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# Phytochemical, Ethnopharmacological, and Medicinal Importance of *Catharanthus roseus* (*Apocyanaceae*): A Mini-review

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***Authors' contributions***

*This work was carried out in collaboration among all authors. Authors MKH, UTN and NJ did the conceptualization. Authors UTN, MRI, SRA and NJ did the data curation. Authors UTN, SRA, NJ, BA, AN did formal analysis. Authors UTN, SRA and NJ did the investigation. Authors UTN, SRA, NJ and MRI performed methodology. Authors MKH and UTN helped in project administration. Authors UTN, SRA, NJ, BA and AN searched for resources. Authors UTN, SRA and MRI did software analysis. Author MKH supervised the study. Authors MKH and MRI did data validation. Author MRI did data visualization. Authors UTN, NJ, SRA, BA, AN, MRI, MKH wrote, reviewed and edited the manuscript. All authors read and approved the final manuscript.*

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## ABSTRACT

From the ancient period, nature has always blessed human beings with a variety of medicinal plants having no or less side effects. *Catharanthus roseus* (*Apocyanceae*) is a well-known ayurvedic herb that can be found in vast quantities all around the world. The common name for *C. roseus* are periwinkle, pink periwinkle, Madagascar periwinkle, old maid, graveyard plant, cape periwinkle, and bright eyes. The present research has aimed to review the presence of phytochemicals, ethnopharmacological, traditional, and important medicinal information on *C. roseus.* This plant has traditionally been used to treat muscle discomfort, central nervous system depression, and wasp stings. Recent research has revealed that *C. roseus* contains more than 70 different types of alkaloids (indole alkaloids), saponins, flavonoids, carbohydrates, and chemotherapeutic agents that are effective in treating life-threatening diseases like cancers. The phytoconstituents present in *C. roseus* exhibited antidiabetic, anticancer, antiulcer, antioxidant, antibacterial, and other pharmacological effects in different *in vitro* and *in vivo* studies. Vinca alkaloids (vincristine and vinblastine) are one of the prominent phytoconstituents present in this plant which highly contribute to cancer chemotherapy. This mini-review will provide valid and crucial information about *C. roseus* to future research in natural drug discovery processes and also for clinical researchers to find vital and effective medication to treat life-threatening conditions.

*Keywords: Catharanthus roseus; phytoconstituents; medicinal use; pharmacological activity; Vinblastine; vincristine.*

## 1. INTRODUCTION

The medicinal plant has great significance in humans' lives as they are composed of chemical compounds that combat sufferings from dawn to civilization [1]. Traditional medicines have been serving a large portion of the population for millennia. They have an abundant impact on developing most of the modern synthetic medicines. A lot of traditional medicines are now under scientific assessment due to their bioactive efficacy and safety [2]. In the initial stages, medicinal herbs were mostly preferred for treatment rather than disease prevention. Recently immense research has been done on herbal plants and their bioactive constituents that can be employed as alternative therapeutic instruments to prevent or treat a variety of infectious diseases. *Catharanthus* is a genus like a vinca, commonly known as periwinkle. Among eight known species, seven are endemic to Madagascar. Scottish botanist George Don determined the botanical nomenclature of *Catharanthus roseus* (L) *(C. roseus)*. *C. roseus* (L.), an essential medicinal plant in the Apocynaceae family, is used to treat a wide range of fatal conditions. The plant has a long history of usage in Ayurvedic medicine and traditional Chinese medicine, but it was only in the twentieth century that Western medical science began to investigate it. It is an evergreen, bushy flowering plant, erect annual herb, native species to the Indian Ocean Island of Madagascar. It is also found in India, Australia, Southern Europe, Africa, and southern parts of the United States in California, Texas, Georgia, Florida, Mississippi, Louisiana, South, and North Carolina [3]. The word *Catharanthus* came from the Greek language which meant "pure flower" and *roseus* means rose. Thus, the Madagascan periwinkle has been given the name the "rosy" periwinkle. *C. roseus* is mainly used as an ornamental plant that measures 80 cm in height. There are different varieties of *C. roseus* by flower coloration, prevailing those of white color, white with a red center, purple, white with dispersing center, or with dark center bordered with red [4]. Its leaves are commonly oval to oblong, 2.5-3 cm long, and 3.5cm broad, glossy green hairless with a pale midrib and a slender petiole around 1-1.8 cm long, grouped in opposing pairs [5]. Generally, plants contain two types of phytochemical constituents which contribute to the pharmacological effects of medicinal plants. These are primary metabolites and secondary metabolites. Primary plant metabolites are those that execute vital life functions found in large amounts such as carbohydrates, protein, fatty acids, nucleic acids, etc. Secondary metabolites, non-essential to life are the products of the metabolism of primary metabolites having biological effects at certain doses such as terpenes, phenolic compounds, alkaloids, etc. In the traditional and folk medicinal systems, secondary plant metabolites were used to cure several ailments. In modern medicine, they are being used as true lead compounds for drug development [6]. *C. roseus* is a medicinal

