

Novel Bioactive Molecules



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To Study the Phytochemical and Antioxidant Activity
of *Catharanthus roseus* : A Bioactive Plant

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CHAPTER 11

To Study the Phytochemical and Antioxidant Activity of *Catharanthus roseus* : A Bioactive Plant

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Abstract

Catharanthus roseus (L.) is an important plant commonly seen in household garden. Many scientific evidence has proved the Potential health benefits of individual phytochemicals extracted from this plant. Various *vitro* elements found in *Catharanthus roseus* leaf. It has been found to contain a range of alkaloids possessing antidiabetic, anticancer, antioxidant, antialzheimer's, antibacterial, antifungal, antiviral, activities. In the Ayurvedic system of medicine, different parts of *C. roseus* are used in folklore herbal medicine for treatment of many types of diseases. In the present study we have tried to collect traditional uses, phytochemical constituents and pharmacological properties of the plant.

Keywords: *Catharanthus roseus*, Phytochemical, Antioxidant, Ayurvedic, pharmacological.

Introduction

Catharanthus roseus is a conventionally used remedial plant belonging to the family Apocynaceae, and is found abundantly all over the world. This herb is now common in many tropical and subtropical regions. The World Health Organization (WHO) has prepared a list of 21000 medicinally significant plants. *Catharanthus roseus* is widely grown to 100 cm tall in subtropical areas. This plant possesses known antibacterial, antimicrobial, antifungal, antioxidant, anticancer and antiviral activities. Pharmacological studies have revealed that *C. roseus* contain more than 400 different types of alkaloids (Indole alkaloids) and chemotherapeutic agents that are effective in treating various types of cancers. The anticancer drugs vincristine and vinblastine are synthesized from alkaloids of *Catharanthus roseus*. The plant is also known for its antihypertensive and antispasmodic properties, due to the presence of alkaloids like Ajarnalicine, Serpentine and Reserpine. *Catharanthus roseus* is an important Ayurvedic medication in traditional medicine. *C. roseus* also possess good antioxidant potential. There are about two common cultivars of *C. roseus* which is named on the basis of their flower color that is the pink flowered 'Rosea' and the white flowered 'Alba'. *C. roseus*

is extensively cultivated in northern India in order to meet their commercial and the ever increasing demand in the indigenous systems of the medicine also their need to the pharmaceutical industry

Therapeutic plants grow naturally around us. Natural products including plants, animals and minerals have been the basis of treatment of human diseases. Use of plants as a source of medicine has been inherited and is an important component of the health care system.

Traditionally, leaves of *C. roseus* are used as medicine for the treatment of menorrhagia, rheumatism, dyspepsia, indigestion, dysmenorrhea, diabetes, hypertension, Cancer, menstrual disorders, Skin diseases, Bleeding Diarrhea and has Sedative and Antiviral properties. Medicinal plants contain physiologically active constituents, which over the year have been exploited in traditional medical practice for the treatment of various ailments (Okigbo and Igwe, 2007)¹. Plant extracts from them have been used for the cure of many disease conditions and some of their effectiveness have been established (Sofowora, 1993)². Research is currently being conducted on medicinal plant extracts to isolate and purify the active fractions for preparation of drugs from natural sources (El-Mahmood and Amey, 2007)³, due to their less toxic effect and affordability.

