



# Pharmacognostic, Phytochemical and Pharmacological Approaches of *Alstonia Scholaris* (Apocynaceae): A Review

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## KEYWORDS

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## ABSTRACT:

*Alstonia scholaris*, also known as the Indian Devil Tree, is a tropical plant with many medicinal uses, due to the presence of natural compounds. This review looks at the key bioactive compounds in the plant, such as alkaloids, flavonoids, tannins, saponins, and terpenoids, and their potential health benefits. These compounds give *A. scholaris* its antimicrobial, anti-inflammatory, pain-relieving, antidiabetic, and anticancer properties. Alkaloids, like echitamine, help with pain and inflammation, while flavonoids act as antioxidants and boost the immune system. Tannins have antimicrobial and wound-healing effects, and saponins can help with diabetes and inflammation. Terpenoids also show promise in fighting cancer and reducing inflammation. Studies suggest that *A. scholaris* may help treat various health problems, including infections, chronic pain, diabetes, and digestive issues. However, the plant can be toxic at high doses, so it should be used with care. This review highlights the need for more research to better understand how these compounds work and their safety. By summarizing current findings, this review provides an overview of the plant's medicinal properties and its potential use in modern medicine.

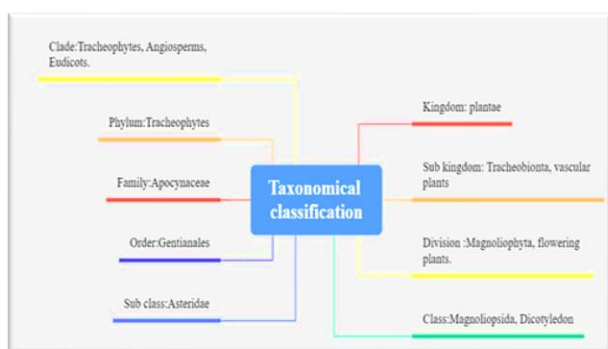
## 1. Introduction

Even though pharmaceutical companies are increasingly using synthetic and combinatorial chemistry approaches to develop new drugs, therapeutic plants remain a significant origin of the new chemical entities. The natural world has been a major origin of the medication compounds for ages. Natural resources have served as the foundation for the development of many modern drugs. Numerous bioactive compounds have been identified from plants based on their application in traditional medicine.[1] Ethnobotanical knowledge of traditional plant applications has played a significant role in the discovery of numerous medicinal plants.[2] One such plant is *Alstonia Scholaris*, a noteworthy evergreen species sometimes referred to as the devil's tree, chalkboard tree, or scholar tree.[3] This tree, which is indigenous to portions of Australia, Southeast Asia, and the Indian subcontinent, is valued for its many medicinal uses in ancient medical systems including Ayurveda, Unani, and Siddha.[4]The Apocynaceae family, which includes *Alstonia*, has about 40 species spread over the tropics. In the evergreen woods of the majority of tropical nations, *Alstonia* develops into enormous trees and does well along the banks of moist rivers. Because of its many pharmacological qualities,

including Inflammation suppressant, Pain reliever, Hypoglycemic agent, antibacterial, and Anticarcinogenic effects, several of the biological entity—including *A. scholaris*, *A.Bboonei*, *A. Cogenesis*, and *A.Neriifolia*—are the most common and significant resources of pharmaceuticals in formulation. Since "sapta" means Heptad and "parna" or "parni" means leaflets in Sanskrit, the plant is called "Sapthaparna" or "Saptaparni" due to the arrangement of its leaves in spirals of seven. Linnaeus officially named the shrub *Echites Scholaris*. Other synonyms for the plant are *Tabernaemontana alternifolia*, *Pala scholaris* (L.) Roberty, and *Echitespala Buch-Ham ex Spreng*. [5] The tall, straight *A.Scholaris* tree may grow up to 40 meters in height. When cut, the entire plant releases a large amount of white latex, and its bark is gray to pale gray with many lenticels. The glossy dark green leaves, which have many lateral veins and a pronounced midrib, are grouped in whorls of four to eight. The tree has tiny, fragrant, white or cream-colored tubular blooms that grow into long, thin follicles that hold many seeds with silky hair tufts to help them spread by the wind. [3] *A.Scholaris* has been used to treat a wide range of illnesses in many traditional medical systems.[6]Numerous beneficial chemicals are abundant



