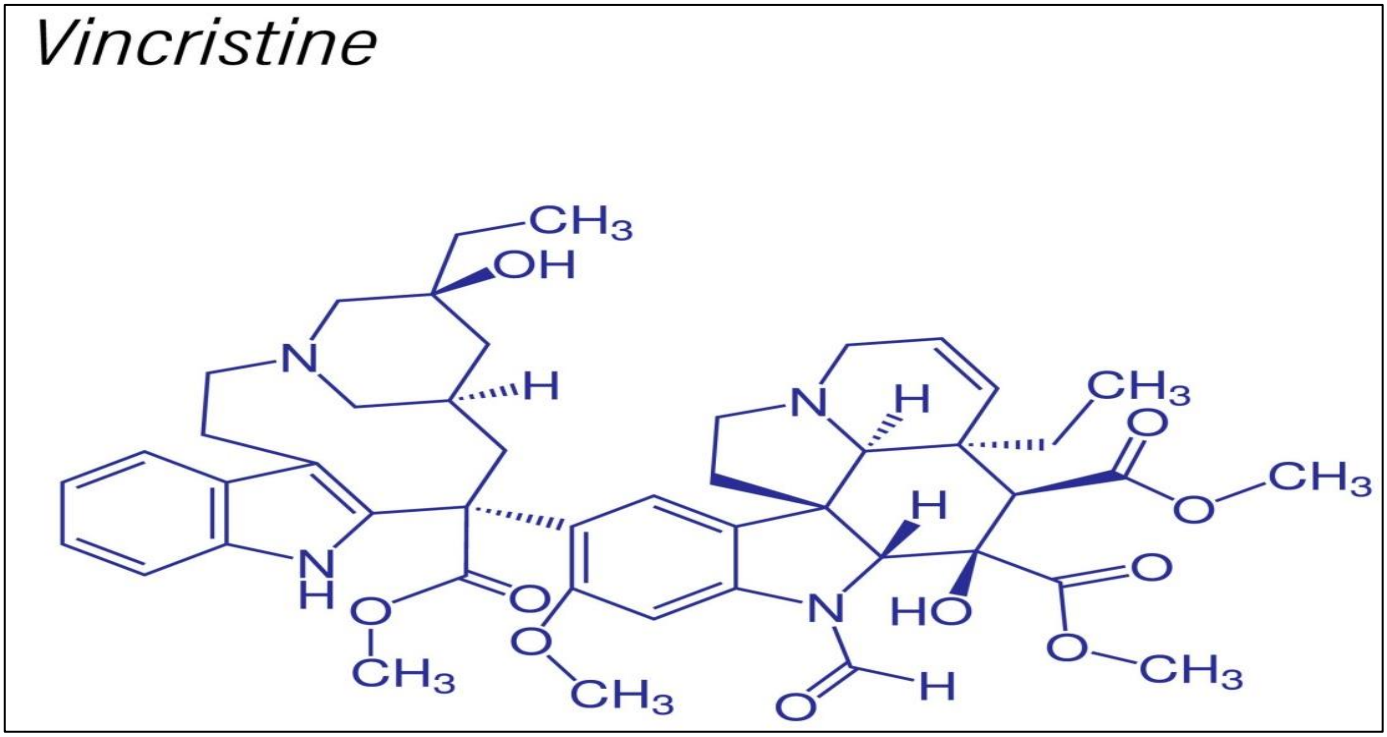

Fig 7 (Vincristine)