plant containing a group of about 130 alkaloids, 70 of which are pharmacologically active. Different alkaloids have different medicinal effects against various diseased conditions such as hyperglycemia, and microbial infections, while others assist in lowering blood pressure, cancer treatment, and so on [7]. Vinblastine and vincristine are potent alkaloids present in this plant which exhibit strong anticancer properties and are now commercially used in anticancer chemotherapy. They also possess tumor inhibition activity for the treatment of leukemia, lymphosarcoma, lymphogranulomatosis, and other malignant tumors. Vinblastine alone is used to treat Hodgkin's disease, advanced testicular tumors, choriocarcinoma, breast carcinoma, Kaposi carcinoma, Letterer-site disease, and leukemia in children including acute myeloid leukemia and acute lymphoblastic leukemia. Furthermore, both vinblastine and vincristine are sold and marketed under the brand name, Velban and Oncovin [8].

Monoterpene indole alkaloids, ajmalicine, and serpentine have anti-inflammatory and anti-hypertensive properties. Yohimbine is effective in the treatment of erectile dysfunction [9]. Vindoline, indoline, and vindolinine showed an antidiabetic effect in vitro. Moreover, the promising fact is that recently isolated indole alkaloids of *C. roseus* such as catharoseumine, 17-deacetoxyvinamidine, 17-deacetoxycyclo-vinblastine,14`,15`didehydrocyclo-vinblastine exhibited *in vitro* human cancer cell line inhibition properties. These findings denote the illuminating prospects of further investigation of the *C. roseus* plant [10]. Furthermore, as there are a large number of alkaloids present in *C. roseus* and the amount of these active alkaloids is very meager, the isolation process is very costly and laborious. It has been measured that the plenty of dried periwinkle leaves (nearly 500 kg of dried leaves) is needed to isolate and purify 1g of vinblastine [11]. *C. roseus* possessed antioxidant properties due to the presence of phenolic compounds in different parts of it [12]. Aqueous extract of it has also been used for wound healing [13] as well as blood coagulation properties. It is also recognized for having properties like anti-microbial [5], antibacterial [5], and antidiabetic [7], antihypertensive [14]. So, owing to their notable pharmaceutical value and constituting a minor part of this complex mixture, *C. roseus* is considered a plant of enormous pharmaceutical interest to researchers.

This review paper aims to elucidate the medicinal, traditional, and pharmacological knowledge of this plant along with its new and developed treatment approach.

## 2. METHODOLOGY

The findings of the existing research were based on a literature review of the phytochemistry, pharmacological characteristics, and medicinal uses *C. roseus*, which was conducted utilizing data from numerous internet sources, Scopus, Google Scholar, PubMed as well as Science Direct databases. Other information sources included pre-electronic sources, journal articles, book chapters, and other scientific articles gathered from the library at the university. We used numerous keywords during the search for information from different databases. These keywords include *Catharanthus roseus OR Madagascar Periwinkle, Vinca rosea* OR traditional AND phytochemical.

## 3. RESULTS AND DISCUSSION

In this process of data acquisition, all the articles were assessed for eligibility to be included in this mini-review. Some of the articles were removed due to duplication and others were removed for not fulfilling the inclusion criteria. However, those articles lack full text and irrelevant titles were excluded from our mini-review. After downloading and organizing the 185 scientific publications for this review into a folder, we carried out the preliminary search and removed any papers that didn't include the information we needed. Following that, 67 articles were added for full-text screening. Ultimately, 73 publications that covered details about the plant's traditional uses as well as phytochemical and pharmacological information were included for this study. The actions of *C. roseus*, which are described in depth in the following selections, have been used to characterize these several articles.