in *A.Scholaris*, according to phytochemical investigations.[7]The bark's therapeutic qualities are attributed to a number of alkaloids, including as strictamine, ditamine, and echitamine. Additional phytochemicals found in various plant components include phenolic compounds, flavonoids, saponins, and tannins.[3]Numerous traditional applications of *A.Scholaris* have been confirmed by contemporary pharmacological research. Significant antimicrobial activity has been shown by plant extracts prevent multiple infections involving bacteria and fungi, including some that are resistant to several drugs.[7] The plant's high flavonoid and phenolic content is also responsible for its antioxidant qualities.[8]Interestingly, *A.Scholaris* has demonstrated promise in the treatment of cancer..[4]In addition to the plant's radiomodulatory, chemomodulatory, and chemopreventive qualities, studies have shown that phytochemicals such echitamine and alstonine have antitumor effects.[9]Despite *Alstonia Scholaris*'s many therapeutic uses, it's important to remember that excessive dosages might be harmful. In animal models, studies have demonstrated that extracts can harm key organs; the degree of toxicity varies according to the plant portion utilized and the harvest season. When opposed to bark taken in the summer, bark collected during the monsoon season is often less harmful.[3]



**Figure 1:** Taxonomical classification of *A. Scholaris* [10]

**Table 1-** Indian names of *A.Scholaris* [11]

Bangla	Chattim
Hindi(Khari Boli)	Saptaparni,shaitankajhar,chitvan
Kanarese	Aelelehaale,bantale,doddapala
Malayali	Daivappala
Maharashtri	Satvin
Deva-vani	Saptaparna

Tamizh	Ezilaopillai,mukumpali
Tenugu	Daevasurippi
Gujrati	Satvana



**Figure 2.** *A. Scholaris* tree leaves and flower

#### Phytochemistry

The bioactive plant metabolites of *A.Scholaris* have been thoroughly examine; over 400 distinct substances have been have been found and isolated. The primary chemical components were found to include monophenols, nitrogenous chemicals derived from plants, monoterpene glycosides, lactone derivatives, bioflavonoids, anthocyanin precursors, monosaccharide reducers, steroidal compounds, plant glycosides, and polyphenolic astringents.[12]Monophenols, plant-based nitrogenous chemicals, lactone derivatives, monoterpene glycosides, bioflavonoids, anthocyanin precursors, monosaccharide reducers, and steroidal compounds are often found in *A. scholaris*. Leaf extract contains eight elements: calcium, chromium, Manganese, Cadmium, zinc, iron, and Copper.[13]Monoterpene glycosides, lactone derivatives, anthocyanin precursors, monophenols, nitrogenous chemicals derived from plants, bioflavonoids, and monosaccharide reducers The blooms contain all of the steroidal chemicals.[14] Among the additional ingredients, isookanine-7- $\alpha$ -l-rhamnopyranoside, a bioflavanone rhamnoside, and iridoid glycoside, a seco-iridoid derivative, have been identified. Acetyl lupeol, venenative, aphrodin, agr-amyrin, and bgr-amyrin have all been found. The plant's other botanical components include terpinenol-4, alphaterpineol, linalool, cis and trans linalool oxides, floral acetate, and steroidal chemicals.[11]

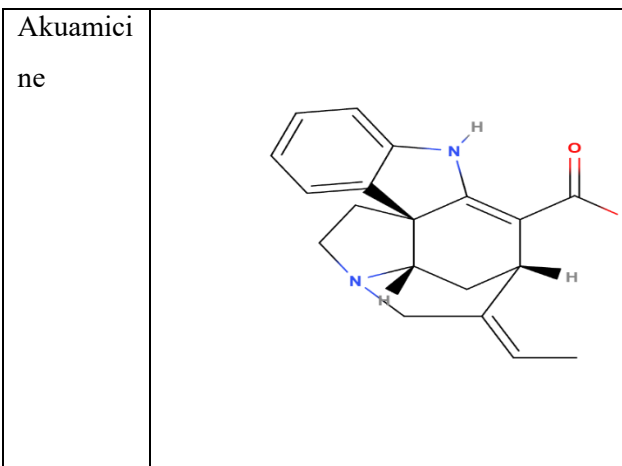


**Table 2.** Phytochemical present in A.Scholaris [15]

Plant Part	Chemical compound
Stem bark	Corialstonine, Corialstodine, $\alpha$ -Amyrin, Stigmast-5-en-3 $\beta$ -ol, $\beta$ -Sitosterol
Leaves	Akummiginone, Lagummine, Angustilobine B-acid, Losbanine
Roots	Tubotaiwine, Echitamine, Manilamine, vallesamine, Angustilobine-B
Flowers	$\alpha$ -Amyrin or $\beta$ -Amyrin, Lupeol, Stigmast-5-en-3 $\beta$ -ol, $\beta$ -stigmasterol

