

A Comprehensive Review on Phytochemical and Pharmacological Profile of *Alstonia Scholaris* (L.) R. Br.

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ABSTRACT

Medicinal plants contain different types of secondary metabolites and phytoconstituents, these substances are essential for nourishment, maintenance of life, defense, growth and development of plant in different environmental conditions. *Alstonia scholaris* (L.) R. Br (Apocynaceae) is one of the ancient important medicinal plant among folks and traditional, Ayurvedic, Unani, Homoeopathy and Sidhha/Tamil types of alternative medicinal systems against different ailments such as asthma, malaria, fever, dysentery, diarrhea, epilepsy, skin diseases, snakebite etc. This review compiles reports on phytochemical and pharmacological aspects of *Alstonia scholaris* (L.) R. Br related to various studies in relation to several ailments. There is a huge possibility for the study of different phytoconstituents present in the plant for their several pharmacological studies.

Keywords: *Alstonia scholaris*, saptaparna, pharmacological action, phytochemical constituents

I. INTRODUCTION:

The good relationship between humans and the nature is since ancient times. The different natural substances from ancient to present time are used for betterment of human civilization. Plant sources are vastly used in medicinal purpose also. Plants have played an important role in maintaining human health and rising the standard of human life for thousands of years and have served humans well as valuable elements for medicines, seasonings, beverages, cosmetics and dyes. Herbal medication is predicated on the premise that plants contain natural substances that may promote health and alleviate illness.

The use of herbal medicinal products and supplements has increased tremendously over the past decades with not less than 80% of people worldwide relying on them for some part of primary healthcare. The use of herbal medicines and phytonutrients or nutraceuticals continues to expand rapidly across the world with many people now resorting to these products for treatment of various health challenges in different national healthcare settings[1].

Ayurveda is the most ancient system of medicine and some of the Indian plants have been investigated for their use in treatment of various ailments like cancer, inflammation, diabetes, immunomodulatory activities and *Alstonia scholaris* is one of them.

Alstonia scholaris, also known as blackboard tree or devil's tree is an evergreen tropical tree in the family Apocynaceae family. This plant is a native of India, Sri Lanka, Pakistan, Nepal, Thailand, Burma, Malaysia, Southeast Asia, Africa, Northern Australia, Solomon Islands, and Southern China.[2] In India it grows throughout the humid regions, especially in West Bengal and west-coast forest of south India.[3]

Alstonia scholaris or Saptaparni is used as a bitter and as an astringent herb for treating skin disorders, malarial fever, urticaria, chronic dysentery, diarrhea, in snake bite and for upper purification process of Panchakarma. The Milky juice of the tree is applied to ulcers.[4]

PLANT PROFILE

Common name: Indian Pulai, White Cheesewood, Devil Tree, Blackboard Tree, Milkwood Pine, Dita Bark, Bitter Bark



Fig. 1. Leaves of *Alstonia scholaris*



Fig. 2. Bark of *Alstonia scholaris*



Fig. 3. Flower of *Alstonia scholaris*



Fig. 4. Fruits of *Alstonia scholaris*

Table 1: Vernacular name of *Alstonia scholaris*

Language	Name
English	Dita bark, White cheese wood
Hindi	Chatian, Satvin
Sanskrit	Saptaparna
Bengali	Chattin
Tamil	Pala
Gujarati	Saptaparni

Table 2: Systematic position of *Alstonia scholaris*

Kingdom	Plantae
Order	Gentianales
Family	Apocynaceae
Tribe	Plumeriae
Subtribe	Alstoniinae
Genus	<i>Alstonia</i>
Species	<i>Alstonia scholaris</i>

Macroscopic characteristics

Leaves: The leaves are thick, dark green, arranged in whorls, obovate to oblanceolate, narrow at the base, entire, rounded or bluntly acuminate at apex, petioles 6– 12 mm long.

Bark: Bark is rough, tessellated corky grey to grey white and contains whorled branches. The outer blaze is cream to yellowish in color with abundant, milky latex that flows rapidly when cut.