### 3.1 Common Name

*C. roseus* is commonly known as rose periwinkle, pink periwinkle, Madagascar periwinkle, old maid, graveyard plant, cape periwinkle, and bright eyes. It is known in different countries with different names such as Sadabahar in India, Nayantara in Bangladesh, Baahramaase phool in Nepal. It is also introduced by the name of Annual vinca, Running myrtle, Vinca rosea, Vinca roseus, Jasmine, Tahi ayam.

**Fig. 1. *Catharanthus roseus* (Flower)**

## 3.2 Botanical Description

*C. roseus* is mainly used as an ornamental plant that measures 80 cm in height. There are different varieties of *C. roseus* by flower coloration, prevailing those of white color, white with a red center, purple, white with dispersing center, or with dark center bordered with red [4]. Its leaves are commonly oval to oblong, 2.5-3 cm long, and 3.5 cm broad, glossy green hairless with a pale midrib and a slender petiole around 1-1.8 cm long, grouped in opposing pairs [5].

## 3.3 Ethno Medicinal Knowledge

*C. roseus* has been used in folk medicine to treat diabetes and high blood pressure [15], especially to treat diabetes for ages in Europe. The juice of its leaves was used to treat wasp stings in India. The herb was boiled in Hawaii to form a poultice to stop bleeding. It was used as an astringent, diuretic, and cough medicine in China. It was utilized as a home treatment for lung congestion and inflammation in Central and South America. An extract from the blossoms was used to prepare a treatment to cure eye irritation and infections throughout the Caribbean. When Western researchers learned about a tea that Jamaicans were drinking to treat diabetes in the 1950s, they became aware of this plant. They observed that it contained several alkaloids that were beneficial to humans (130 in all at last count). Some of them were catharanthine, leurosinesulfate, lochnerine, tetrahydroalstonine, vindoline, and vindolinine which reduced blood sugar levels. Besides, other alkaloids like vincristine and vinblastine were recognized as haemostatics (stop bleeding), and had anticancer properties. The alkaloids like reserpine and serpentine had been recognized as potent tranquilizers, were also found in periwinkle [16] *C. roseus* had been used to combat a wide variety of diseases from time immemorial which were summarized in Table 1.

## 3.4 Phytochemistry of *Catharanthus roseus*

C. *roseus* contains a variety of alkaloids (Nitrogen-containing organic compounds other than amino acids, peptides, purines and derivatives, amino sugars, and antibiotics) [10]. These compounds had a nitrogen atom that was not found in any of the ring systems found in ephedrine, cathinone, or colchicine. This plant had been discovered to have a variety of key bioactive components that contributed significantly to herbal medicine production; nevertheless, their levels in the plant were generally insignificant. Plant secondary metabolite production was involved with the biotic and abiotic influences. Because of the plant`s protective function, environmental disturbances have been discovered to induce the development of secondary metabolites, including alkaloids. As a result, more *in-vitro* and *in- vivo* investigations are focusing on manipulating environmental variables such as light, salinity, soil types and nutrients, drought, and metal stress to increase the levels of these chemicals. Citronellol (7.9%), geraniol (7.9%), (E,E)-2,4-hexadienal (7.7%), (Z,E)-pentadecanal (6.6%), and phytol (6.4%) were the primary volatile chemicals found from an Indian sample; tricosane(37.9%), heneicosane (20.8%), and tetracosane (6.1%) were the main volatile compounds discovered in the flower, palmitic acid (64.9%), methyl palmitate (7.7%), and myristic acid (6.6%) were found in high concentrations in the leaves, as well as palmitic acid (28.9%), methyl palmitate (13.1%), and geranylacetone (5.2%) were contained in the marcs-industrial plant residues [35]. Table 2 gives the structure of a few important chemical constituents.

