

Alstonia scholaris (L.) R.Br. : A Comparative Review on Phytochemistry & Pharmacological Studies

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ABSTRACT

An evergreen tree that is frequently seen in Southeast Asia is *Alstoniascholaris*. This plant's bark is thought to have pharmacological properties in conventional medicine. This work aims to characterize the compounds found in bark extracts of *A. scholaris* and investigate their antibacterial activity. The bark was extracted utilizing a maceration technique with solvents such as hexane, benzene, methanol, and water. Our natural environs are home to a wide variety of plants, many of which have healing properties. These medicinal plants have been essential to human evolution. They are composed of substances that support and sustain life and encourage development. Medicinal plants are starting to play a bigger role in the world health care system. A tropical evergreen tree in the Apocynaceae family, *Alstoniascholaris* is also referred to as *saptaparna*, *dita bark*, and the *devil's tree*. Some parts of it have been shown to be effective in treating a wide range of illnesses, such as skin disorders, fever, rheumatism, dysentery, and malaria. They include a wide variety of phenolic chemicals, flavonoids, and alkaloids.

Keywords: *Alstoniascholaris*; Antioxidant activity; Antimicrobial activity; Cytotoxic activity

INTRODUCTION

Since herbal remedies have been utilized historically and are currently being studied scientifically, they are now an essential component of modern treatment. Natural compounds included in herbal treatments have the potential to both prevent and cure disease. Many herbs are used in Ayurveda medicine to address a range of ailments. A plant in the Apocynaceae family called *Alstoniascholaris* is also referred to as the *Dita Bark tree* or the *Devil's tree*. It is used to treat illnesses and ailments in humans in Ayurvedic, Unani, and Siddha/Tamil traditional medicine. Lowland and mountain rainforests in Queensland, Southern China, Asia-Pacific, and India are home to the plant's cultivation.¹

For their essential medical needs, many societies still rely on locally grown medicinal plants throughout the world.²Currently, plants used by traditional healers provide 25% of the pharmaceuticals on the market.³It is a fact that traditional medical systems are starting to raise serious international issues. Even in affluent nations where access to modern treatment is

widespread, people are still choosing complementary and alternative medicines, such as herbal remedies. Scientists have done extensive research on the medicinal potential of a select few plant species that yield therapeutic herbs. Safety and efficacy data are available for an even smaller number of herbs, their extracts, active ingredients, and the preparation containing them. Between 40 and 45,000 plant species with developmental potential are found in tropical and subtropical Africa; 5,000 of these species are used medicinally.⁴ Despite this enormous potential and diversity, there is still a paradox: just 83 of the 1100 classic medications have come from the African continent.⁴ African traditional medicine is currently valued less for its own sake and more for its capacity to yield other medicines. Research projects and the ensuing commercial applications have frequently depended on community data and haven't always profited greatly from the study's findings.⁵ In Africa, millions of people rely on traditional healers and plant-based treatments for their well-being. It's interesting to compare the general population of African nations with traditional healers and university-educated medical professionals. For example, there are 224 people for every traditional healer in Ghana's Kwahu district, but approximately 21,000 people for every doctor with a university degree.⁵ Research on medicinal plants, including *Alstonia boonei*, has generally concentrated on taxonomy, pharmacology, ethnobotany, and the bioactivity of its chemical ingredients. Microbes are crucial human pathogen microorganisms that can cause illness and even death. Antimicrobial agents were among the most significant medical discoveries of the 20th century. But just five decades into the "antibiotic era," humanity is currently confronted with the worldwide issue of growing resistance in almost all infections.⁶ Antivirals, antimycotics, and practically all antibiotic classes have developed resistance.⁷ This is concerning because, in 1990, it was estimated that infectious and parasitic diseases were responsible for 9.2 million of the 39.5 million deaths that took place in developing countries; additionally, infectious diseases accounted for 98% of all child deaths in developing countries.⁸ Due to overuse and indiscriminate use, antibiotics are now widely used.⁶ About one-third of the 150 million written prescriptions for antibiotics each year are deemed irrelevant in human medicine alone, as per the US Centers for Disease Control & Prevention. Identifying suitable remedies related to medication resistance is crucial.⁹ Drug-resistant bacteria that cause diseases in humans require the development of new antimicrobial medicines. In addition, natural, preservative-free, microbiologically safe foods and cosmetics are still in high demand among consumers.¹⁰⁻¹⁴ For almost 60 years, researchers have examined the antibacterial qualities of extracts derived from natural sources. Since pathogenic bacteria are becoming more resistant to the antimicrobial medications already in use and other anti-infectives are toxic or cause unfavorable human reactions, interest in their antimicrobial properties has grown over the past 20–25 years.¹⁵ The antibacterial extracts work by lysing or disrupting the outer membrane of microorganisms. Others result in pore development and leakage or interact with certain internal targets.¹⁶ Undiscovered biodynamic chemicals with untapped medical potential can be found in the intricate chemical stores of plants.¹⁷⁻²¹ Natural compounds found in plants have long been known to possess antibacterial, antiviral, and antifungal properties.²²

