



## Pharmacological Properties of Ethno-Medicinal Plant: *Plumbago zeylanica*

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**ABSTRACT:** The world's tropical and subtropical climates are home to the shrub known as *Plumbago zeylanica* L., sometimes referred to as Doctorbush. The literature demonstrates its extensive use in traditional systems of medicine for treating a range of ailments, including anti-inflammatory, anti-malarial, anti-fertility, anti-microbial, antioxidant, blood coagulation, wound healing, memory enhancer, and anti-cancer effects. Numerous bioactive substances found in the plant, including elliptinone, zeylanone, sistosterol, and plumbagin, have been linked to the plant's therapeutic applications. The goal of this review is to provide thorough information, including taxonomical description, phytochemistry, pharmacological characteristics, and traditional usage.

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**Keywords:** *Plumbago zeylanica*, plumbagin, bioactive compound, cancer, therapeutic uses.

### INTRODUCTION

Throughout history, researchers have found that plants are a rich source of ideas for innovative medicinal molecules. Ayurveda is a natural medicine used in India that has been around for thousands of years and has been shown effective in treating a wide variety of diseases. The main classics that provide a full account of more than 700 different plants are called Atharveda (about 1200 BC), Charak Samhita (1000-5000 BC), and Sushrut Samhita (1000-5000 BC). There are around 45,000 different plant species in India. The World Health Organization (WHO) estimates that around 80 percent of the world's population relies on traditional herbal medicine as their major source of medical care.

*Plumbago zeylanica* L., which has the chromosome number  $2n=24$ , is a member of the family Plumbaginaceae and is used as a medicinal herb. The *P. zeylanica* plant is utilised more frequently than any other plant in the ancient medical practises of India. The species was originally found in South Asia, but it has since spread throughout the majority of the world's tropical and subtropical regions. It may be found growing in deciduous woods, savannas, and scrub lands at any elevation from sea level to 2,000 metres. 1-3 In cases of dysentery, a laxative, expectorant, astringent, and abortifacient are some of the uses for the root. An antiperiodic agent is made from a tincture of root bark. Scabies can be treated with the

leaves because of their caustic nature. *Plumbago* is characterised chemically by the presence of naphthoquinones, flavonoids, terpenoids, and steroids, all of which are responsible for a variety of biodynamic activities. *Plumbago* is a member of the genus *Plumbago*. *Plumbago zeylanica* is most often known by its common name, lead wort. In various regions of the world, people refer to this plant by a plethora of different names. The word "Chitrak" is what most people in India call it.

### *Plumbago zeylanica*

There are 280 different species and 10 different genera that make up the family Plumbaginaceae. *Plumbago zeylanica* is a natural plant that can be found in several parts of India; however, due to its medicinal properties, it is also cultivated and several uses in the field of therapy. Chitthra mulam is a common name for this substance, which has a place in traditional indigenous medical practises.

Classification

Kingdom: Plantae

Order: Caryophyllales

Family: Plumbaginaceae

Genus: *Plumbago*

Species: *zeylanica*

### MORPHOLOGICAL OF PLUMBAGO ZEYLANICA

A sub-scandent, rambling perennial herb or under shrub that has green branches for its habit.

**Roots** at least 30 centimetres in length, at least 6 millimetres in diameter, robust, cylindrical, friable, blackish red in colour, light yellow in colour when fresh, reddish brown when dry, straight, unbranched, or slightly branched with or without secondary roots, with homogeneous and smooth texture. It has a distinctive smell and a taste that is sharp and astringent.

**Stems** are somewhat woody, spreading, terate, striate, and glabrous in appearance. It can grow as tall as 0.5–2 metres (1.6–6.6 feet) in height (Figure 1A). The bark is quite thin and has a brown hue.

**The leaf** is simple, alternate, about 8 centimetres long and 3 centimetres broad, ovate or oblong, and the petiole is short, amplexicaul at the base, and it frequently dilates into auricles that resemble stipules.

**Inflorescence** is of the terminal raceme type and ranges in length from 6 to 30 centimetres. There are many flowers.

**Flower** white in colour, 10–25 centimetres long, odourless, inbracteate, axillary and terminal elongated spikes, and bisexual in nature are the characteristics of the flowers. A calyx that is thickly coated with stalked glands that are sticky. The corolla is white, extremely slender and tubular, and there are five stamens that are not joined together. The ovary is superior, 5-gonous, and contains a single cell with a single basal ovule.