**Table 3.** Chemical constituents of A.Scholaris [14]

Chemical constituent	Structure
Picrinine	
Alstonine	
Echitamine	



Pharmacological activity

Traditional uses

A.Scholaris is used as an erotic stimulant, fever reducer, activator, mucolytic, alternative, flatulence reliever, anti-relapsing agent, cauterizing agent, and digestive stimulant.[16] Furthermore, the leaf infusion may be used to treat fever, while the bark infusion can be used to treat lung cancer, chronic obstructive pulmonary disease, elevated blood pressure, and bronchopneumonia.[17] Lactating moms are also given the bark of A. Scholaris to improve nursing and treat some of the major postpartum fatigue and gastrointestinal issues. Mothers are given raw ginger or zedoary tincture with leaves after giving birth.[16]

**Table 4.** Plant parts and their pharmacological uses

Parts	Uses	Reference
Bark	Restorative, <b>Flatulence reliever, Activator, Phlegm remover, Tonic, Sexual enhancer, Fibrifer, Antirelapsing, Pucker er, and Stomach problem. Used To Treat Kala-azar, Ague, Gastric discomfort, And Hansen's disease.</b>	16



Milky Juice	Pustule, Tooth deterioration (Pus in gums).	16
Tender Leaves	Pulverised leaves are used to produce a Cataplasm to heal ulcers. Utilised in cases of Arachnid and <b>Serpent bites</b> .	18
Leaves	Utilised for healing lesion, Musculoskeletal soreness, Airway hyperresponsiveness and Chronic hyperglycemia	19
Flower	Utilised in Airway hyperresponsiveness and Pulmonary issues	20
Roots	Utilised in Hepatomegaly with Agony	20

#### Anti Malarial

Alkaloids offer great antiplasmodial potential, according to several studies. Although *A.Scholaris* has a high alkaloid content, nothing is known about its antimalarial potential. Only two publications have verified *Alstoniascholaris*'s antimalarial properties.[21][22]

#### Antimicrobial

the anti-bacterial and antifungal efficacies of the petroleum ether, dichloromethane, ethyl acetate and butanol fractions of the methanolic extracts of leaves, stem, root and bark of *A.Scholaris* in gram-positive bacteria (*Bacillus cereus*, *B. coagulans*, *B. megaterium*, *B. subtilis*, *Lactobacillus casei*, *Micrococcus luteus*, *M. roseus*, *Staphylococcus albus*, *S. aureus*, *S. epidermidis*, *Streptococcus faecalis*, *S. pneumoniae*, *S. mutans*) and gram-negative bacteria (*Agrobacterium tumefaciens*, *Citrobacter freundii*, *Enterobacter aerogenes*, *Escherichia coli*, *Klebsiella pneumoniae*, *Neisseria*

*gonorrhoeae*, *Proteus mirabilis*, *P. vulgaris*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Salmonella typhimurium*, *Serratia marcescens*). Fractionation greatly increased the activity and produced strong effects with the butanol fractions as compared to the total crude extract.[23] Khyade and Vaikos also discovered that the leaves' extract made from methanol exhibited a wide range of antibacterial properties against *Salmonella typhi*, *Pseudomonas aeruginosa*, *Corynebacterium glutamicum*, *Salmonella aureus*, *B. subtilis*, *E. coli*, and *Bacillus megaterium*, with the best results against *Salmonella typhi*, *Bacillus aureus*, and *Bacillus megaterium*. The leaf extracts in acetone and chloroform shown diminished activity, while the extract made from petroleum ether wasn't showing any inhibition. [24]

#### Antioxidant

The antioxidants are chemicals that prevent the adverse consequences of nitric oxide, extra free radicals, and oxygen species that are reactive.[25][26] Plant-based organic antioxidants are a great way to reduce your risk of heart disease, stroke, and cancer. [26-28] The antioxidant activity of *A. scholaris* has so far been investigated using in vitro assay. The antioxidant capacity of *A. scholaris* in vivo has not been reported. James and associates [29] found that the antioxidant activity of floral methanol extracts was greater than that of fruit. The observed antioxidant and radical scavenging activities were shown to be caused by the phenol and flavonoids content of leaves as well as the flavonoids content of floral and extracts of fruit. [30][31]