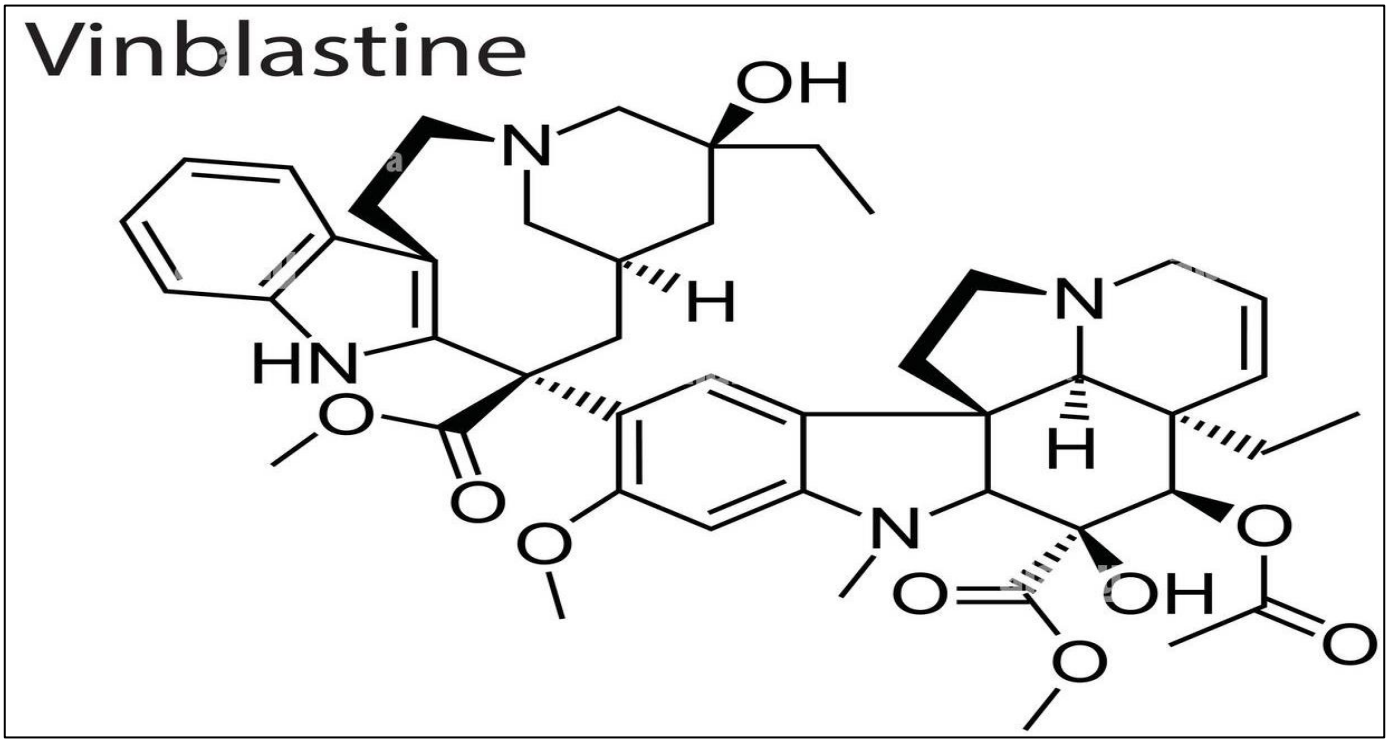

Fig 8 (Vinblastine)

IV. USES

➢ *Traditional:*

The roots and shoots are poisonous, but they are used in Indian traditional medicine, or Ayurveda, to treat a number of ailments. Extracts from it have been used to treat a variety of illnesses in traditional Chinese medicine, such as Hodgkin's lymphoma, diabetes, and malaria. [16]. In the 1950s, while searching for anti-diabetic medications, several vinca alkaloids, including as vinblastine and vincristine, were discovered in Catharanthus roseus. [17] Increased study on vinblastine and vincristine's chemotherapeutic potential has resulted from this fortunate discovery. Accusations of biopiracy have arisen because of a discrepancy between past indigenous use and a 2001 patent that western pharmaceutical corporations obtained on medications derived from C. roseus without payment. [18]

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➢ *Medicinal:*

Vinblastine and vincristine, chemotherapy medications used to treat a range of tumors, are found in the plant [19]. Vindoline and catharanthine, two alkaloids, combine to form these medications. [20] A semi-synthetic chemotherapeutic medication called vinorelbine is used to treat non-small-cell lung cancer. [21] Vindoline and catharanthine or the vinca alkaloid leurosine through anhydrovinblastine can be used to make it. [22] Vincoline, the plant's insulin-stimulating compound, has been isolated.