**Fruit:** Oblong (7.5–8 mm long) five-furrowed capsule containing single seed. Each seed is oblong in structure, 5–6 mm long and reddish-brown to dark brown in colour.

#### PHYTOCHEMISTRY

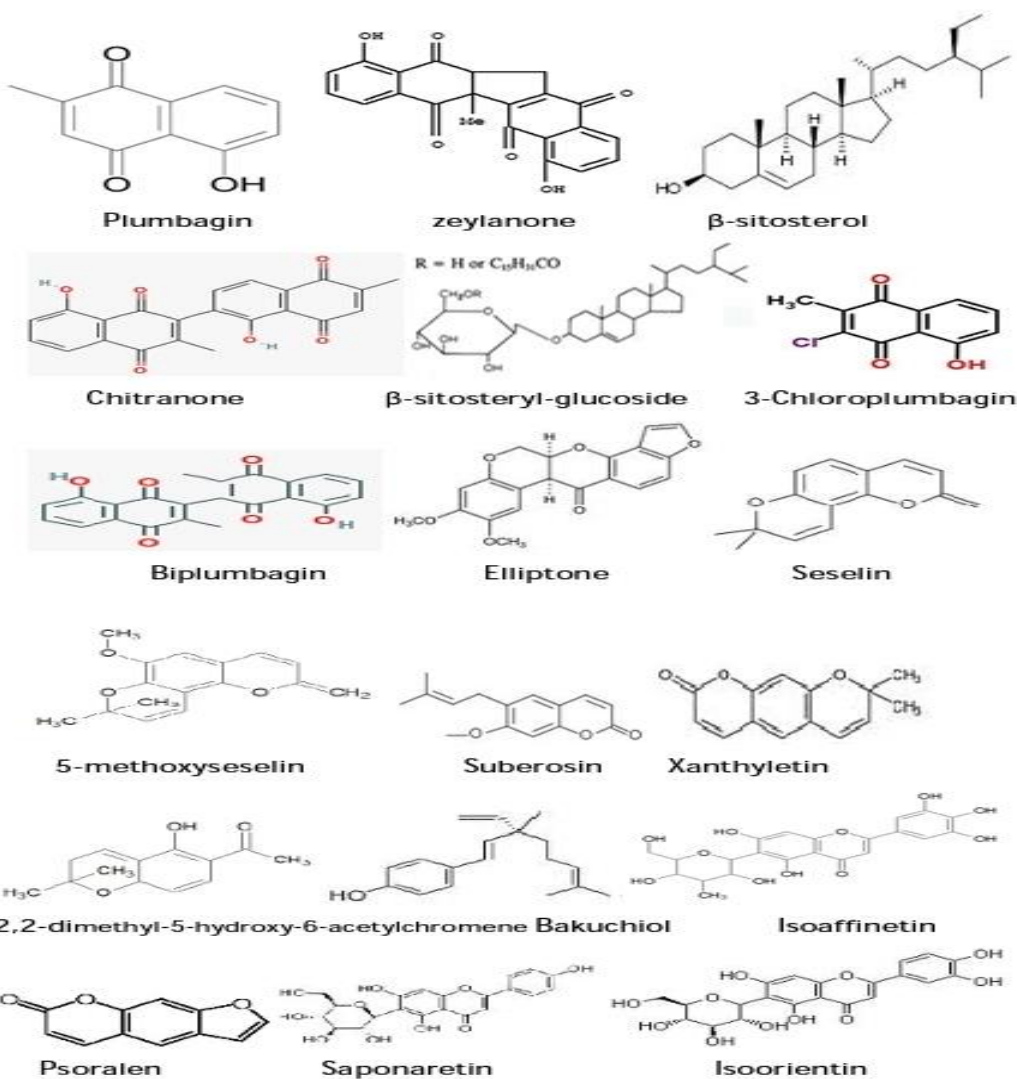
**Stem** contain plumbagin, zeylanone, isozeylanone, sitosterol, stigmasterol, campesterol, and dihydroflavinol-plumbaginol.