#### Antidiabetic potential

Researchers conducted a number of in vitro and in vivo investigations to assess *A.Scholaris*'s traditional and local anti-diabetic claims. The  $\alpha$ -glucosidase inhibitory and hypoglycemic activities of *A.Scholaris* were investigated in relation to its potential as an anti-diabetic [32].[33] *A.Scholaris* leaves and stem bark have been shown to have strong anti-diabetic properties thus far [34]. Patients with noninsulin-dependent diabetes mellitus consistently get a hypoglycemic effect from the powdered leaves of *A.Scholaris*. The powdered leaves of *A.Scholaris* were found to have a hypoglycemic impact in individuals with noninsulin-



dependent diabetes mellitus because of their direct insulin-like and insulin-triggering properties.[35]

#### Radioprotective effect

It has been demonstrated that ionizing radiation increases the synthesis of oxygen species that are reactive, which harm DNA and result in dying cells.. A.Scholaris bark's radioprotective properties have been thoroughly investigated both before and after treatment. It was shown that giving irradiated mice a hydro-alcoholic extract of A.Scholaris bark beforehand significantly increases erythrocytes, hematocrit, and hemoglobin levels while also significantly lowering lipid peroxidation levels.[36] Aqueous bark extracts of A.Scholaris have also been shown in the posttreatment investigation to reverse radiation-induced biochemical changes in mice.[37]

#### Immunomodulatory

Immune activation protects against infectious diseases and immunostimulants which enhance the overall immunity of the host, and present a non-specific immune response are of use.[38] Studies by Iwo, et al showed that the immunomodulatory activity exhibited by the aqueous extract of the bark was better than that of the ethanolic extract in the BALB/c mice. An increase in the lytic activity of peritoneal exudates by the aqueous extract was observed against E. coli in mice with an induction of cellular immune response and inhibition of delayed type hyper-sensitivity reaction.[39]

#### Antidiarrhoeal and Spasmolytic

Diarrhea, often caused by gastrointestinal illnesses, kills more than 1.8 million people annually in developing countries..[40, 41] Diarrheal disorders can be effectively treated with diphenoxylate, loperamide, opium alkaloids, anticholinergics, and other substances; however, prolonged use of these drugs has been associated with negative effects. [40] A.Scholaris bark extracts, both alcoholic and aqueous, have been shown in studies by Patil et al. [42] to have antidiarrheal effects in mice against the experimental form of diarrhea caused by castor oil..[42] It has also recently been shown that the aerial part of A.Scholaris exhibits antidiarrheal properties in the castor oil-induced experimental paradigm in mice.[43]. The extract inhibited both spontaneous and high K<sup>+</sup> (80 mmol/L)-

induced contractions in the rabbit jejunum, with half maximal effective concentrations (EC50) of 1.04 and 1.02 mg/mL, respectively. Since the extract pretreated the tissue, the Ca<sup>2+</sup> concentration-response curves shifted to the right, like those of verapamil, a popular calcium channel blocker, suggesting that the effects were mediated by inhibiting calcium channels.[43]

#### Chemosensitization Effects

According to studies, using certain plants in combination with chemotherapy medications may improve their effectiveness while lowering their side effects. Research by According to Baliga and Jagetia , tumor-bearing rats that received a hydroalcoholic solution of A.Scholaris together with 25 mg per kilogram of cyclophosphamide [1/10th of the median lethal dosage (LD50) dose] showed favorable antitumor effects[44]. The most beneficial combination was 120 mg/kg extract plus 25 mg/kg cyclophosphamide, which increased the tumor-bearing animals' survival duration and induced the most tumor shrinkage.[44] Together, echitamine and vitamin A increase Ehrlich ascites carcinoma's lethal effects in vitro. The free radical-dependent mechanism caused the tumoricidal effects, which were comparable to those of bleomycin, mitomycin-C, and adriamycin..[45]

