

Neelakoduvveli (*Plumbago auriculata*): A Garden Gem with Medicinal Secrets

***Asha Elizabeth Jose¹ and B Ganesh Kumar²**

¹Young Professional II, ICAR-NAARM, Hyderabad, India

²Principal Scientist, ICAR-NAARM, Hyderabad, India

***Corresponding Author's email: asha.elizabethjose@gmail.com**

If you've ever wandered through a sunlit garden and paused to admire a cluster of delicate, sky-blue blossoms swaying gently in the breeze, chances are you've encountered *Neelakoduvveli*, the charming *Plumbago auriculata*. Known to the world as Cape Leadwort or Blue Plumbago, this hardy climber is more than just a pretty face in the garden. Beneath its serene blue petals lies a fascinating story of resilience, beauty, and powerful medicinal potential.

Belonging to the *Plumbaginaceae* family, popularly called the leadwort family, this group of about 24 genera and nearly 400 species thrives in warm tropical regions across the globe. The family, rich in herbs and shrubs often found in saline habitats, is known for its unique secretory glands and the remarkable bioactive compound plumbagin, which has drawn the attention of both traditional healers and modern scientists.

Among its relatives, three species of *Plumbago* stand out for their widespread use and study namely, *P. rosea* (syn. *P. indica*), *P. zeylanica*, and *P. auriculata*. Of these, *Plumbago auriculata* captures hearts not just for its ornamental appeal but also for its medicinal virtues. Native to South Africa, this semi-woody climber thrives effortlessly in warm, humid climates, demanding little yet giving plenty, an enduring favorite among gardeners and herbalists alike.

Species name	Common name	Locality	Description	Traditional use	Pharmacological use
 <i>Plumbago auriculata</i>	Cape leadwort, Cape Plumbago, Blue Plumbago (Neelakoduvveli)	South Africa, Africa, America, Asia, India	Bushy perennial evergreen shrub, trusses of pale blue and white flowers, leaves have minute dots and persistent hairy calyx.	Used for warts, fractures, oedema, headaches, skin lesions, piles, rheumatism, diarrhoea and malaria.	Antimicrobial, antiulcer, antimalarial, antifungal, anticancer.
 <i>Plumbago rosea</i> L. (syn. <i>indica</i> L.)	Scarlet leadwort (Lal Chitrak)	Asia, Africa, India, Indonesia, Phillippines	Perennial herbaceous plants with erect half woody stems and red flowers.	Used to treat gastric acidity, skin disease, constipation, haemorrhoids, rheumatoid arthritis, paralysis	Anticancer, antiinflammatory, antiatherogenic



Plumbago zeylanica L.

Ceylon leadwort,
White leadwort

Africa,
Asia,
Australia,
Ethiopia,
India,
China

Herbaceous
shrubby
plants with
climbing or
erect stems,
petiolate
leaves and
white
flowers.

Used to treat
anemia,
bronchitis,
rheumatism,
skin disorders,
internal and
external
trauma, toxic
swelling,
ulcers.

Antibacterial,
antimalarial,
antiplasmodial,
antiinflammatory,
antiatherosclerotic,
antidiabetic,
hypolipidaemic,
antifungal.

Classification of *Plumbago auriculata*

- Kingdom: Plantae
- Division: Magnoliophyta
- Class: Magnoliopsida
- Order: Caryophyllales
- Genus: Plumbago
- Species: *Plumbago auriculata* Lam.

Plumbago auriculata is a bushy evergreen shrub that can grow up to 3 meters tall. It has stems that can climb or trail, with smooth lower parts and fuzzy upper parts. The leaves are thin, with tiny spots and winged stems at the base. These spots are salt glands. The plant has terminal inflorescences with corollas that vary in colour from deep blue to white within the same inflorescence.



Inflorescence of *Plumbago auriculata*

Ornamental Uses

The striking aesthetics of *Plumbago auriculata* make it a popular choice for various landscaping purposes:



Hedges and Borders: When pruned, it serves as a dense hedge or border plant.



Climbers: Trained on trellises or walls, it creates an eye-catching vertical display.



Pollinator Attractant: Its flowers attract bees, butterflies, and other beneficial pollinators



Low Maintenance Landscaping: Farmers and rural households can use it for beautification without the need for intensive care, conserving resources.

Secretory structures

Secretory structures in the plant, such as trichomes, resin ducts, and salt glands, are found in various parts of the plant. These structures primarily function in defense against herbivores and pathogens, producing specialized metabolites. Salt glands help in regulating salt concentration in plant tissue by secreting a wide variety of ions like sodium, potassium, calcium and magnesium, which contribute to metal tolerance in plants.

Glandular and non-glandular hairs known as trichomes, are found on the calyx. Trichomes are epidermal appendages that can be unicellular or multicellular, found on plant surfaces. They play key roles in light reflectance, water loss reduction, thermoregulation, defense against herbivores, pathogens, and radiation. Glandular trichomes such as capitate and peltate types, being the primary secretory structures on aerial plant parts, secreting essential oils and polysaccharides. Trichomes on calyx secrete a resinous, hydrophobic substance that repels crawling insects, promoting cross-pollination by flying insects.



Trichomes on calyx of
Plumbago auriculata



Salt glands on leaves of
P. auriculata

Plumbagin

The genus *Plumbago* contains the potent compound plumbagin, a 5-hydroxy-2-methyl-1,4-naphthoquinone ($C_{11}H_8O_3$) found in the roots, stems, and leaves, with the highest concentration in the roots. Plumbagin has a wide range of therapeutic properties, including anticancer, antifungal, anti-inflammatory, antibacterial, and antidiabetic effects, along with stimulant actions on the intestine, nervous system, and heart, and pain relief for rheumatic conditions.

