# Pharmacological Significance of *Plumbago zeylanica* L - A Review

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## Abstract

*Plumbago zeylinica* L is commonly known as Chitrak belongs to the family Plumbaginaceae. P. zeylanica is being used for centuries in Ayurveda system of medicine to increase longitivity and vitality. It is the most important medicinal plant is extensively used in herbal formulations. Pharmacological properties of this plant have been reviewed in this paper.

**Key words**: Chitrak; Pharmacological activities; Plumbagin; *Plumbago zeylinica* L.

## Introduction

The genus *Plumbago* belonging to the family Plumbaginaceae, comprises 10 genera and 280 species (1)(2). Three main species included in genus *Plumbago* namely, *Plumbago indica* L., *Plumbago auriculata* L. and *Plumbago zeylinica* L. Among these species, *Plumbago zeylanica* L. is more popular due to its therapeutic properties. *Plumbago zeylanica* L. usually referred to as Ceylon leadwort, doctor bush and wild leadwort, is one of the well-known herbal plant. It also named as chitramula and chitrak in Ayurveda. Chitrak is a perennial herb cultivated in shady places in the garden for its brilliant inflorescence (2,3 4). It is widely distributed throughout India and Sri Lanka.

Plant

root

The root of this plant is used as laxative, expectorant, astringent, abortifacient and in dysentery. Tincture of root bark is used as antiperiodic. The leaves are caustic and used in treatment of scabies. Plumbago are chemically characterized by the presence of naphthoquinones, flavonoids, terpenoids and steroids, many of them being responsible for

several biodynamic activities. Popular name of Plumbago zeylanica is lead wort. This plant is also known by several names in different parts of the world. In India its common name is "Chitrak"(5). The root of PZ has been reported to be a powerful poison when given orally or applied to ostium uteri, causes abortion.(6,7) The methanol root extract of PZ in rabbits produced a limited toxic effect and did not produce any overt signs of toxicity in skin28 and possible in vivo protective effect against cyclophosphamide-induced genotoxicity and oxidative stress in mice.(8,9,10) Moreover the acute toxicity studies of PZ in albino rats revealed that the oral LD50 of the drug is 65mg/kg body weight and in the dead animals, the post mortem revealed a profuse bleeding in the viscera.(11,12) The medico legal aspects have also described by Goutam and Goutam(13)

**Classification** (14)

Kingdom: Plantae

Order: Caryophyllales

Family: Plumbaginaceae

Genus: Plumbago

Species: Zeylanica

**Synonyms of P. Zeylanica**

Hindi: Chira, Chitra

Sanskrit: Agni, Vahini

English: Lead wort, Ceylon lead wort

Punjabi: Chitra

Bengali: Chita

Gujarati: Chitrakmula

Kannada: Chitrakmula, Bilichitramala

Malayalam: Vellakeduveli

Tamil: Kodiveli, Chitramoolam

Telugu: Chitramulam

**Phyto- constituents:**

**Root-** The root bark of P. zeylanica contains plumbagin. New pigment, viz, 3-chloroplumbagin, 3, 3- biplumbagin, binaphthoquinone identified as 3', 6'- biplumbagin, and four other pigments identified as isozeylanone, zeylanone, elliptinone, and droserone (15) (16) The isolation of plumbagin, droserone, isoshinanolone and a new napthalenone i.e., 1, 2 (3)-tetrahydro-3, 3'-plumbagin reported from the phenolic fraction of the light petrol extract of the roots (17)

Flowers contain plumbagin, zeylanone, and glucose. Leaves contain plumbagin, chitanone. and Stem contain plumbagin, Droserone, zeylanone, isozeylanone, sitosterol, stigmasterol, campesterol, and dihydroflavinol-plumbaginol.

The present review aimed to compile up to date and comprehensive information of Plumbago zeylanica with special emphasis on its pharmacological activities.

**Pharmacological activities:**

**Antimicrobial activity**

Antifungal potential of Plumbago *zeylanica* L was studied by Jain et al (18) against four pathogenic fungal species *Fusarium oxysporum, Rhizoctonia solanii, Alternaria* sp. and *Sclerotium rolfsii*. Result indicated excellent inhibitory activities against *Alternaria* spp. whereas least against *S. rolfsii* at 62.5 µg/ml. Similarly, Ogunleye and co-workers (19) evaluated the antibacterial activity of the ethanoic extract of *Plumbago zeylanica* L. root bark against seven bacteria extracted from two dumpsites within the city of Akure. Results revealed, antibacterial activity of the extract enhances with increasing concentration. Shweta and Dubey studied antimicrobial properties of the leaves extracts of the plant against some known drugs. The in-vitro antimicrobial activity and the minimum inhibitory concentration (MIC) of the crude extract and the standard antibiotics were studied. Maximum inhibition was reported with leaves extracts as compared to the standard antibiotics (20). In another study Singh and colleagues examined methanolic extracts of the stem and the leaves against six bacterial species and nine fungal species for antimicrobial studies. Leaves extract indicated maximum antimicrobial activity against both *Staphylococcus aureus* and *Fusarium oxysporum* whereas the stem extract was noted to be more antimicrobial against the *Pseudomonas aeruginosa* and the *Penicillium expansum* species. Results indicated that the methanolic extract of *Plumbago zeylanica* L. stem possess significant antibacterial activity (21).

**Abortifacient & Antifertility Activity**

PZ plant studied for its abortifacient and antifertility activity. Azad Chowdhury et al (22) and Edwin et al ((23) investigated that the acetone and ethanol extracts of PZ were most effective to interrupt the estrous cycle and exhibited a prolonged diestrous stage of the estrous cycle resulting to a temporary inhibition of ovulation. Also in human, PZ acts as family planning agents ((24,25). and anti-implantation agents that appear to interfere with progesterone synthesis or utilization. (26,27).