**Table 1. Traditional uses of *C. roseus***

| Preparation | Disease | Origin | Mode of administration |
|---|---|---|---|
| Hot water extract of dried leaves | Menorrhagia, Diabetes | Australia, South Africa | Oral [17,18] |
| Root bark extract | Febrifuge | Australia | Oral [17,19] |
| Hot water extract of dried whole plant | *Diabetes mellitus* | Brazil | Oral [17,20,21] |
| Hot water extract of aerial parts | Menstrual regulation | China | Oral [17,22] |
| Decoction of dried leaves | Diabetes Hypertension Cancer | Cook island | Oral [17,23] |
| Decoction of dried leaves | *Diabetes mellitus* | Europe | Oral [17,24] |
| Hot water extract of whole plant | Anti galactagogue | France | Oral [17,25] |
| a) Hot water extract of dried whole plant b) Hot water extract of dried leaves c) Root extract | Cancer Hodgkin's disease Menorrhagia | India | Oral [17,26] |
| Hot water extract of dried leaves | Diabetes | Jamaica, Kenya | Oral [17,25] |
| Infusion of entire plant | Stomach problem | Mexico | Oral [17,27] |
| a) Hot water extract of leaves b) Root extract | Diabetes, rheumatism, Hypotensive, febrifuge | Mozambique | Oral [17,28] |
| Hot water extract of dried entire plant | Cancer, Heart disease, Leishmaniasis | Peru | Oral [17,29] |
| Hot water extract of dried ovules | Diabetes | Pakistan | Oral [17,30] |
| Hot water extract of roots | Abortion | Philippines | Oral[17,31] |
| Decoction of dried whole plant | *Diabetes mellitus*, Liver disease | Taiwan | Oral [17,32] |
| Hot water extract of dried plant | Diabetes | Thailand | Oral [17,33] |
| Water extract of dried root | Venereal disease | Venda | Oral [17,25] |
| Hot water extract of whole plant | Diabetes, Hypertension, Dysentery, Cancer | Vietnam | Oral [17,34] |
| Hot water extract of leafy stems | Diabetes | West indies | Oral [17,25] |

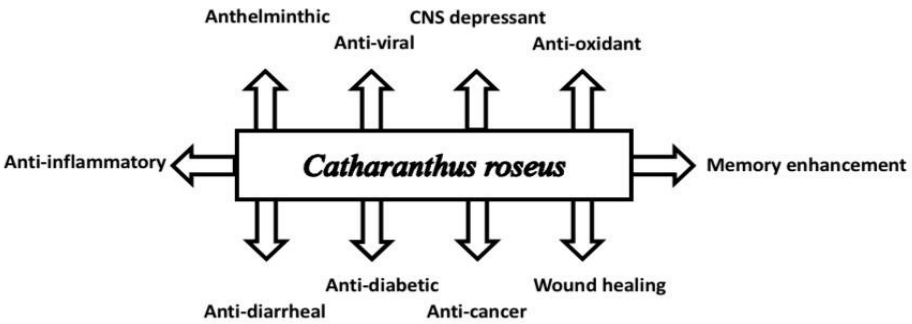
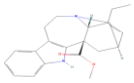
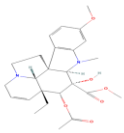
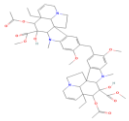
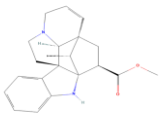
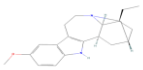
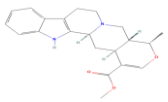
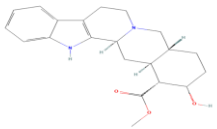
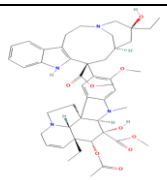
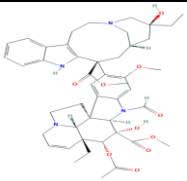
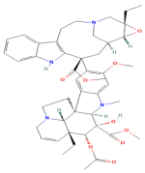
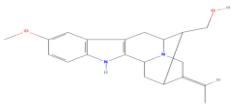
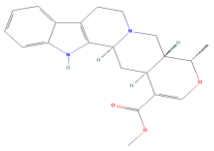
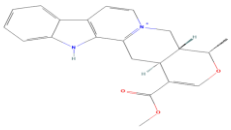
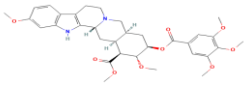
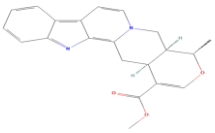
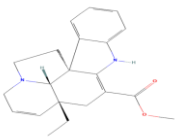
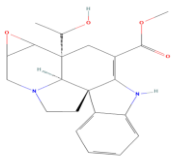
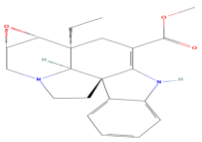
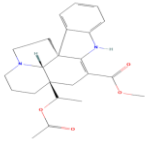
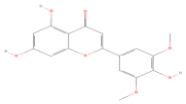
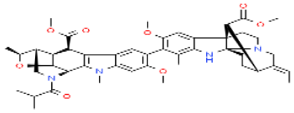
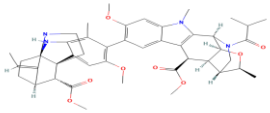