V. PHARMACOLOGICAL ACTIVITY

➢ *Anticancer Activity:*

Vinca alkaloids, which are well known for their anti-cancer effects, are produced by C. roseus. Vinblastine, vincristine, vindesine, and vinorelbine are a few of the alkaloids. Anti-cancer medications made from C. roseus bind to alpha and beta-tubulin to act as tubulin inhibitors. This stops it from attaching itself to microtubules, which provide cells the flexibility and structure they require for division and replication.[1]

➢ *Anti-Oxidant Activity:*

Although C. roseus was found to have greater antioxidant activity than C. alba, the results demonstrated that the ethanolic extract of periwinkle kinds' roots had a sufficient scavenging effect across the entire essay in a concentration-dependent way. Catharanthus roseus contains significant amounts of phenolic and volatile compounds, including flavanol glycosides and caffeoylquinic acids, which are known to have antioxidant properties. As antioxidants against reactive oxygen species (ROS), which are dangerous because they are produced by regular cell aerobic respiration, it plays a crucial part in the body's defensive mechanism.[1]

➢ *Anti-Diabetic Activity:*

It lowers blood sugar similarly to the popular drug glipalamide. The hypoglycemic effect has emerged as a result of the elevated hepatic glucose utilization. [1] Catharanthus roseus has been used to treat diabetes and high blood pressure since ancient times because it was thought to improve the body's synthesis of insulin or, in the case of diabetes, to increase the body's use of the sugars from food.[2]

➢ *Anti-Microbial Activity:*

According to phytochemical and antimicrobial studies, Catharanthus roseus has a number of important antibacterial components, including alkaloids, flavonoids, steroids, phenolics, tannins, and saponins. [1] The plant leaf extract shown antibacterial activity against Salmonella typhimuruim NCIM2501, Staphylococcus, and pseudomonas aeruginosa NCIM2036. It was also discovered that the extracts might be used as a preventative measure in the treatment of numerous ailments.[2]

➢ *Anti-Helmintics Activity:*

Helminth infections are a chronic illness that can impact both people and animals. Catharanthus roseus has been used as an anti-helminthic from ancient times, it was found. [1] Using piperazine citrate as the standard reference and pheretima Posthuma as an experimental model, the anti-helminthic properties of Catharanthus roseus have been assessed.[2]

➢ *Anti-Ulcer Activity:*

The plant's alkaloids, vincamine and vindoline, are utilized as anti-ulcer agents to treat the condition. Vincamine, an alkaloids found in plant leaves, has neuroprotective and cerebrovasodilatory properties. Rats with artificially caused stomach injury showed anti-ulcer efficacy from the plant leaves. [2]

VI. EXTRACTION

The periwinkle extraction process typically involves preparing the plant material followed by extraction of alkaloids using solvents like methanol or chloroform, and then purification and analysis of extract.[7]

➢ *Preparing the Plant Material*

Harvesting: Collect fresh or dried leaves and stems.
Drying: Dry the plant material in the sun or an oven.
Grinding: Grind the dried leaves into a fine powder.[8]

➢ *Extracting the Alkaloids*

Choosing a Solvent: Use methanol, ethanol, or an acidic solution (e.g., water with sulfuric acid).
Extraction Methods:
Hot Ethanolic Extraction: Soak the plant powder in hot ethanol until it loses colour.
Acidic Extraction: Use an acidic solution to extract alkaloids.
Soxhlet Extraction: Repeatedly extract the plant material using a specialized apparatus.
Microwave-Assisted Extraction: Use microwaves to speed up extraction.
Filtration: Remove solid particles from the extract.[9]

➢ *Purifying and Isolating the Alkaloids*

Solvent Partitioning: Use different solvents to separate alkaloids from other plant compounds.
Chromatography: Use techniques like column chromatography to purify alkaloids.
Crystallization: Turn the alkaloids into crystals for purity.
pH Adjustment: Modify the acidity to optimize extraction.
Evaporation: Remove the solvent, leaving behind the alkaloid-rich solid.[9]
This process helps obtain pure vinca alkaloids, which are used in medicines like cancer treatments.