Taxonomical Position²³

Local name: Saptaparni

Botanical name: *Alstoniascholaris*

Kingdom: Plantae

Family: Apocynaceae

Subkingdom: Viridiplantae

Division: Tracheophyta

Class: Magnoliopsida

Order: Gentianales

Family: Apocynaceae

Genus: *Alstonia*

Species: *Scholaris*

Tribe: Plumeriae

Subtribe: Alstoniiae

COMMON NAMES

English: Devil's tree, blackboard tree, dita bark, birrba, white cheese wood, milkwood pine, milkwood, and milky pine

Hindi: saitan-ki-jhad, chatian, satni, satwin

Malay: Pulai, pulailinlin,

Nepali: Chhataun, chhatiwan,

Gujarati: Satuparni

Bengali: Chattin, satiani, chatium

Burmese: Lettok

Botanical Description²⁴⁻²⁶

The large, evergreen *Alstoniascholaris* tree can reach a height of 6 to 10 meters. (Figure 1)



Figure1: *Alstoniascholaris* tree

Bark:When damaged, the rough bark releases a bitter latex that is yellowish in color and has an interior color ranging from gray to whitish. (fig.2&3)



Figure2: *Alstoniascholaris* bark



Figure3: *Alstoniascholaris* bark

Leaves:The obovate to oblanceolate, thick, dark green leaves are grouped in whorls and have entire, rounded, or bluntly acuminate petioles that are 6–12 mm long and narrow at the base. (fig.4)



Figure4: *Alstoniascholaris* leaves

Flowers: Small, umbellate-branched flowers that are greenish-white in color. Their lobes are 7–10 mm long, hairy tubes, and either sparsely or densely pubescent. Their left margins overlap and are strongly scented. In India, the months of December through March are when flowers bloom. (fig.5)



Figure:5 *Alstonia scholaris* flower

Fruit: The fruits are two linear, glabrous, 20–50 cm long, narrowly winged follicles attached to a single suture. The fruiting season in India runs from May–July. (fig,6)



Fig.6 *Alstonia scholaris* flower

Seeds: The flattened oval seeds measure 7-8 mm in length, with a tuft of brownish hair at each end.

PHYTOCHEMISTRY

Alkaloids, coumarins, flavonoids, leucoanthocyanins, reducing sugars, simple phenolics, steroids, saponins, and tannins are among the substances that are frequently found in *A. scholaris* plants. Cu, Zn, Fe, Ca, Cr, Mn, and Cd are among the eight elements found in leaf extract.²⁷ Four picrin-type monoterpenoids—indole alkaloids, 5 β methoxyaspidophylline, picrinine, picralinal, and 5-methoxystrictamine—are present in the ethanolic leaf extract. In contrast, the initial seco-uleine alkaloids are present in the methanolic leaf extract.²⁸ Two or three astonic acids A and B, secoferane triterpenoids, and N methoxymethyl picrine, an indole alkaloid, are present in the hydroalcoholic leaf extract.²⁹

Traditional and Local Uses

In India, Ayurveda, Siddha, and Unani medicine have all used various sections of *A. scholaris* to treat conditions like cancer, gastrointestinal disorders, jaundice, and malaria. *A. scholaris* bark has laxative, astringent, antipyretic, and cardiogenic properties. In addition, it is used to treat skin disorders, bronchitis, asthma, pruritis, and ulcers. For a very long time, leaves were used to treat dysentery, diarrhea, & malaria. Fruits are utilized to cure epilepsy as well as being tonic and anthelmintic.³⁰