Today all major life saving drugs such as reserpine, atropine, quabbin, vinblastine, vincristine and taxol are derived from plants. According to the estimate of the World Health Organization approximately 80% of the people in developing countries chiefly rely on traditional medicines for primary health care, of which a major portion involves the use of plant extracts or active principle originating from parts of plants (Farnsworth *et al.*, 1985)⁴. Plants and their secondary metabolite constituents have a long history of use in modern "Western" medicines and in certain systems of traditional medicine and are the sources of important drugs such as atropine, codeine, digoxin, morphine, quinine and vincristine. Various plants have been used in day-to-day life in Indian house Plants have been used in the preparation of traditional medicine for a long time and most of these folk medicines were prepared from locally grown wild plants. Knowledge about the uses of plants was compiled by trial and error and passed down from one generation to another orally. Nowadays, world markets are turning to plants as the sources of ingredients in healthcare products. It offer alternative remedies with tremendous opportunities to generate income, employment and foreign exchange for developing countries. Many traditional healing herbs and their parts have been shown to have medicinal value and can be used to prevent, alleviate or cure several human diseases. Herbal drugs constitute a major part in all traditional system of medicines. It is a triumph of popular therapeutic diversity. In developing countries, it is estimated that about 80% of the population rely on traditional medicine for their primary health care. Most of the pathogens causing enteric infections have developed resistance to the commonly prescribed antibiotics. Bacterial resistance to antibiotics increases mortality, likelihood of hospitalization and the length of stay in the hospital. Therefore, the

research and reviews for new and effective anti-microbial agents with broad-spectrum of activity from natural sources is increasing day by day (Monokesh KhmerSen.et al, 2013)⁵ olds.

The plant stem, leaf and roots are a source for more than 400 Indolalkaloids and two terpene indol alkaloids: vinblastine and vincristine these alkaloids have used for treatment of cancer⁶ Where as ajmalicine, vinceine, vineamine, raubasin, reserpine are present in root and basal stem part of *Catharanthus roseus*. Rosindinis an anthocyanins pigment found in the flower of *C.roseus*⁷ In ayurveda different part of *C.roseus* are used in folklore herbal medicine for treatment of many types of cancer, diabetes, stomach disorders kidney, liver and cardiovascular disease⁸ . The plant have good antioxidant and antifungal, antibacterial and antiviral activity^{9,10} . *Catharanthus roseus* contain volatile and phenolic compound such as caffeoylguinic acid flavonalglycosides are antioxidant against reactive oxygen and play important role in plant¹¹ .

Catharanthus roseus possesses known antibacterial, antifungal, antidiabetic, anticancer and antiviral activities. The extracts have demonstrated significant anticancer activity against numerous cell types.

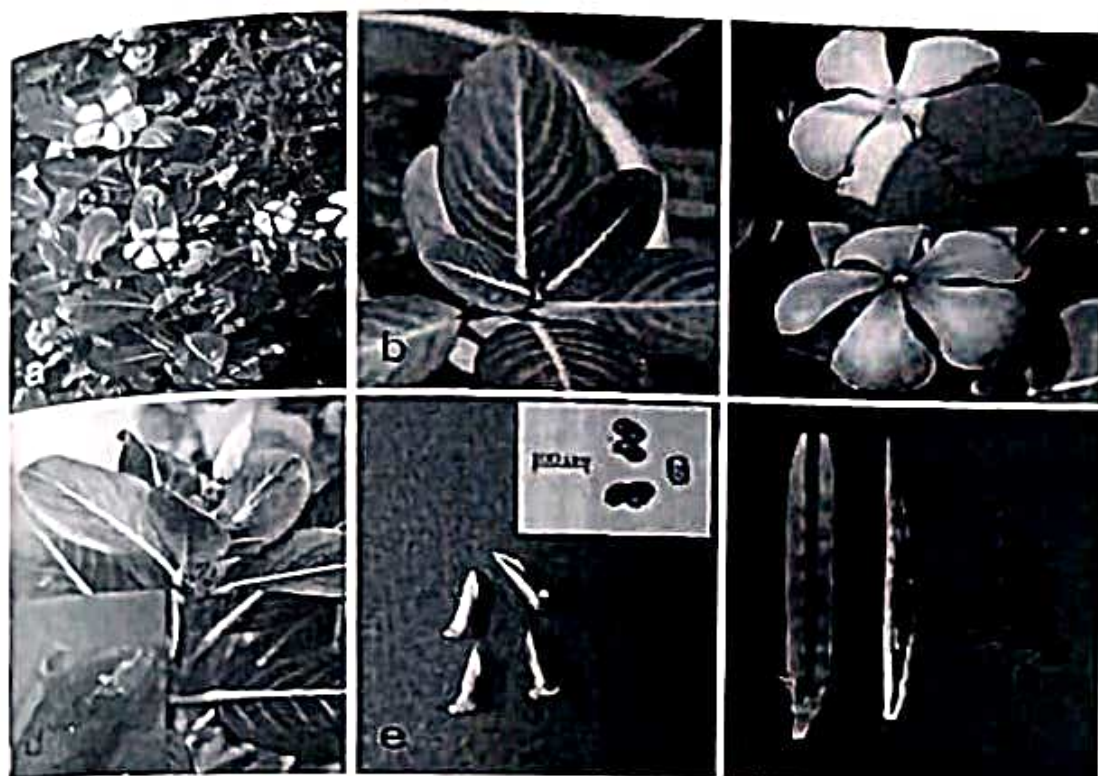
An antioxidant is a molecule capable of inhibiting the oxidation of other molecules, oxidation is a chemical reaction that transfers electrons from a substance to an oxidizing agent. Oxidation reactions can produce free radicals, in turn, these radicals can start chain reactions that damage cells. Antioxidants terminate these chain reactions by removing free radical intermediates and inhibit other oxidation reactions. They do this by being oxidized themselves, antioxidants are often reducing agents such as thiols, ascorbic acid or polyphenols. Although oxidation reactions are crucial for life they can also be damaging; hence plants and animals maintain complex system of multiple types of antioxidants such as glutathione, vitamin C and vitamin E as well as enzymes such a catalase, superoxide, dismutase and various peroxidase. Low levels of antioxidants on inhibition of the antioxidant enzymes cause oxidative stress and many damage or kill cells.