VII. DOSAGE FORM

The Catharanthus roseus comes in following dosage form:

Tablets and capsules
Injectable solutions
Liquid extract or Tinctures
Topical formulation
Herbal teas or decoction [12]

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➢ *Tablets and Capsules:*

Contain powdered leaf or whole plant extract.

Commonly used for antidiabetic and antioxidant purposes.

- *Advantages:*

Numerous pharmacological activities, including anticancer/cytotoxic, antidiabetic, antibacterial, antioxidant, larvicidal, and pupicidal properties, must be present in the extracts and separated compounds of C. roseus.

The comparative toxicity of extracts and bioactive compounds was examined in a dose-dependent manner. [12]

➢ *Injectable Solutions:*

Vincristine and vinblastine, alkaloids obtain from the plant, are formulated as injections.

Used in chemotherapy for various cancers like leukemia and lymphoma.

- *Advantages:*

It is used to treat some kinds of cancer as well as some noncancerous conditions. [13]

➢ *Liquid Extracts/Tinctures:*

Alcoholic or aqueous extracts used in traditional medicine.

Often taken in drops or spoonful for managing diabetes and infections.

- *Advantages:*

Shown significant efficacy to cure the various diseases like cancers, including Hodgkin's lymphoma and leukemia.[14]

➢ *Topical Preparations:*

Creams, gels, or ointments prepared from plant extracts

Used for wound healing, skin infections, and inflammation.

- *Advantages:*

Leaf decoction is used for gripping discomfort in infants, while latex is helpful for scabies. Root paste is used for septic wounds; root decoction is used for fever; leaves are used for menorrhea; and leaf juice is used for bleeding dysentery. [14]

➢ *Herbal Teas or Decoctions:*

Made by boiling the leaves or flowers.

Used traditionally for blood sugar control and immune support.

- *Advantages:*

medicinal effects on conditions like high blood pressure, diabetes, malaria, and skin disorders.

The plant's leaves, flowers, and roots are used in different preparations, such as teas, infusions, or topical applications.[15]

VIII. SIDE EFFECT

It can cause nausea, vomiting, stomach issues, and serious damage to the nerves, kidneys, and liver. Taking too much can lower blood pressure too much. Some people are at higher risk of severe side effects. [10]

There are some potential side effects like:

Gastrointestinal Issues: Nausea, vomiting, and other stomach and intestinal symptoms are possible.

Periwinkle can potentially cause damage to these organs: Nerve, Kidney, and Liver Damage

Low Blood Pressure: It can lower blood pressure, which can be dangerous for individuals with pre-existing low blood pressure conditions.

Allergic Reactions: Some time may experience allergic reactions like itching, rashes, or difficulty breathing.

Drug Interactions: It may interact with certain medications, potentially leading to unexpected side effects or complications.

Other: It can occasionally result in nerve issues, seizures, low blood sugar, bleeding, hearing loss, dizziness, hair loss, and even death.

Constipation: Periwinkle has a drying effect on tissues, which can worsen constipation.[11]

IX. CONCLUSION

Catharanthus roseus (sadaphuli), frequently known as Madagascar periwinkle. It has been widely studied and utilized due to its rich source of pharmacologically active compounds, especially the alkaloids vincristine and vinblastine, which are vital in to cure of several types of cancer, including leukemia and Hodgkins lymphoma. These alkaloids have revolutionized cancer chemotherapy and have become an essential part of many modern medical treatments. From a botanical perspective, the plant is also admired for its ornamental value due to its attractive, brightly colored flowers. It is easy to cultivate, thrives in a range of climates, and contributes to ecological balance. Furthermore, the ongoing research into its phytochemical properties continues to reveal new potential therapeutic uses, emphasizing the plant's promise in the field of natural product-based drug development.In conclusion, Catharanthus roseus stands as a remarkable example of a plant that bridges traditional and modern medicine. Its immense pharmaceutical potential, combined with its adaptability and ease of cultivation, makes it a plant of great importance. Conservation and further scientific exploration of this species are essential, not only for preserving biodiversity but also for discovering new compounds that may lead to future breakthroughs in medicine. As science advances, Catharanthus roseus will likely remain a cornerstone in the quest for natural remedies and innovative treatments.

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