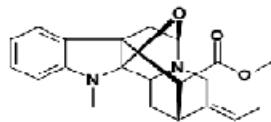
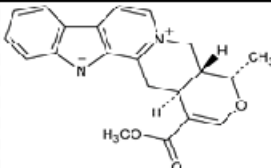
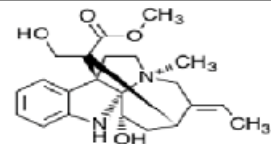
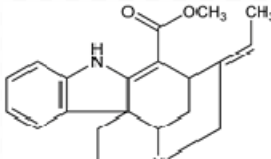
Flowers: Greenish white small flowers in umbellate branched manner. They are 7-10 mm long, the tube is hairy, lobes sparsely or densely pubescent; 1.5-4 mm long, the left margins overlapping, strongly perfumed. in India, the flowering period is during December to March

Fruits: Fruit a pendulous, two lobed, dehiscent follicles, brown or green, dry or wood, spindle shaped, 15-32 cm long, 4- 6mm in diameter, containing numerous flat, oblong, brown seeds.

Chemical composition

The various chemical constituents isolated from different parts of *Alstonia scholaris*.

Around four hundred compounds have been isolated and characterized. A wide range of chemical compounds have been reported in different parts of *Alstonia scholaris*. Alkaloids, iridoids, coumarins, flavonoids, leucoanthocyanines, reducing sugars, simple phenolics, steroids, saponins and tannins were documented as the chief chemical constituents [5] Leaf extract contain the eight elements such as Cu, Zn, Fe, Ca, Cr, Mn and Cd.8 Ethanol extract of leaves contain four picrin type monoterpenoids indole alkaloids, 5β methoxyaspidophylline, picrinine, picralinal, 5-methoxystrictamine, methanolic extract of leaves contain the first seco-uleine alkaloids.9 The hydro alcoholic extract of leaves contain 2, 3 secofernane triterpenoids, alstonic acids A and B, together with an indole alkaloid, N-methoxymethyl picrine.[6] the flowers are found to contain alkaloids, carbohydrates, amino acids, phenol, tannins, cardiac glycosides, saponins, flavonoids, terpenoids, steroids, fixed oils and fats.[5]

Chemical constituent	Structure
Picrinine	
Alstonine	
Echitamine	
Akuamicine	

Phytochemical present in *Alstonia scholaris* [7]

Plant Part	Chemical Constituents Present
Root	Tubotaiwine Echitamine Manilamine vallesamine Angustilobine-
Flowers	Amyrin Lupeol acetate stigmasterol β -stigmasterol
Leaves	Akummiginone Lagummine AngustilobineB-acid Losbanine
Bark	Corialstonine Corialstodine Alpha amylin, Stigmasterol Betasitosterol

Pharmacological Investigation

Important pharmacological findings of *Alstonia scholaris* are summarized below:

Antioxidant activity: Antioxidants are the substances which counteract with the excess free radicals, reactive oxygen species, and nitric oxide; and nullified their pathological [50,51]. Plants are the excellent source of natural antioxidants which reduce the risk of certain diseases such as cancer, heart diseases, and stroke. The observed radical scavenging and antioxidant potential of potential of leaves were ascribed to its phenolic and flavonoid content, and of flower and fruit extracts to their flavonoid content. [8] These various antioxidant activities were compared to standard antioxidants such as butylated hydroxyanisole (BHA) and l- ascorbic acid. These results indicate that dichlormethane and ethyl acetate fractions of *Alstonia scholaris* Linn. possess antioxidant property. The results observed were comparable to antioxidant properties of BHA and l-ascorbic acid.[3]

Antibacterial activity: In-vitro antibacterial activity of methanolic, aqueous and total alkaloid extracts from the trunk bark against two gram-positive bacteria including bacillus subtilis and streptococcus pyrogens and four gram negative bacteria, Escherichia coli, pneumoniae, Pseudomonous aeruginosa and proteus mirabilis using disk diffusion method. All extracts showed varying degrees of inhibitory activity against all bacteria. Aqueous extract was found very active against both gram-positive and gram-negative bacteria in comparison to other extracts. Total alkaloid extract was found only active against gram-negative bacteria.[9]