PHARMACOLOGICAL ACTIVITY

Antimicrobial activity

According to ethnobotanical sources, skin conditions, stomachaches, and urinary tract infections were commonly treated with decoctions made from the leaves & stem barks of *Alstonia macrophylla*. The previously mentioned traditional claims are further supported by recent antibacterial research on this plant. The antimicrobial properties of *Alstonia macrophylla* have been studied less than those of *Alstonia scholaris*. The antimicrobial activity of crude extracts from the leaves and stem bark of *A. macrophylla* was evaluated against a range of bacteria, yeasts, and dermatophytic fungi that can cause urinary tract problems, skin conditions, and stomachaches. Sterols, triterpene, saponins, flavonoids, and other phytochemical elements of the stem and leaf extract were linked to the generally modest found antibacterial potential.³¹

Antibacterial activity

In a methanolic extract, it was found that the bark of *A. scholaris* demonstrated activity against two gram-positive and gram-negative bacteria, *Bacillus coagulans* and *Escherichia coli*.³²

Analgesic & anti-inflammatory activity

A number of in vivo studies have shown that the alkaloids found in *A. scholaris* leaves, such as picrinine, vallesamine, and scholaricine, have analgesic and anti-inflammatory properties. The three inflammatory mediators COX-1, COX-2, and 5-LOX were all inhibited by the alkaloids, according to in vitro experiments.³³

Antidiabetic and antihyperlipidemic activity

Glibenclamide and the ethanolic extract of *A. scholaris* were found to significantly increase body weight, muscle and liver glycogen, and antioxidant status while significantly lowering blood glucose, glycosylated hemoglobin, and lipid peroxidation. Pancreatic histopathology, however, demonstrated that the damage to pancreatic β -cells caused by streptozotocin did not heal.³⁴

Anti-arthritic and antioxidant activity

The ethanolic extract of *A. scholaris* effectively reduced arthritis, as evidenced by observable improvements in body weight, leukocyte infiltration, arthritis index, gastric lesion indices, and gastric juice output. Antioxidant enzymes like glutathione, glutathione peroxidase, and superoxide dismutase were found to be significantly elevated in the articular tissue, whereas lipid peroxidation and myeloperoxide levels were clearly decreased.³⁵

Anticancer activity

The bark extract of *A. Scholaris* has shown antitumor efficacy against radiation-induced biochemical alterations in rats by lowering cholesterol and lipid peroxidation. It has been observed that alcoholic extracts of *A. scholaris* lower both the overall frequencies of aberration in vivo and the total number of aberrant cells.³⁶

Antitubercular activity

It has been demonstrated that *A. scholaris* leaf, stem, and root bark methanolic extracts have anti-tubercular properties. The anti-mycobacterial activity demonstrated the extract from *A. scholaris*'s potential to treat tuberculosis.³⁷

Antifertility activity

It has been claimed that luteol acetate, which was separated from *A. scholaris*'s benzene extract, has antifertility properties.³⁸

Hepatoprotective activity

Hepatocytes' ability to function was successfully increased by *A. scholaris*'s methanolic stem bark extract, which also showed a notable decrease in biochemical markers like TP, TB, ALP, SGOT, & SGPT.³⁹

CONCLUSION

A particular kind of evergreen tree is *Alstoniascholaris*. Ancient medical systems employed a variety of plant parts to treat a broad range of ailments, such as asthma, as well as astringent, antibacterial, and antimicrobial conditions. The bulk of the plant's chemical makeup is composed of alkaloids, coumarins, flavonoids, leucoanthocyanins, reducing sugars, simple phenolics, steroids, saponins, and tannins. Furthermore, this plant has been extensively studied, revealing a wide range of pharmacological characteristics.

