



Unlocking the secrets of *Alstonia scholaris*: Ethnobotany, phytochemistry, and pharmacological potential

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Abstract

Alstonia scholaris, also known as the Indian devil tree, is a plant that has been used for centuries in traditional medicine in Southeast Asia, India, and China. Its bark, leaves, and roots have been used to treat a variety of ailments, including fever, dysentery, malaria, and asthma. *Alstonia scholaris* is also used in Ayurvedic medicine to treat skin conditions, snakebite, and gastrointestinal disorders. But what makes this plant so special? In this paper, we will unlock the secrets of *Alstonia scholaris*, exploring its ethnobotanical uses, phytochemical properties, and pharmacological potential. We will delve into the research that has been done on this fascinating plant, discovering the compounds that make it so effective and the ways in which it can be used to treat a range of illnesses.

Keywords: *Alstonia scholaris*, ayurvedic, ethnobotanical, phytochemical and pharmacological

Introduction

Alstonia scholaris and its significance

Alstonia scholaris, also known as the Indian Devil Tree or Saptaparni, belongs to family Apocynaceae is a tree species that holds immense significance in the field of ethnobotany, phytochemistry, and pharmacology (Pandey *et al* 2020) ^[1]. Native to the Indian subcontinent, this evergreen tree has long been revered for its medicinal properties and cultural importance.

In traditional medicine systems, various parts of *Alstonia scholaris*, including the bark, leaves, and roots, have been utilized for centuries to treat a wide range of ailments (Khare CP 2007) ^[2]. The tree's bark is particularly renowned for its potent antimalarial and antidiarrheal properties. Its leaves are often employed to alleviate respiratory disorders, while the roots have been used to address gastrointestinal issues (Akhtar and Bano 2002) ^[3].

Beyond its medicinal applications, *Alstonia scholaris* holds cultural and religious significance in many communities. In Hindu mythology, the tree is believed to be sacred and associated with Lord Shiva (Raji, R and RK 2011, Bhandary, M J 2020) ^[4, 5]. Its wood is utilized in the construction of temples and religious artifacts, further emphasizing its cultural importance.

With the growing interest in natural remedies and plant-based therapies, there has been a surge in scientific research focused on unlocking the secrets of *Alstonia scholaris*. Phytochemical studies have revealed the presence of various bioactive compounds such as alkaloids, flavonoids, and terpenoids, which contribute to the tree's therapeutic properties (Thakamani *et al* 2011, Akbar, S & Akbar S 2020) ^[6, 7].

Moreover, pharmacological investigations have demonstrated the potential of *Alstonia scholaris* in treating conditions such as malaria, diarrhea, respiratory disorders, and even certain types of cancer (Dodoo, K. *et al* 2020) ^[8]. These findings have sparked enthusiasm among researchers and healthcare professionals, paving the way for further exploration and development of this remarkable plant's pharmacological potential (Kumar *et al* 2010, Shah, BN 2010, Pratheepa and Sukumaran 2014) ^[9, 10, 11].

In this paper, we will delve deeper into the world of *Alstonia scholaris*, exploring its ethnobotanical uses, the phytochemical compounds it contains, and its promising pharmacological properties. By shedding light on its significance, we aim to showcase the untapped potential of this botanical treasure and open doors for future advancements in the field of natural medicine.

Ethnobotanical uses of *Alstonia scholaris* in traditional medicine

Alstonia scholaris, commonly known as the Devil's Tree or Dita, is a fascinating plant with a rich history of ethnobotanical uses in traditional medicine. This section will delve into the various ways this plant has been utilized by different cultures for centuries. In traditional medicine practices across Asia, *Alstonia scholaris* has been highly valued for its therapeutic properties. The bark leaves, and roots of this tree have been utilized in the treatment of a wide range of ailments. One of the most notable uses is in the management of malaria (Guhabakshi *et al* 1999, Mollik *et al* 2020) ^[12, 13]. The plant contains alkaloids, such as echitamine and echitenine, which have been found to possess antimalarial properties. The indigenous communities of India, Nepal, and Bangladesh have long employed various parts of the tree to combat this debilitating disease. Additionally, *Alstonia scholaris* has been employed as an antidote for snakebites (Prusti and Behera 2008) ^[14]. The latex obtained from the tree has been applied topically to snakebite wounds to alleviate pain and swelling. The plant's constituents, including indole alkaloids, have been shown to possess antivenom activity, making it a valuable resource in regions where snakebites are prevalent.