Broncho-vasodilatory: The decoction of the dried bark is used extensively to treat asthma and pneumonia in traditional and folk medicines. Experiments by Channa, et al (52) have shown that the ethanolic extract of the leaves possesses bronchodilatory effects in the carbachol-induced bronchoconstriction experimental model of study. That effect was comparable to that by isoprenaline and salbutamol. The extract also produced its effects on cardiovascular system as a significant inhibition in carbachol-induced hypotension and bradycardia, was observed to be similar to that of isoprenaline. The bronchodilatory effects were observed to be devoid of the dilation of smooth bronchial muscle, as in vitro experiments on guinea pig trachea did to show replicatory activities.[10]

Hepatoprotective activity: The methanolic stem bark extract of *Alstonia scholaris* was effective in bringing the functional improvement of hepatocytes and proven to significantly decrease the biochemical parameters such as SGOT, SGPT, ALP, TP and TB.[11]

Anticancer activity: Several in vivo and in vitro study reports are available on the possible anticancer potential of *Alstonia scholaris* (Table 5). Thus far, potent anticancer activity was reported to stem bark, root bark, leaves, alkaloid fraction and isolated alkaloids of *Alstonia scholaris* [12]The anticancer/tumor effect of *Alstonia scholaris* cells could be linked to its cytotoxic effect and anti proliferative effect.

Anti diabetic activity: Several in vitro and in vivo studies were undertaken by researchers to evaluate traditional and local anti-diabetic claim of *Alstonia scholaris*. An anti-diabetic potential

of *Alstonia scholaris* was studied in terms of its α -glucosidase inhibitory and hypoglycemic effects [14]. To date, potent anti-diabetic activity was reported to the leaves and stem bark of *Alstonia scholaris* [15]. The powder of *Alstonia scholaris* leaves exert a consistent hypoglycemic effect in patients suffering from non-insulin dependent diabetes mellitus. The hypoglycemic effect *Alstonia scholaris* leaves powder in patients suffering from non-insulin dependent diabetes mellitus was ascribed to their insulin triggering and direct insulin-like actions [16]

Immune stimulating effect: The immune stimulating effect of *Alstonia scholaris* bark extracts was studied in BALB/c mouse by Iwo et al (28). The aqueous extract at 100 mg/kg b.w. increased lytic activity of peritoneal exudate cells against *Escherichia coli*. At the doses of 50 and 100 mg/kg b.w., the aqueous extract had no effect on primary antibody level. The aqueous extract at 50 mg/kg b.w. induced the cellular immune response while at 100 mg/kg b.w. inhibited the delayed type of hypersensitivity reaction [17].

Analgesic and anti-inflammatory activity: At present there are several NSAID drugs present in market which offers both analgesic as well as anti-inflammatory effects but due to their possible side effects many researches are going for any herbal alternative. Alcoholic extracts of leaves of *Alstonia scholaris* has potent analgesic and anti-inflammatory activity (Table 5). Arulmozhi et al. (2012) further showed that dichloromethane fraction of ethanolic extract of leaves of *Alstonia scholaris* was more active. It has been reported that alkaloid content of *Alstonia scholaris* leaf, especially alkaloids picrinine, vallesamine and scholaricine, could be responsible for these effects (Arulmozhi et al., 2007). The analgesic and anti-inflammatory potential of these alkaloids was found to be associated with their inflammatory mediators (COX-1, COX-2 and 5-LOX) inhibitory potential. [18-19]

Molluscicidal and anti-cholinesterase activity: The aqueous extract of stem barked leaf of drug has molluscicidal as well as in vivo and in vitro anticholinesterase activity against the snail *Lymnaea acuminata*. The aqueous stem bark extract shows strong molluscicidal activity in comparison to leaf at all exposure periods in time as well as dose-dependent manner (LC50 value decreases from 665.82 to 138.32

mg/L). The anticholinesterase activity is also dose dependent. [20]

II. CONCLUSION

Alstonia scholaris is generally known as "Saptaparni". It continues to be one of the most researched plants in phytochemistry. The recent studies exhibit promising activities like analgesic, anti-inflammatory, antipyretic, antiarthritic, antibacterial, anti asthmatic and anticancer activities. These activities have been accounted for by applying a variety of biological arrangements, such as laboratory mice, rats, rabbits, cell lines and viruses.

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