Reference

1. Khatale VL, More DB, A review on saptaparna, IAMJ, 4(3), 2016 March, 355-357.
2. N. Farnsworth, A. O. Akerele, A. S. Bingel, D. D. Soejarto, and Z. Guo, "Medicinal plants in therapy," Bulletin of the World Health Organization, vol. 63, no. 6, pp. 965–981, 1985.
3. G. Cragg and D. J. Newman, "Biodiversity: a continuing source of novel drug leads," Pure and Applied Chemistry, vol. 77, no. 1, pp. 7–24, 2005.
4. B.-E. Van Wyk, "A broad review of commercially important Southern African medicinal plants," Journal of Ethnopharmacology, vol. 119, no. 3, pp. 342–355, 2008.
5. E. Rukangira, "Overview on medicinal plants and traditional medicine in Africa," Qualitative Health Research, vol. 14, pp. 675–690, 2004.
6. Peterson LR, Dalhoff A. Towards targeted prescribing: will the cure for antimicrobial resistance be specific, directed therapy through improved diagnostic testing? The Journal of antimicrobial chemotherapy. 2004;53(6):902-5.
7. Eloff JN. On expressing the antibacterial activity of plant extracts - a small first step in applying scientific knowledge to rural primary health care. South African Journal of Science. 2000; 96:116-8.
8. Murray CJ, Lopez AD. Mortality by cause for eight regions of the world: Global Burden of Disease Study. Lancet (London, England). 1997;349(9061):1269-76.
9. Martini N, Eloff JN. The preliminary isolation of several antibacterial compounds from *Combretum erythrophyllum* (Combretaceae). Journal of ethnopharmacology. 1998;62(3):255-63.
10. Zink DL. The impact of consumer demands and trends on food processing. Emerging infectious diseases. 1997;3(4):467-9.
11. Wijesekera RBO. Plant derived medicines and their role in global health. The Medicinal Plant Industry. CRC Press 1991.

12. Marvdashti LM, Abdolshahi A, Hedayati S, Sharifi-Rad M, Iriti M, Salehi B, et al. Pullulan gum production from low-quality figsyrup using *Aureobasidium pullulans*. *Cellular and Molecular Biology*. 2018;64(8):22-6.
13. Salehi B, Sharopov F, Martorell M, Rajkovic J, Ademiluyi AO, Sharifi-Rad M, et al. Phytochemicals in *Helicobacter pylori* infections: What are we doing now? *International Journal of Molecular Sciences*. 2018;19(8).
14. Abdolshahi A, Naybandi-Atashi S, Heydari-Majd M, Salehi B, Kobarfard F, Ayatollahi SA, et al. Antibacterial activity of some Lamiaceae species against *Staphylococcus aureus* in yoghurt-based drink (Doogh). *Cellular and Molecular Biology*. 2018;64(8):71-7.
15. Sharifi-Rad M, Fokou PVT, Sharopov F, Martorell M, Ademiluyi AO, Rajkovic J, et al. Antiulcer agents: From plant extracts to phytochemicals in healing promotion. *Molecules*. 2018;23(7).
16. Huang X, Xie W, Gong Z. Characteristics and antifungal activity of a chitin binding protein from *Ginkgo biloba*. *FEBS letters*. 2000;478(1-2):123-6.
17. Plotkin MJ. Conservation, ethnobotany, and the search for new jungle medicines: pharmacognosy comes of age ... again. *Pharmacotherapy*. 1988;8(5):257-62.
18. Mishra AP, Sharifi-Rad M, Shariati MA, Mabkhot YN, Al-Showiman SS, Rauf A, et al. Bioactive compounds and health benefits of edible *Rumex* species-A review. *Cellular and Molecular Biology*. 2018;64(8):27-34.
19. Ayatollahi AM, Ghanadian M, Afsharypuor S, Mesaik MA, Abdalla OM, Shahlaei M, et al. Cycloartanes from *Euphorbia aellenii* Rech. f. and their antiproliferative activity. *Iranian Journal of Pharmaceutical Research*. 2011;10(1):105-12.
20. Ayatollahi SAM, Kobarfard F, Asgarpanah J, Choudhary MI. Antiglycation Activity of *Otostegia persica* (Burm.) Boiss. *African Journal of Biotechnology*. 2010;9(24):3645-8.
21. Choudhary MI, Hussain A, Adhikari A, Marasini BP, Sattar SA, Atia Tul W, et al. Anticancer and α -chymotrypsin inhibiting diterpenes and triterpenes from *Salvia leriifolia*. *Phytochemistry Letters*. 2013;6(1):139-43.
22. Sharifi-Rad J, Tayeboon GS, Niknam F, Sharifi-Rad M, Mohajeri M, Salehi B, et al. *Veronica persica* Poir. extract - antibacterial, antifungal and scolicidal activities, and inhibitory potential on acetylcholinesterase, tyrosinase, lipoxxygenase and xanthine oxidase. *Cellular and Molecular Biology*. 2018;64(8):50-6.
23. Abhijith D, *Alstoniascholaris* R.Br (Apocynaceae): Phytochemistry and Pharmacology: A concise review, *J Appl Pharm Sci*, 1(6), 2011, 51-7.