**Leaves:** Leaves contain plumbagin, chitanone.

**Flower:** Flowers contain plumbagin, zeylanone, and glucose.

**Fruit:** It has sitosterol, glucopyranoside, and plumbagin.

**Seeds:** Plumbagin is present in seeds.



**Roots:** Plumbagin is present in the root bark of *P. zeylanica*. The root produces new pigments such as 3-chloroplumbagin, 3-biplumbagin, 3- and 6-biplumbagin, binaphthoquinone, and four other pigments such as isozeylanone, zeylanone, elliptinone, and droserone 2, 3. From the phenolic portion of the light petrol extract of the roots, plumbagin, droserone, isoshinanolone, and a novel naphthalenone, 1, 2 (3)-tetrahydro-3, 3'-plumbagin, were isolated. Five naphthaquinones (plumbagin, chitranone, maritnone, elliptinone, and isoshinanolone) and five coumarins (seselin, methoxyseselin, suberosine, xanthyletin, and xanthoxyletin) were also isolated from the roots together with two plumbagic acid glucosides, 3'-o-beta-glucopyranos.

### PHARMACOTHERAPEUTIC ACTIVITIES

Numerous therapeutic qualities of the plant *P. zeylanica* are classified as anti-inflammatory activity.

**Anti-inflammatory:** One of the most significant medicinal plants for treating anti-inflammatory illnesses is the plumbago species. The anti-inflammatory properties of *P. zeylanica* root extract with methanol were investigated. The methanolic extracts at 300 and 500 mg/kg provided 31.03 and 60.3% reduction of acute inflammation, respectively, in raw paw oedema caused by carrageenin, demonstrating the anti-acute-inflammatory properties of *P. zeylanica* roots. Ethiopians use the powdered bark, root, or leaf to treat tuberculosis, gonorrhoea, and syphilis. The roots are used by the Zambians to treat chest, throat, and mouth discomfort by boiling them in milk. Using in vivo experimental models, Sheeja et al. investigated the anti-inflammatory effects of several *P. zeylanica* leaf extracts. When compared to the control group, the acetone extract significantly ( $p < 0.01$ ) reduced inflammation in the carrageenan-induced rats. Yedapo tested the *P. zeylanica* roots' phosphate buffered saline extract for anti-inflammatory properties. The plant's anti-inflammatory qualities have been exploited. 7,8 Two models of acute inflammation were examined using three medicinal plants: *Phyllanthus emblica*, *P. zeylanica*, and *Cyperus rotundus*. The results showed that *P. zeylanica* reduced oedema, whereas *P. emblica* combined with aspirin reduced inflammation. Additionally, *P. zeylanica* reduced the activation of NF-kappa B in tumour cells and stopped the death of mice caused by Graft Versus Host Disease.

**Wound healing activity:** *Plumbago zeylanica* was examined by Devender Rao Kodati et al.<sup>12</sup> and Reddy et al. for its ability to promote wound healing in rats. It was discovered that a methanolic root extract of *Plumbago zeylanica* possessed significant wound healing potential.

**Antidiabetic activity:** Olagunju et al.<sup>13</sup> examine the antihyperglycemic impact that *P. zeylanica* has on rats who have been manipulated to develop diabetes. In diabetic rats that had been treated with streptozotocin, Zarmouh et al.<sup>14</sup> found that oral administration of ethanolic root extract of *P. zeylanica* (100 mg, 200 mg/kg/p.o), tolbutamide (250 mg/kg/p.o) increased the activity of hexokinase and decreased the activity of glucose-6-phosphatase ( $P < 0.001$ ) respectively. The antidiabetic properties of plumbagin, which was extracted from the root of *P. zeylanica*, and its effect on GLUT4 translocation in STZ-induced diabetic rats were also investigated by Christudas Sunil and colleagues.

**Memory-inducing activity:** The impact of *P. zeylanica* roots on scopolamine-induced amnesia for learning and memory in mice was observed by Mittal et al. 16 in their study. The memory-improving effects of the chloroform extract of the plant at a concentration of 200 mg/kg have been proven to be promising in mice. The amnesia brought on by scopolamine (0.4 mg/kg intraperitoneally) was significantly reversed by the extract.

**Blood coagulation activity:** The active principal ingredient of *Plumbago zeylanica* has a structure that is quite comparable to that of vitamin K. After one day, 15 days, and 31 days of treatment, the effect of the *P. zeylanica* extract (2 mg/kg body weight) and naphthoquinone (2 mg/kg body weight) given to individual groups was evaluated for its impact on bleeding time (BT), clotting time (CT), prothrombin time (PT), platelet count, and platelet adhesion in albino rats. *Plumbago zeylanica* and naphthaquinone treatment resulted in a considerable reduction in platelet adhesion in the animals tested, although there was no change noticed in either the treated groups or the control group.