**Antiviral activity:**

Antiviral activities of the 80% methanolic extracts of Plumbago zeylanica have been examined against coxsackievirus B3 (CVB3), influenza A virus and herpes simplex virus type1 Kupka (HSV-1) using cytopathic effect (CPE) inhibitory assays in HeLa, MDCK, and GMK cells, respectively. The antiviral activity of the most active compound was confirmed with plaque reduction assays. In addition, CVB3 was inhibited by the extracts of Plumbago zeylanica (28)

**Anti-allergic activity:**

Dai et al (29) reported that 70% ethanol extract from Plumbago zeylanica stems (EPZ) dose-dependently inhibited systemic anaphylactic shock induced by compound 48/80 in mice, reduced homologous passive cutaneous anaphylaxis and skin reactions induced by histamine or serotonin in rats. EPZ (50 μg/ml) markedly increased intracellular cAMP content of rat mast cells. These findings demonstrate that EPZ inhibits mast cell-dependent immediate allergic reactions, which is probably mediated by reducing the release of mediators such as histamine from mast cells via elevating intracellular cAMP level and weakening the inflammatory action of mediators

**Antimalarial Activity**

Plumbago zeylanica root has been used for a potential of antiplasmodial properties and to treat fever or malaria. (30,31) The study was examined in vitro for antiplasmodial properties against Plasmodium falciparum. Malaria is normally transmitted to people by mosquitoes infected with the malaria parasite. Avoiding the bites of Anopheles mosquitoes is the best way to prevent Malaria. On the other hand, the highest Larvicidal potential was found in methanol extracts of PZ roots against Anopheles aegypti and A. stephensi. (32,33) The hexane and chloroform extracts of PZ also found to have highest larvicidal activity against Anopheles gambiae (34).

**Toxicity studies**

Teshome et al. (35) conducted toxicity studies on dermal application of plant extract of P. zeylanica used in Ethiopian traditional medicine. Repeated dose toxicity test was associated with increased relative testis weight ($P < 0.05$) as well as higher values for blood urea nitrogen and K+ ($P < 0.05$) in both sexes with the highest dose (1000 mg/kg) group, although histopathological analyses failed to lend support to these observations. Taken together, the dermatotoxicity test results from this study suggest that P. zeylanica toxic effects might be limited to effects like moderate irritation.

. Anti-inflammatory Activity Chen et al, (36) reported that plumbagin modulates COX-2, MMP-9 and suppress NF-κB activation and gene expression in the peripheral blood mononuclear cell and this arrest cell cycle progression so P. zeylanica extract containing saberosin which exhibit anti-inflammatory activity. Vishnu anta et al, (37) also reported the hydro alcoholic extract of P. zeylanica leaf showed anti-inflammatory activity. Sheeja et al, (38) and Dang et al, (39). showed that P. zeylanica reduces the oedema thus comforting the body part, it was also investigated to suppress the NF-kB activation in the tumour cells and for prevention of graft versus host disease (40). Arunachala et al, (41) revealed the anti-inflammatory effect of P. zeylanica in carrageenin induced raw paw oedema in rats. In the investigation, four groups were taken where two groups were treated with 300mg/kg and 500mg/kg which confirm the 31.03% and 60.30% acute inflammation inhibition.

**Antiplasmodial activity**

In-vitro screening of Indian medicinal plants for antiplasmodial properties against Plasmodium falciparum. of 80 analyzed ethanol extracts, from 47 species, significant effects were by Simonsen et al. (2001) and found for 31 of the extracts one of that was P. zeylanica. activity. (42)

**Hypocholesterolemic activity**

Sharma et al., (1991) plumbagin isolated from the roots of PZ and introduced in the hyplipidemic rabbits which reduces serum cholesterol and LDL- Cholesterol by 53 to 86% and 61 to 91% respectively. Plumbagin prevents the accumulation of cholesterol and triglycerides in liver and aorta. (43)

**Central nervous system activity**

A study reported that hydro-alcoholic leaf extract of P. zeylanica were evaluated for its CNS activity and it was found that the extract showed significant CNS depressant activity with the muscle relaxant properties (44). Vishnukanta et al., also investigated the anti-convulsant activity of hydro-alcoholic leaf extract of P. zeylanica and results showed that it did not possess the anti-convulsant activity (45)

**Wound healing activity**

Wound healing activity of methanolic extract of P. zeylanica root reported in wistar albino rats (46) A study investigated the wound healing activity of ethanoic root extract of P. zeylanica in wistar rats and found that the activity is due to the presence of phytochemicals such as terpenoids, alkaloids, flavonoids, saponins etc. and these compounds are responsible for the wound healing activity of the plant (47). Another study reported the evidence of oxidative stress in pathogenesis of non-healing ulcers. As the wound healing mainly depends on low level of oxidant so the antioxidant nature of the plant extract obtained from P. zeylanica helps in controlling the wound oxidative stress thus accelerating wound healing (48).

**Conclusion**

Plumbago zeylanica is being used for centuries in Ayurveda system of medicine to increase longitivity and vitality. It is the most important medicinal plant is which extensively used in herbal formulations. It is chemically rich with its diverse content of active compounds, such as plumbazin, chitranone, zeylanone and many useful naphthaquinone constituents of multipurpose medicinal agent. From the above reviewed work, it is evident that plant Plumbago zeylanica L. has great potential to be integrated into conventional medical practice for the treatment and management of various kind of diseases. Presence of wide number of biologically active phytochemicals and its pharmacological activities indicates its future perspective in pharmaceutical industry to bring out new innovations in the field of medicine.

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