Another traditional use of *Alstonia scholaris* is in the management of respiratory conditions. The leaves and bark of the tree are often used to prepare decoctions or herbal infusions that are believed to alleviate symptoms of coughs, asthma, and bronchitis (Singh and Sangawan 2011) ^[15]. These preparations are thought to possess expectorant and bronchodilatory properties, providing relief to individuals

suffering from respiratory ailments. Furthermore, the plant has been utilized in traditional medicine to address gastrointestinal issues. Its bark and leaves are often employed in the treatment of diarrhoea, dysentery, and other digestive disorders (Khyade MS, *et al* 2014) ^[16]. The presence of bioactive compounds like saponins and tannins in *Alstonia scholaris* is thought to contribute to its beneficial effects on the gastrointestinal system (Pratyush K 2010, Chauhan, S and Singh, A 2014) ^[18]. It is important to note that while *Alstonia scholaris* has a long history of traditional use in ethnobotanical practices, further scientific research and clinical studies are necessary to confirm and validate its pharmacological potential. Understanding the traditional uses of this plant provides a foundation for exploring its phytochemical composition and potential therapeutic applications in modern medicine.

Exploring the phytochemical composition of *Alstonia scholaris*

Alstonia scholaris, commonly known as Saptaparni, is a tree native to the Indian subcontinent with a long history of traditional use in Ayurvedic medicine. In recent years, researchers have turned their attention to unraveling the secrets of this remarkable plant through the field of ethnobotany, phytochemistry, and pharmacology (Prankti *et al* 2012) ^[19].

Phytochemical analysis of *Alstonia scholaris* has revealed the presence of various bioactive compounds, including alkaloids, flavonoids, terpenoids, phenols, and glycosides. These phytochemicals are responsible for the plant's therapeutic properties and have attracted the interest of scientists and pharmaceutical companies alike (Okoye NN *et al* 2021, Omitola, OJ 2021) ^[20, 21].

One of the most intriguing phytochemicals found in *Alstonia scholaris* is echitamine, an indole alkaloid with potent antimalarial and anticancer activities (Pant *et al* 2017) ^[22]. Studies have shown that echitamine exhibits remarkable antimalarial efficacy against different strains of Plasmodium, the parasite responsible for malaria. Additionally, it has demonstrated promising anticancer potential by inhibiting the growth of cancer cells and inducing apoptosis, or programmed cell death. Apart from echitamine, other alkaloids present in *Alstonia scholaris*, such as ditamine and conessimine, have shown significant pharmacological activities. These alkaloids exhibit antifungal, antibacterial, antidiabetic, anti-inflammatory, and analgesic properties, making *Alstonia scholaris* a potential source of natural remedies for various ailments (Sultana, N *et al* 2020, Zhao, Y. L. *et al* 2021) ^[23].

In addition to alkaloids, the plant contains flavonoids, which are known for their antioxidant and anti-inflammatory effects. Flavonoids, such as quercetin and kaempferol, have been reported to possess anticancer (Nanditha, R *et al* 2020) ^[25], neuroprotective, and cardioprotective properties. These compounds contribute to the overall medicinal potential of *Alstonia scholaris* (Pratap B 2013) ^[26]. The comprehensive exploration of the phytochemical composition of *Alstonia scholaris* has laid the foundation for further research on its pharmacological potential. Scientists are now focusing on isolating and characterizing specific compounds to better understand their mechanisms of action and develop new therapeutic agents.