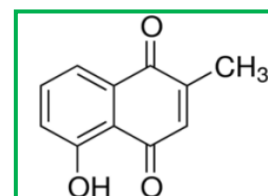


Fig: Plumbagin

Plumbagin displays anticancer activities over a wide range of tumors such as breast cancer, ovarian cancer, prostate cancer, pancreatic cancer, lung cancer, skin cancer, leukemia, liver cancer, renal cancer, cervical cancer (Padhye et al., 2010). *P. auriculata* leaves were dried and extracted with methanol, which was tested on ovarian, lung, and cancer cell lines for its ability to kill or stop the growth of cells. The analysis showed that the compound sitosterol was present in the extract, and it showed good anticancer activity at low concentrations (10-40 µg). The study confirmed that *P. auriculata* contains new anticancer compounds (Lakshmanan et al., 2016).

Plumbagin has been shown to inhibit topoisomerase-II, an enzyme involved in rheumatoid arthritis (Jackson et al., 2008). Orally administered plumbagin was reported to significantly lower blood glucose levels (glucose-6-phosphatase and fructose-1,6-bisphosphatase) and normalize other biochemical parameters.

Sumsakul et al. (2014) found that plumbagin has antimalarial effects in both lab tests and a mouse model, showing effectiveness and low toxicity at doses up to 100 mg/kg for short-term use and 25 mg/kg for longer use. In Mozambique, where malaria is endemic, the aerial parts of *P. auriculata* are used to treat malaria symptoms like vomiting and fever (Ramalheite et al., 2008).

In Manchale, a rural village in India, herbal healers use the plant's root to treat piles by making a paste with water and applying it directly (Poornima et al., 2012). Some Indian tribes also prepare a root extract by soaking fresh roots in rainwater and consuming it for a week to treat acidity (Jain et al., 2010). Roots and leaves are used to treat warts, fractures, oedema, headaches, skin lesions, and diarrhoea. Root extracts of *P. auriculata* are used to treat diarrhea in cows (Dold and Cocks, 2001).

Plumbago roots were dried, powdered, soaked in limewater, and extracted with ethanol (Ittiyavirah and Paul, 2016). The ethanolic root extract was tested for antiulcer activity using goat intestines, and the study found that *P. auriculata* exhibited strong acid-neutralizing abilities and excellent antioxidant properties, as shown by the DPPH assay.

Plumbago is toxic because it produces reactive oxygen that can damage biomolecules (Jose et al., 2014). In low doses, it irritates and inhibits cell division, and in higher doses, it can cause death from respiratory failure, paralysis, and cell damage. Common side effects of plumbagin include skin rashes, diarrhea, increased white blood cells and liver toxicity. In India, tribes use roasted roots in small amounts for wound healing, as large quantities or prolonged use can be deadly (Jain et al., 2010). *P. auriculata* is classified as toxicity class 4, meaning its sap or thorns can cause skin irritation (Stone and King, 1997).

References

1. Dold, A.P. and Cocks, M.L. (2001). Traditional veterinary medicine in the Alice district of the Eastern Cape Province, South Africa. *South African Journal of Science* 97: 375-379
2. Ittiyavirah, S.P. and Paul, A.S. (2016). Gastroprotective effect of plumbagin and ethanolic extract of plumbaginales in experimentally-induced ulcer. *Journal of HerbMed Pharmacology* 5: 92-98.
3. Jain, D.L., Baheti, A.M., Jain, S.R. and, Khandelwal, K.R. (2010). Use of medicinal plants among tribes in Satpuda region of Dhule and Jalgaon districts of Maharashtra- An ethnobotanical survey. *Indian Journal of Traditional Knowledge* 9: 152- 157.
4. Jose, B., Dhanya, B.P., Silja, P.K., Krishnan, P.N. and, Satheeshkumar, K. (2014). *Plumbago rosea* L.- A Review on Tissue culture and pharmacological research. *International Journal of Pharmaceutical Sciences Review and Research* 25: 246-256.
5. Lakshmanan, G., Bupesh, G., Vignesh, A., Sathiyaseelan, A. and, Murugesan, K. (2016). Micropropagation and anticancer activity of methanolic extract of *Plumbago auriculata* Lam. *International Journal of Advanced Biotechnology and Research* 4: 2001-2011.
6. Poornima, G., Manasa, M., Rudrappa, D. and, Prashith, K.T.R. (2012). Medicinal Plants used by herbal healers in Narasipura and Manchale villages of Sagara Taluk, Karnataka, India. *Science, Technology and Arts Research Journal* 1: 12- 17.
7. Ramalhet, C., Lopez, D., Mulhovo. S., Rosario, V.E. and, Ferreira, M.J.U. (2008). Antimalarial activity of some plants traditionally used in Mozambique. *Workshop Plantas Medicinai s e Fitoterapeuticas nos Tropic os* 31: 1-9.
8. Stone, E. and, King, A. (1997). "Know your plants...safe or poisonous?". California Poison Control System. pp 1-11.
9. Sumsakul, W., Plengsuriyakarn, T., Chaijaroenkul, W., Viyanant, V., Karbwang, J. and, Na-Bangchang, K.1. (2014). Antimalarial activity of plumbagin in vitro and in animal models. *BMC Complimentary and Alternate Medicine* 12: 14-25.
10. The Plant List (2017). A working list of all plant species: *Plimbago*. Accessed on 2017/03/13. Available from site: <http://www.theplantlist.org/tpl1.1/search?q=Plumbago>.