**Fig. 2. Pharmacological properties of *Catharanthus roseus***

**Table 2. Some crucial phytochemical structure of *C. roseus***

| Chemical constituents | Chemical structure | Isolated from |
|---|---|---|
| Catharanthine |  | Whole plant [10,36] |
| Vindoline |  | Leaf, stem, and root [10,36,37] |
| Vindolicine |  | Leaf [10,37] |
| Vindolinine |  | Leaf [10,37] |
| Ibogaine |  | Leaf [10,38] |
| Raubasine |  | Leaf [10,38] |
| Yohimbine |  | Leaf, stem, root [10,39] |
| Vinblastine |  | Leaf, stem, root [10,39] |
| Vincristine |  | Leaf, stem, root [10,39] |
| Leurosine |  | Whole plant [10,40] |

| Chemical constituents | Chemical structure | Isolated from |
|---|---|---|
| Lochnerine |  | Whole plant [10,41] |
| Ajmalicine |  | Leaf, stem, root [10,39] |
| Serpentine |  | Root [10,39] |
| Reserpine |  | Leaf, stem, root [10,39] |
| Alstonine |  | Root [10,42] |
| Tabersonine |  | Root [10,43] |
| Horhammericine |  | Root [10,44] |
| Lochnericine |  | Root [10,45] |
| Echitovenine |  | Root [10,46] |

| Chemical constituents | Chemical structure | Isolated from |
|---|---|---|
| Tricin |  | Flower [10,45] |
| Vingramine |  | Seeds[10,47] |
| 9Methylvingramine |  | Seeds [10,47] |

## 3.5 Pharmacological activities

### 3.5.1 Anticancer activity

Vinblastine and vincristine are anticancer alkaloids isolated from the stems and leaves of *C. roseus*. Some human cancers respond to these alkaloids by slowing down their growth. They block the formation of the mitotic spindle by preventing the assembly of tubulin dimers into microtubules [48]. Vinblastine is suggested for Hodgkins's disease and choriocarcinoma and is used experimentally to treat neoplasms. Another alkaloid, vincristine, is used to treat childhood leukemia. In vitro, different percentages of crude methanolic extracts of *Catharanthus* were discovered to have considerable anticancer activity against a variety of cell types, with the greatest activity against multidrug-resistant tumor types. The major mechanisms of the cytotoxicity of vinca alkaloids include interactions with tubulin and disruption of microtubule function, especially of microtubules that help to compensate the mitotic spindle apparatus, resulting in the metaphase arrest. They have a different mechanism of action and do not have cross-resistance with drugs that alkylate deoxyribonucleic acid (DNA) [49].

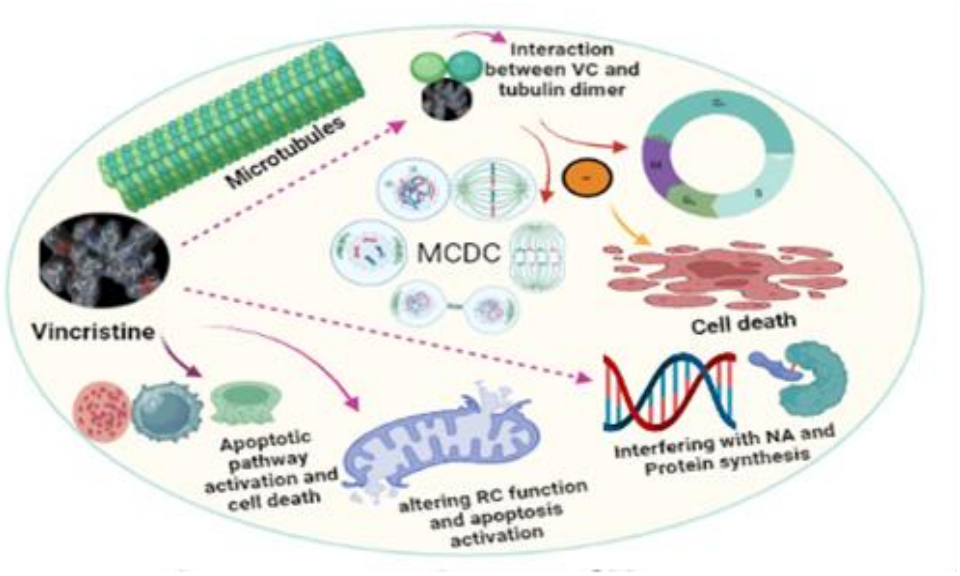



**Fig. 3. Mechanism of action of vincristine**

*(Source references: Dhyani P et al, 2022; Thirumaran R et al, 2007; Starobova H and Vetter I, 2017; Lahare RP et al, 2020; Saha A, 2022)*