Taxonomy of *catharanthus roseus*

C.roseus is known as Madagascar periwinkle. It is a common decorative easy growing evergreen, dicotyledonous ornamental flowering plant. The flower are white and dark pink in colour with darker in center. Leaves of the plant are 2.5 to 9 cm long 1 to 3.5 cm broad hairless glossy and green in colour. Basal tube 2.5 to 3 cm long and a corolla 2 to 5 cm diameter with five petal like lobes. The fruit is a pair of follicles 2 to 4 cm long and 3 mm broad.

Prevalent botanical characters of *Catharanthus roseus*. a Fully grown *C. roseus* plant at its flowering stage, b elliptic-ovate to oblong leaves, c blooming flowers of "Rosea" (pink) and "Alba" (white) cultivars, d development of flowers in axils on long cylindrical tube (inset ovary and stigma head), e anthers and plens (inset), f fruit with a pair of elongated follicles is gamopetalous, mature fruit bursted and released seeds

(photographs are not in scale) (source: unpublished photographs of Anamika Das and Sakat Gantait)



TRADITIONAL USES OF *C. ROSEUS*

Catharanthus roseus has been used in medicine. The dried leaf is boiled with water and then the extract is taken orally to treat diabetes¹². The whole plant powder mixed with cow's milk is taken orally to treat diabetes¹³. Whole plant is boiled with water and taken orally for the treatment of throat, stomach, oesophageal cancer in Kenya¹⁴. The root is air dried, grained and decocted and taken orally for the treatment of urogenital infection in South Africa¹⁵.

Pharmacological Activity

Anticancer activity

C. roseus is carried out intravenously after which they are eventually metabolized by the liver and excreted. Hair loss, peripheral neuropathy, constipation and hyponatremia are the major side effect of this drugs. To improve the therapeutic index semi-synthetic alkaloids such as vinorelbine and vinflunine were developed. Vinblastine is use for treatment of neoplasms and Hodgkin's disease, chorio carcinoma. *C. roseus* was found to the anticancer activity against numerous cell type in vitro conditions. Vinea alkaloids hence successfully prevent cancer cell from dividing. Different vinca alkaloids have unique properties¹⁶. *C. roseus* is well known plant for anticancer activity. The antitumor activity investigate in *C. roseus* presence of dimeric alkaloids vinblastine, vincristine and anhydrovinblastine which are already in use.