**Anti-malarial activity:** Mosquitoes that are infected with the malaria parasite are the vectors that typically spread the disease from person to person. The best strategy to prevent malaria is to avoid getting bitten by mosquitoes of the *Anopheles* species. Since the beginning of time, people in India have been using various plants to treat malaria and other fevers caused by the disease. *Plumbago* species have been examined for their potential to kill mosquito larvae. Hexane ( $LC_{50} = 6.4$  g/mL) and chloroform ( $LC_{50} = 6.7$  g/mL) extracts are the crude extracts that have shown the strongest larvicidal efficacy against *Anopheles gambiae*. 18 Patil et al. evaluated the larvicidal activity of extracts of *P. zeylanica* and *C. nocturnum* against second, third, and fourth instar larvae of *Aedes aegypti*.

**Allergic and modulatory effects:** Plumbagin, which comes from *P. zeylanica*, has been shown to influence cellular proliferation as well as carcinogenesis and radioresistance. The activation of the transcription factor NF-kappa B activation

pathway ought to be responsible for the regulation of all of these reactions. The activation of NF-kappa B that is caused by TNF, as well as other carcinogenic and inflammatory stimuli like phorbol myristate acetate, can be inhibited by plumbagins. The ability of plumbagin derived from *P. zeylanica* to modulate peritoneal macrophages of BALBC mice was investigated in this study. Antibactericidal action, specifically directed towards staphylococcus aureus, is one of the roles of macrophages. According to a recent study, plumbagin increases the antibacterial activity of macrophages at lower doses but has the opposite effect at greater ones.

**Central nervous system activity:** The effects of a 50% ethanol extract of the root of *P. zeylanica* on the locomotor behaviour and central dopaminergic activity of rats were studied by Bopaiah et al. The extract produced a noticeable and considerable increase in the animals' natural motility. The stereotypical behaviour that occurs as a result of exposure to a dopamine agonist exhibited biphasic effects. They observed that the extract of the root of *P. zeylanica* selectively improved the spontaneous ambulatory movement without producing any stereotypical behaviours. *Plumbago zeylanica* leaf hydroalcoholic extract was tested for its effects on the central nervous system by Vishnukanta and Rana AC. They reported that the extract had strong CNS depressive effect, in addition to having characteristics that relax the muscles. Additionally, it was found to have anxiolytic properties.

**Anti cancer activity:** It has been discovered that the plant *Plumbago zeylanica* demonstrates anti-cancer action against a number of different cancer cell lines. There are a great number of studies that demonstrate the effectiveness of the plant *Plumbago zeylanica* as an anti-cancer agent. In an animal model of Ehrlich ascites carcinoma, preliminary phytochemical screening and anticancer evaluation of *Plumbago zeylanica* L. were carried out by Sachin Hiradeve et al. They discovered that the ethanolic extract of *Plumbago zeylanica* L. possessed considerable

anticancer action, and it also reduced the elevated level of lipid peroxidation. This was possible due to the higher presence of terpenoids and flavonoids in the extract.

## CONCLUSION

This article provides a concise overview of the historical and folkloric uses, as well as the pharmacological and therapeutic benefits, of the plant *Plumbago zeylanica* L. This is an effort to aggregate and document information on various aspects of *P. zeylanica*, as well as to bring attention to the necessity of further research and development. It is clear from the analysis of the research that *P. zeylanica* has been utilised for the treatment of a wide variety of diseases in Ayurvedic medicine for hundreds of years. It is often considered to be the most important therapeutic plant that may be found in herbal preparations. It has a broad content of active chemicals, such as plumbagin, chitranone, and zeylanone, as well as several beneficial naphthaquinone elements that can be used as multi-purpose medicinal agents. This gives it a chemically rich composition. The evidence that was presented in this review demonstrated that *Plumbago zeylanica* L. has a significant potential to be incorporated into conventional medical practise for the purpose of the treatment and management of a variety of metabolic syndromes, hepatotoxic, diabetes, inflammation, cancer, and other disease complications. It is anticipated that this review will provide some useful information that may be applied to the ongoing investigations of this unique species and the phytochemicals that it contains. Future research on *P. zeylanica* would not only provide much needed knowledge on this popular herbal medicine, but it would also offer a noticeable socioeconomic impact in the form of turning a common weed into beneficial nutraceutical and pharmaceutical products. This is because future research on *P. zeylanica* would provide knowledge on this popular herbal medicine.

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