The anticancer mechanism of action of Vincristine leads to cancer cell arrest and death. Vincristine (VC) causes the depolymerization of microtubules through binding to tubulin leading to the mitotic cell division cycle (MCDC) being arrested at metaphase steps. This disrupted the formation & assembly of the mitotic spindle, mainly during the S and M phases of the cell cycle. Therefore, destabilization & interruption in microtubule dynamics leads to automated cell death or apoptosis. It alters the function of the respiratory chain (RC) in mitochondria, followed by the activation of apoptosis and cell death. It provides an effect contributing to the degradation of cancer cells through the activation of the immune system and apoptotic pathway. Another mechanism involves interfering with the synthesis of protein & nucleic acid (NA) by blocking the utilization of glutamic acid [50-55].

### 3.5.2 Anti-diabetic activity

Diabetes and related complications are major medical problems despite the introduction of anti-diabetic agents. Patients with non-insulin-dependent diabetes mellitus (NIDDM) are treated orally by folklore with various plant extracts since time immemorial. Crude extracts of *C. roseus* were found to possess significant anti-diabetic potential in different methods, including oral glucose tolerance test (OGTT) on rodent model, alloxan, and streptozotocin-induced diabetic rats and rabbits at different doses [56,57]. Vindoline, vindolicine, vindolinine, vinculin, and vindogentianine were the remarkable natural alkaloids isolated from the leaf extract of *C. roseus* that might contribute to this potential effect [58]. Xin-gang Yao et al. investigated that vindoline improved glucose homeostasis significantly in db/db mice and streptozotocin combined with a high-fat diet (STZ/HFD) induced type 2 diabetes in rats [59]. During 2019, Oluwafemi Omoniyi et al reported that vindoline provided a prominent reduction in the blood glucose level in diabetic rats as well as reducing different complications including diabetic cardiovascular and kidney disease [60]. It provides antidiabetic action through different mechanisms including increasing insulin secretion and insulin sensitivity, protecting the pancreatic-beta cell from dysfunctions and apoptosis, inhibiting the expression of different inflammatory mediators, and reducing diabetic complications [61]. Earlier a computational background on α-glucosidase inhibitors indicated that vindoline showed the highest binding affinity for the target enzyme among 32 natural alkaloids isolated from different plants [62]. Vindogentianine provided the potential for the treatment of type 2 diabetes (T2D) through the enhancement of glucose uptake and PTB-1B inhibition [63].