Vinca alkaloids are widely used from in anticancer drugs. Vinca alkaloids are one of the second most used classes¹⁷.

Antidiabetic activity

1:1 ratio of dichloro methane and methanol extract of the leaves and twigs of *C.roseus* plant in streptozotocin induced diabetic at the dose of 500 mg/kg that has been intake orally for 7 and 15 days. The ethanolic extracts of the leaves and flowers of *catharanthus roseus* revealed that a dose dependent decreasing of blood sugar is similar to the standard drug. Decreasing of blood sugar in comparable to the standard drug glibenclamide. The hypoglycemic action has been arosed due to the result of the increase glucose utilization in the liver¹⁸.

Antimicrobial Activity

Phytochemical and antimicrobial activity showed by compounds like steroids, phenols, tannins, saponine, alkaloids, and flavonoids in *catharanthu sroseus*. Aldehydes and phenolic compound of the plant extract showed antimicrobial activity . Patil and Ghosh¹⁹ reported antibacterial activity from the crude extracts from different parts of *C.roseus*against *pseudomonas aeruginosa*, *salmonella trphimuruim* *staphylococusaureus* and found that the leaf extract show high antibacterial activity.

Antioxidant Activity

Antioxidant are radical scavengers that give protection to humans body against free radicals by inhibiting the oxidizing chain reaction. When these substances are present at low concentrations in the body they prevent the oxidation of an oxidizable substance. Aerobic respiration and metabolic activity create free radicals which are harmful for our bodies. The antioxidant activity is present more in *C.roseus* than *C. alba*²⁰. Salah et al.²¹ reported antioxidant properties of *catharanthus roseus* due to presence of phenolic compounds. Patel et al²² reported that in leaf juice of plant vinpocetine like compound was present which showed antioxidant activity similar to flavonoids. Free radicals scavenging activities of extract of *C. roseus* was measured by DPPH assay.

Other Benefits use

Catharanthus roseus is a important Medicinal plant. Ethanol extract of *C. roseus* leaf, stem, flower and root have been reported antibacterial^{23,24} activity against various bacteria. Yohimbine an alkaloids isolated from the plant leaf, stem and root²⁵ was found not only antibacterial, antifungal activity but also antiviral activity against herpes simplex virus (type 1)²⁶. Wound healing is a process of restoring cellular structure and tissue layer in damaged part of body. The ethanol extract of *C. roseus* flower and leaf have been possess wound healing activity in rats^{27,28}. The leaf extract show hypotensive and lipid lowering properties in adrenaline - induced hypertensive rats²⁹. Oxidation reaction produces free radicals and then start a cascade of biochemical reactions, causing oxidation stress that damage cells and participate to cell ageing, cardiovascular disease, brain disease, mutagenic changes and cancerous

tumour growth^{30,31}. Additionally *C.roseus* extracts and isolated alkaloids including vindoline, vindolidine, vindolicine, and vindolinine were found to possess antioxidant properties^{32,33,34,35}, which could reduce and prevent the oxidation of other molecules.

Discussion

Different pharmacological studies and the traditional uses proved the high Medicinal properties of the *catharanthus roseus*. Which are continuously being used in the treatment of number of diseases. Present study was concerned with the evaluation of the antioxidant Potential of *C.roseus*. element and phytochemicals present in the extracts of *C.roseus* solvent.

Conclusion

In the study we presented result of various *in vitro* elemental analysis and total anti radical potential of different extract of *catharanthus roseus*. Based on result of this study it is clear that *C.roseus* leaf extract can be used as a potential source of easily accessible natural antioxidant as well as in Pharmaceutical applications. The plant were widely used in folklore remedy for treatment of several diseases

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