In conclusion, the phytochemical analysis of *Alstonia scholaris* has revealed a treasure trove of bioactive

compounds with immense pharmacological potential. This remarkable plant holds promise for the development of novel drugs to combat malaria, cancer, microbial infections, inflammation, and other diseases. Further studies and clinical trials are warranted to fully unlock the therapeutic secrets of *Alstonia scholaris* and harness its benefits for human health.

Potential pharmacological properties of *Alstonia scholaris*

Alstonia scholaris, commonly known as the "Devil Tree" or "Saptaparni," is a fascinating plant that has long been used in traditional medicine across various cultures. This section will delve into the potential pharmacological properties of *Alstonia scholaris* that have been extensively studied and documented.

1. Anti-inflammatory Effects

One of the notable pharmacological properties of *Alstonia scholaris* is its anti-inflammatory potential. Research has shown that extracts from different parts of the plant, such as leaves, bark, and roots, possess anti-inflammatory properties (Zhao *et al* 2017, 2018) ^[27, 28]. These properties can help alleviate symptoms associated with inflammatory conditions, such as arthritis, asthma, and gastrointestinal disorders (Arulmozhi *et al* 2007) ^[29].

2. Antimicrobial Activity

Alstonia scholaris has also demonstrated significant antimicrobial activity against various pathogens. Studies have revealed its effectiveness against both gram-positive and gram-negative bacteria, as well as certain fungal strains (Arulmozhi *et al* 2007) ^[32]. These findings suggest that *Alstonia scholaris* could be a valuable natural resource for developing novel antimicrobial agents to combat infectious diseases (Misra *et al* 2011) ^[17].

3. Antioxidant Properties

The plant exhibits potent antioxidant properties, which play a crucial role in protecting cells from oxidative stress and damage caused by free radicals. Antioxidants help prevent the development of chronic diseases, including cardiovascular disorders, neurodegenerative conditions, and certain types of cancer (Jagetia and Balinga 2004) ^[31]. *Alstonia scholaris*, with its rich phytochemical composition, possesses compounds that can effectively scavenge free radicals and neutralize their harmful effects.

4. Anti-diabetic Potential

Alstonia scholaris has shown promising potential in managing diabetes and related complications. Research indicates that certain bioactive compounds present in the plant possess anti-diabetic properties. They help regulate blood glucose levels, improve insulin sensitivity, and reduce oxidative stress associated with diabetes (Nkono *et al* 2014) ^[33]. These findings open up possibilities for developing natural remedies or complementary therapies for individuals with diabetes.

5. Anti-cancer Properties

Studies exploring the anti-cancer potential of *Alstonia scholaris* have revealed promising results. Extracts from the

plant have exhibited cytotoxic effects against various cancer cell lines, inhibiting their growth and inducing programmed cell death (Jagetia and Balinga 2005) ^[34]. These findings suggest that *Alstonia scholaris* could be a valuable source for the development of anti-cancer drugs or complementary therapies in the future.

In conclusion, *Alstonia scholaris* possesses a wide range of potential pharmacological properties, making it a subject of great interest in medicinal research. Its anti-inflammatory, antimicrobial, antioxidant, anti-diabetic and anti-cancer activities highlight the plant's significant therapeutic potential. However, further studies and clinical trials are required to fully unlock the secrets of *Alstonia scholaris* and harness its botanical treasures for the benefit of human health.

Antimicrobial properties of *Alstonia scholaris* extracts

Alstonia scholaris, commonly known as the Devil's Tree or Saptaparni, is a fascinating plant with a rich history of traditional medicinal use. One of the most intriguing aspects of this plant is its potential antimicrobial properties, which have been the subject of extensive scientific research (Baliga, MS 2012) ^[35].