#### Antitussive, antiasthmatic and expectorant

A. scholaris was shown to have expectorant, antitussive, and anti-asthmatic qualities by Xiao-Dong Luo et al. They found that the alkaloids portion of the leaf of A. scholaris has expectorant, antitussive, and antiasthmatic properties. It could also be a good starting point for creating medications for respiratory conditions. The quality of products manufactured from A. scholaris leaf may be assessed using picrinine, the main Anticough agent and Asthma-relieving agent chemical. [46] Shabana et al. claim that the leaves of A. scholaris exhibit broncho-vasodilatory effects. They found that the broncho-vasodilatory action of A. scholaris leaves appears to be mediated via EDRF and prostaglandin calcium antagonism.[47] The acute effects and longevity of safety of Sapthaparna's hydro-alcoholic extracts in rats and mice have been reported by Jagetia et al. They discovered that compared to the untreated controls, the mice given 240 mg/kg of ASE had reduced levels of total proteins, albumin, a RNA, DNA, lipids, sugar, glutathione, and total thiols. The



haematological analysis showed a significant increase in lymph cells, Eosinophil and basophils but dose-dependent reductions in RBC, WBC, hemoglobin, neutrophils, and monocytes. One possible explanation for the negative effects of ASE that have been noted is echitamine. [48]

#### Antimutagenic

Genetic material harm and flaws in its repairing are the initial stages of cancer formation. It has been demonstrated that *A. scholaris* possesses antimutagenic qualities against methylmethanesulfonate, mitomycin-C, and dimethylnitrosamine.. This micronucleus test has demonstrated that the treatment of *A.Scholaris* reduces clastogen-induced mutations in DNA in the bone marrow cells..[49,50] In the gastrointestinal tract carcinogenesis experiment, it was demonstrated that administering extracts before to, during, and after treatment to the carcinogenic benzo(a)pyrene lowered the amount of tiny nuclei in the spleen cell..[51] It has also been shown that luteol, a substance found in *A.Scholaris*, lessens a strand of DNA breaks in the dermis of mice. caused by DMBA.[52]

#### Miscellaneous

This plant is currently under investigation for a range of additional pharmacological effects, including antioxidant, anthelmintic, antitussive, hepatoprotective, immunomodulatory, wound healing, anticholinesterase, neuroleptic, antidepressant, antiepileptic, and antianxiety properties. However, a detailed analysis of these action has not been included in this review because insufficient reliable data and the questionable credibility of existing findings. It is recommended that research groups with expertise in pharmacology reassess these various effects of *A. scholaris* to confirm and validate their potential. [53]

**Table 5.** Table of published patents pertaining to skin-related issues

S.no	Patent ID; title	References
1	JPH0987164A; Preparing the skin for external application	54
2	JPH10316541A; Composition for head	55

3	EP1281396B1; Skin-vitalizing formula for external application as an anti-aging product	56
4	EP1426030A1; Materials that can increase the production and use of laminin 5 in epidermal cells	57
5	JP2004018471A; Collagen synthesis promoters of types IV and VII and the ingredients that make up the skin's basement membrane	58
6	US20070059269A1; The application of 8-hexadecene-1,16-dicarboxylic acid to encourage the epidermal horny layer 1 to adhere	59
7	JP2008184439A; Skin preparation used externally to reduce the cytotoxicity of active oxygen species	60
8	KR20090085844A; A cosmetic formulation that reduces skin irritation by using a natural medicinal plant extract	61
9	WO2016183634A1; Skin exfoliant composition	62
10	WO2016110872A1; Foot care compositions	63
11	WO2016183633A1; Skin cleansing composition	64



12	WO2016183630A1; Skin moisturizing composition	65
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**Table 6.** List of respiratory disease patents that have been published

S.no	Patent ID; title	References
1	CN1989987A; Folium <i>A. scholaris</i> dripping tablets and how they are made	66
2	CN101084951A; medications for respiratory conditions, as well as their use and preparation techniques	67
3	CN103768228A; Composition of traditional Chinese medicine for the treatment of winter-spring swine enzootic pneumonia and method of preparation	68
4	WO2017080485A1; Pharmaceutical formulation for the management of respiratory conditions	69
5	CN106890209A; The process of production of cough-relieving compounds	70

### Conclusion

The *A. Scholaris* tree has a variety of health-promoting substances with strong therapeutic potential. Its alkaloids, flavonoids, terpenoids, and other active components offer a wide range of health benefits, including hepatoprotective, anti-inflammatory, analgesic, anti-cancer, anti-diabetic, and antibacterial qualities. due of its many attributes. It is a tenable

choice for the creation of organic therapeutic substances. More clinical trials and research are required to fully comprehend the processes behind its therapeutic effects, even for the most promising. To evaluate the safety profile of *A. scholaris*, comprehensive toxicology investigations are also required. *A. scholaris* may be viewed as being a valuable natural resource in medicine that provides either an adjuvant or an alternative to conventional therapies, given the rise in chronic illnesses and growing concerns about antibiotic resistance.

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