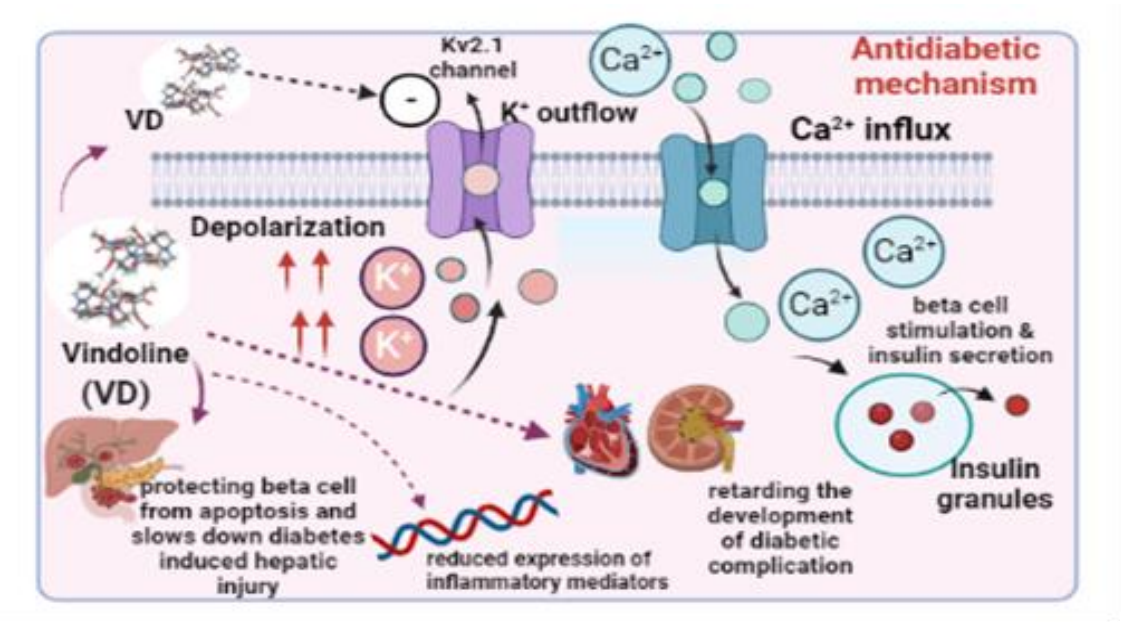



**Fig. 4. Mechanism of action of vindoline against type-2 diabetes**

*(Source references: Yao XG et al., 2013; Oguntibeju OO et al., 2019; Goboza M et al., 2019; Tiong SH et al., 2015; Goboza M et al., 2020; Prabhakar PK and Doble M, 2011)*

Vindoline provided antidiabetic activity by increasing the action potential of the membrane through inhibition of Kv2.1 (voltage-gated K channel) leading to enhanced $Ca^{2+}$ flow through an L-type voltage-dependent $Ca^{2+}$ channel. Increased intracellular $Ca^{2+}$ caused stimulation of pancreatic beta cells and secretion of insulin from beta cells through the exocytosis process. It also acted as an insulin sensitizer and protected the pancreatic beta cell from apoptosis induced by cytokine through Kv2.1 inhibition. It prevented diabetes-induced hepatic diseases by decreasing serum alanine transferase (ALT), alkaline phosphatase, and aspartate aminotransferase (AST) levels. It inhibited inflammatory gene expression (IL-1β, IL-6, and TNF-α) by nuclear factor kappa light chain enhancer of activated β-cells (NF-kB) pathway. It also slowed down the diabetic cardiovascular complications development through the reduction of total cholesterol (TC), low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), and triglycerides (TG), and diabetic nephropathy by lowering the serum urea and creatinine level [59,60,61,63,64,65].

### 3.5.3 Antioxidant activity

In case of *C. roseus*, the presence of phenolic compounds had been reported. The presence of caffeoylquinic acids was found in parts of *C. roseus* in addition to other flavonoid derivatives. DPPH inhibitory activity of four alkaloids vindoline, vindolidine, vindolicine and vindolinine were evaluated and compared to ascorbic acid which was used as the reference standard. All four alkaloids showed free radical scavenging activities. DPPH inhibitory activity of vindoline, vindolidine, and vindolinine was better than that of the control [66]. Investigation concurred by Asheesh Kumar et al (2012) of the antioxidant activity of *C. roseus*, found that the habitat temperature affected the antioxidant activity of *C. roseus*. Previous research presented the results of several *in vitro* antioxidant assays in investigating the effect of solvent on the extraction and total antiradical potential of varieties extracts of *C. roseus* [38/67, 39/68].

### 3.5.4 Anti-diarrheal activity

An investigation was conducted *in vivo* antidiarrheal activity of the ethanolic extract of *Catharanthus roseus* in Wistar rats [69]. Ethanolic leaf extract of *C. roseus* had exhibited antidiarrheal activity by reducing castor oil-induced diarrhea in Wistar rats and the investigation notified that the fractions of the ethanolic extract were responsible for the observed antidiarrheal effect of *C. roseus* [69].

### 3.5.5 Anthelminthic activity

Infections with helminths cause chronic diseases in humans and livestock. The anthelminthic properties of *C. roseus* were assessed using *Pherethima posthuma* as an experimental model and piperazine citrate as a standard reference. The ethanolic extract at 250 mg/ml showed significant anthelminthic action with a death time of 46.33 minutes, while the conventional medication at 50 mg/ml showed a death time of 40.67 minutes. The ethnomedical claims of *C. roseus* as an anthelminthic plant were supported by this study [70].