Studies have shown that various extracts obtained from different parts of the *Alstonia scholaris* plant exhibit significant antimicrobial activity against a wide range of microorganisms. The leaves, bark, stem, and even the seed extracts have been found to possess potent antimicrobial effects. The active compounds responsible for these antimicrobial properties are believed to be alkaloids, flavonoids, and other phytochemicals present in the plant. These compounds have shown inhibitory effects against both Gram-positive and Gram-negative bacteria, as well as certain fungal species. The antimicrobial activity of *Alstonia scholaris* extracts has been tested against various pathogens, including *Staphylococcus aureus*, *Escherichia coli*, *Candida albicans*, and *Aspergillus niger*, among others. In many cases, the extracts have demonstrated comparable or even superior antimicrobial effects when compared to standard antibiotics or antifungal agents. This promising antimicrobial potential of *Alstonia scholaris* extracts opens up new possibilities for the development of natural and effective alternatives to combat microbial infections. Further research is needed to isolate and identify the specific bioactive compounds responsible for these antimicrobial properties and to explore their mechanisms of action.

By unravelling the secrets of *Alstonia scholaris* and its antimicrobial properties, we can unlock the potential of this plant as a valuable resource in the field of pharmacology. Its traditional uses in treating various infections and skin ailments find scientific validation through these studies, paving the way for future developments in the synthesis of novel antimicrobial agents inspired by nature.

Anticancer potential of *Alstonia scholaris* compounds

Alstonia scholaris, commonly known as the Devil's Tree, is a fascinating plant with a rich history of traditional medicinal use (Khare, CP 2007) ^[36]. In recent years, scientific studies have begun to shed light on its potential in the field of cancer research.

Researchers have identified several compounds present in *Alstonia scholaris* that exhibit promising anticancer properties (Keawpradub, N *et al* 1997) ^[37]. One such compound is alstonine, which has demonstrated significant

cytotoxic activity against various cancer cell lines. Studies have shown that alstonine induces apoptosis, or programmed cell death, in cancer cells, while sparing healthy cells. This makes it a potential candidate for the development of targeted cancer therapies with minimal side effects.

Another compound of interest is echitamine, which has been found to possess potent anti-proliferative effects against cancer cells. It inhibits the growth and division of cancer cells by interfering with their DNA replication process. Additionally, echitamine has shown the ability to induce cell cycle arrest and promote apoptosis in cancer cells, further highlighting its potential as an anticancer agent.

Furthermore, research has revealed that the alkaloids present in *Alstonia scholaris* exhibit anti-angiogenic properties. Angiogenesis, the formation of new blood vessels, is a crucial process for tumor growth and metastasis. By inhibiting angiogenesis, these compounds can effectively starve tumors of the nutrients they need to thrive, thereby impeding their progression.

While the exact mechanisms of action and therapeutic potential of these compounds are still being explored, the anticancer properties of *Alstonia scholaris* are undoubtedly intriguing. Further research and clinical studies are needed to fully understand and harness the pharmacological potential of this remarkable plant. Nevertheless, these findings offer hope for the development of novel treatments and therapies in the fight against cancer.

The role of *Alstonia scholaris* in managing respiratory disorders

Alstonia scholaris, is an evergreen tree that holds a prominent place in traditional medicine practices across various cultures. One of the most fascinating aspects of this remarkable plant is its potential in managing respiratory disorders.

In ethnobotany, the study of the traditional uses of plants by indigenous communities, *Alstonia scholaris* has been widely recognized for its therapeutic properties in respiratory ailments. The plants bark leaves, and roots have been used for centuries in the treatment of asthma, bronchitis, and other respiratory conditions.

Recent scientific research has shed light on the phytochemistry of *Alstonia scholaris*, revealing a rich composition of bioactive compounds that contribute to its pharmacological potential. The plant is known to contain alkaloids, flavonoids, terpenoids, and other secondary metabolites, which possess anti-inflammatory, bronchodilatory, and expectorant properties (Bello, I *et al* 2015) ^[38]. These pharmacological activities make *Alstonia scholaris* a valuable resource in managing respiratory disorders. The anti-inflammatory compounds present in the plant help reduce inflammation in the respiratory tract, easing breathing difficulties experienced by individuals with conditions such as asthma. Furthermore, the bronchodilatory properties of *Alstonia scholaris* contribute to the relaxation of bronchial smooth muscles, facilitating the flow of air through the airways. This can provide relief to individuals suffering from bronchitis or chronic obstructive pulmonary disease (COPD).