24. Meena AK, Nithika G, Jaspreet N, Meena RP, Rao MM, Review on ethanobotany, phytochemical and pharmacological profile on *Alstoniascholaris*, *Int Res J Pharm*, 3(4), 2001, 49-54.
25. Dey A, *Alstoniascholaris* R.Br. (Apocynaceae): Phytochemistry and pharmacology: A concise review, *JAPS*, 01 (06), 2011, 51-57.
26. Kaushik P, Kaushik D, Sharma N, Rana AC, *Alstoniascholaris*: It's Phytochemistry and pharmacology, *Chron young sci*, 2(2), 2011, 71-78.
27. Ye YQ, Wu N, Yang LJ, Nian X, Zhang DY, Gao YT, Speciation analysis of eight metal elements in the leaves of *Alstoniascholaris* by flame atomic adsorption spectrometry, *Guang Pu Xue Yu Guang Pu Fen Xi*, 29, 2009, 3416-9.
28. Cai XH, Liu YP, Feng T, Luo XD, Picrinine-type alkaloids from the leaves of *Alstoniascholaris*, *Chin J Nat Med*, 6, 2008, 20-2.
29. Wang F, FC Ren JK, Liu, Alstonic acids A and B, unusual 2, 3- secofernane triterpenoids from *Alstoniascholaris*. *Phytochemistry*, 70, 2009, 650-4.
30. Arulmozhi S, Mazumder PM, Narayan LS. Thakurdesai PA, In vitro antioxidant and free radical scavenging activity of fractions from *Alstoniascholaris* Linn R.Br, *Int J Pharm Tech Res*, 2, 2010, 18-25.
31. (Bhargava, 1983; Chakraborty and Vasudeva Rao, 1988; Dagar and Dagar, 1991).
32. Khan MR, Omoloso AD, Kihara M, Antibacterial activity of *Alstoniascholaris* and *Leea tetramera*, *Fitoterapia*, 74, 2003, 736-40.
33. Shang JH, Cai XH, Feng T, Zhao YL, Wang JK, Zhang LY, Yan M, Luxo XD, Pharmacological evaluation of *Alstoniascholaris*: Anti-inflammatory and analgesic effects, *J Ethnopharmacol*, 129, 2010, 174-81.
34. Bandawane D, Juvekar A, Juvekar M, Antidiabetic and Antihyperlipidemic Effect of *Alstoniascholaris* Linn Bark in Streptozotocin Induced Diabetic Rats, *Ind J Pharm Edu Res*, 45(2), 2011, 114-9.
35. Arulmozhi S, Mazumder PM, Sathiyarayanaran L, Ashok P, Anti-arthritis and antioxidant activity of leaves of *Alstoniascholaris* Linn. R.Br, *Eur. J. Integr. Med*, 3(2), 2011 June, 83-90.
36. Gupta U, Chaudhary R, Goyal PK, Post-treatment effects of *Alstoniascholaris* extract against radiation-induced biochemical alterations in Swiss albino mice, *Iran J Radiat Res*, 8, 2010, 169-77.

37. Macabeo AP, Krohn K, Gehle D, Read RW, Brophy JJ, Franzblau SG, et al. AM, Activity of the extracts and indole alkaloids from *Alstoniascholaris* against *Mycobacterium tuberculosis* H37Rv, *Philipp Agric Sci*, 91, 2008, 348-51.
38. Gupta RS, Bhatnager AK, Joshi YC, Sharma MC, Khushalani V, KachhawaJB, Induction of antifertility with lupeol acetate in male albino rats, *Pharmacology*, 75(2), 2005, 57-62.
39. Kumar A, Khan M.A, Saxena A, Singh RB, Zaman K, Husain A, Hepatoprotective Activity of Methanolic Extract of Stem Bark of *Alstoniascholaris*(l) R.br. Am, *J. PharmTech Res*, 2(2), 2012, 5446- 554