### 3.5.6 Anti-viral activity

*Catharanthus* has an antiviral impact on the simplex herpes virus (type I) with a cytopathogenic effect at 0.8 µg/mL [4]. Catharoseumine, a monoterpenoid indole alkaloid with a unique peroxy bridge, was shown to be a potential inhibitor of falcipain-2 protozoa parasites (causes of malaria) having an $IC_{50}$ value of 4.06 µM. Vinblastine and vincristine had an antiparasitic effect on Trypanosoma where the parasite causing human trypanosomiasis, slowed down the mitosis and changed cellular structure in a dose-dependent way. Here, in comparison, 15 µM vinblastine and 50 µM vincristine decreased cellular division and cytokinesis as well as cellular morphology, whereas 3 µM vinblastine and 10 µM vincristine inhibited cytokinesis without affecting cell cycle progression [4].

### 3.5.7 Anti-inflammatory activity

Various inflammatory diseases such as asthma, rheumatoid arthritis, hepatitis, and colitis are alarming causes of death and disability around the world. The solvent extracts of the whole plant of *C. roseus* had been found to possess the anti-inflammatory potential. The aqueous and ethanolic extracts of *C. roseus* had shown adequate anti-inflammatory properties during *in vivo* carrageenan-induced antiinflammatory study at doses of 250 and 300 mg/kg. During this assay, the ethanolic and aqueous solvent extracts of *C. roseus* plant reduced the carrageenan-induced edema in albino rats. However, the anti-inflammatory activities of ethanolic and aqueous extracts were found more

statistically significant in comparison to non-polar extracts. These reduced inflammation in a dose-dependent manner. Vinpocetine, a synthetic ethyl ester of the apovincamine alkaloid, was found effective in the reduction of carrageenan-induced inflammation [71].

### 3.5.8 Wound healing activity

In 2007, Nayak et al. evaluated the wound healing activity of the ethanolic extract of *C. roseus* flower in Sprague Dawley rats when compared with placebo controls [13]. The study revealed that there was a significant increase in tensile strength and wound contraction leading to an increase in hydroxyproline content which might be attributed to the phytoconstituents present in the extract. Recently Satish et al. (2021) studied the wound healing effect of the extract of *C. roseus* flower in three cutaneous models of wound and sucralfate was used as a standard. This study revealed that the tissue breaking strength was remarkably increased in the incision model, epithelization and period to complete epithelization was decreased in the excision wound and the increase of hydroxyproline content accelerated the rate of wound contraction in the dead space model of adult Albino mice [72]. Further studies should be carried out to formulate a standard topical product of *C. roseus* extract commercially so that it can be used in wound management.

### 3.5.9 CNS depression activity

In experimental animal models, locomotor activity and pentobarbitone-induced sleeping time were used to examine the CNS depressing effect of *C. roseus* leaves. In the experiment, petroleum ether, chloroform, and ethanol extracts were prepared through fractionation sequentially. At the doses of 200 and 400 mg/kg oral administration of petroleum ether extracts, substantial and dose-dependent CNS depressing action was observed. Diazepam at 4 mg/kg was used as a reference standard in this model. In the experimental animals, a dose of 100 mg/kg had no discernible effect. In qualitative chemical analysis, petroleum ether extract revealed the presence of steroids, tannins, flavonoids, glycosides, alkaloids, and phenolic substances. Petroleum ether extracts were high in steroid and phenol content, particularly flavonoids, which had been shown to have sensitive compounds in preclinical investigations for CNS depressive effect. The evaluated properties of *C. roseus* leaves could be due to the presence of steroids, glycosides, and phenolic compounds [73].

### 3.5.10 Memory enhancement activity

Vinpocetine, which was derived from the alkaloid vincamine, has been reported to be the most fascinating dietary substance because of its ability to increase brain function and memory. Therefore, it could be very helpful in the treatment of Alzheimer's disease. Vinpocetine at doses up to 60 mg/d was shown to be well tolerated in clinical trials for dementia and stroke, with no serious side effects reported. Blood thinners including warfarin, aspirin, and various dietary supplements like ginkgo, vitamin E, and garlic should not be used with vinpocetine [53].

## 4. CONCLUSION

In this mini-review, we have identified the presence of vincristine and vinblastine in *C. roseus*, well-known drugs used in cancer treatment. The bark, roots, leaves, and flowers of this plant also other major group of phytochermicals such as saponins, alkaloids, carbohydrates, flavonoids, and other substances. These compounds possess antibacterial, antiulcer, antioxidant, hypolipidemic, antidiabetic, and other properties. We hope this mini-review can comprehensively contribute to identify the chemical components and pharmacological effects of *C. roseus*, intending to facilitate future research. In the future, this review paper will spread awareness about the medicinal properties of this plant to the scientific community.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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