Additionally, the expectorant properties of *Alstonia scholaris* help in the expulsion of mucus from the respiratory system, aiding individuals struggling with coughs and congestion (Channa, S *et al* 2005) ^[39]. By

promoting the clearance of mucus, the plant supports the body's natural defence mechanisms and facilitates easier breathing. While further research is still needed to fully explore and understand the pharmacological potential of *Alstonia scholaris*, the existing evidence highlights its significance in managing respiratory disorders. Incorporating this plant into traditional and modern medicine practices may offer promising solutions for individuals seeking natural alternatives for respiratory health.

It is important to note that consulting with a healthcare professional is essential before incorporating any herbal remedies into one's healthcare routine. The potential benefits of *Alstonia scholaris* warrant further investigation and may provide valuable insights into the development of novel treatments for respiratory disorders.

***Alstonia scholaris* as a potential treatment for digestive disorders**

Alstonia scholaris, has long been celebrated in traditional medicine for its potential therapeutic properties. In recent years, scientific research has begun to unravel the secrets of this remarkable plant, shedding light on its ethnobotanical uses, phytochemical composition, and pharmacological potential (Meena, AK *et al* 2011)^[30, 40].

One area of particular interest is its potential as a treatment for digestive disorders (Lin, SC *et al* 1996)^[41]. Traditional healers have utilized various parts of the *Alstonia scholaris* plant for centuries to alleviate gastrointestinal ailments such as indigestion, diarrhea, and dysentery. The bark leaves, and roots of the tree have been prepared and administered in different forms, including decoctions and infusions, to provide relief and promote digestive health.

Scientists have now turned their attention to understanding the bioactive compounds present in *Alstonia scholaris* that contribute to its medicinal properties. Phytochemical analyses have revealed the presence of alkaloids, flavonoids, terpenoids, and other secondary metabolites, which are known to possess therapeutic effects. These compounds exhibit anti-inflammatory, antimicrobial, and antioxidant activities, which are essential for maintaining a healthy digestive system (Pan, ZQ *et al* 2015)^[42].

In pharmacological studies, extracts derived from *Alstonia scholaris* have demonstrated significant anti-diarrheal effects, reducing the frequency and severity of diarrhoea episodes. Furthermore, they have shown anti-ulcerogenic properties by protecting the gastric mucosa against damage caused by excessive acid secretion or nonsteroidal anti-inflammatory drugs (NSAIDs). These findings hold promise for the development of new therapeutic agents targeting digestive disorders (Ganjewala, D & Gupta, AK 2013)^[43].

However, it is essential to note that further research is still needed to fully understand the mechanisms of action and potential side effects of *Alstonia scholaris* extracts. Rigorous clinical trials are necessary to validate its efficacy and safety as a treatment for digestive disorders in humans. Nonetheless, the wealth of ethnobotanical knowledge combined with emerging scientific evidence suggests that *Alstonia scholaris* holds great potential as a natural remedy for maintaining digestive health.

As research in this field continues to unfold, the secrets of *Alstonia scholaris* are gradually being unlocked, offering new insights into its ethnobotany, phytochemistry, and pharmacological potential (Sharma and Sharma 2010)^[44].

With its long-standing traditional use and promising scientific findings, this remarkable plant may pave the way for innovative therapeutic approaches to address digestive disorders in the future.

Neuroprotective effects of *Alstonia scholaris* on the central nervous system

The neuroprotective effects of *Alstonia scholaris* have been a subject of great interest in the field of ethnobotany and pharmacological research. This magnificent tree, also known as the scholar tree or milkwood pine, has been used in traditional medicine for centuries due to its potential therapeutic properties.

Studies have shown that *Alstonia scholaris* possesses neuroprotective properties that can have a positive impact on the central nervous system. The phytochemical constituents present in this plant, such as alkaloids, flavonoids, and terpenoids, contribute to its neuroprotective effects (Liao, Y. *et al* 2003, Singh, H 2017)^[45, 46]. One of the key areas where *Alstonia scholaris* has shown promising results is in the prevention and treatment of neurodegenerative diseases (Iwuanyanwu, VU *et al* 2023)^[47]. These diseases, including Alzheimer's and Parkinson's, are characterized by the progressive loss of neurons and cognitive decline. The neuroprotective properties of *Alstonia scholaris* can help to mitigate these effects, potentially slowing down the progression of these debilitating conditions.

Furthermore, research has indicated that *Alstonia scholaris* may also have a role in improving memory and cognitive function. By enhancing neurotransmitter activity and promoting neuronal health, it has the potential to enhance learning and memory processes. The pharmacological potential of *Alstonia scholaris* extends beyond its neuroprotective effects. It has also shown anti-inflammatory, antioxidant, and antimicrobial properties, making it a versatile medicinal plant with various therapeutic applications (VP R *et al* 2007, Rudani, M *et al* 2020)^[48, 49].

However, it is important to note that further research is still needed to fully understand the mechanisms behind the neuroprotective effects of *Alstonia scholaris* and to explore its potential clinical applications. Nonetheless, the existing studies provide valuable insights into the promising therapeutic potential of this plant in the field of neuroscience.

In conclusion, *Alstonia scholaris* holds great promise in unlocking the secrets of neuroprotection and cognitive enhancement. Its rich phytochemical profile and traditional use in medicinal practices make it an intriguing subject for further investigation. As researchers continue to unveil its potential, this remarkable plant may hold the key to developing novel treatments for neurodegenerative diseases and improving brain health.

Conclusion and future prospects for *Alstonia scholaris* research

The study of *Alstonia scholaris* has revealed fascinating insights into its ethnobotanical uses, phytochemical composition, and potential pharmacological benefits. Through centuries of traditional knowledge and modern scientific research, we have uncovered the various medicinal properties possessed by this remarkable plant. Ethnobotanical studies have shown that *Alstonia scholaris*

has been utilized by indigenous cultures for its wide range of therapeutic applications. From treating respiratory ailments and digestive disorders to managing fever and skin conditions, this plant has been an integral part of traditional medicine systems.

Furthermore, extensive phytochemical analyses have identified several bioactive compounds present in *Alstonia scholaris*, including alkaloids, flavonoids, and terpenoids. These compounds have exhibited diverse pharmacological activities such as antidiabetic, anti-inflammatory, antimicrobial, and anticancer properties, among others.

While significant progress has been made in understanding the potential of *Alstonia scholaris*, there are still numerous avenues for future research. Firstly, further investigations are needed to isolate and identify specific bioactive compounds responsible for the observed pharmacological effects. This will enable the development of targeted therapies and the exploration of potential synergistic interactions.

Additionally, more comprehensive clinical trials are required to validate the traditional uses and pharmacological benefits of *Alstonia scholaris*. These trials should involve rigorous testing on different populations, exploring optimal dosage forms and regimens, and assessing long-term safety and efficacy.

Furthermore, advanced techniques such as metabolomics and pharmacogenomics can provide deeper insights into the molecular mechanisms of action and individual variations in response to *Alstonia scholaris* treatment. This will allow for personalized medicine approaches and the identification of potential biomarkers for monitoring therapeutic outcomes.

The study of *Alstonia scholaris* holds great promise in the field of ethnobotany, phytochemistry, and pharmacology. Continued research and collaboration among scientists, botanists, pharmacologists, and traditional healers will further unlock the secrets of this extraordinary plant, leading to the development of innovative therapeutics and contributing to the advancement of natural medicine.

In conclusion, our exploration into the secrets of *Alstonia scholaris* has revealed its fascinating ethnobotanical history, intricate phytochemistry, and vast pharmacological potential. This humble tree holds a wealth of medicinal properties that have been utilized by various cultures for centuries. From its antimalarial and anti-inflammatory effects to its potential as a cancer-fighting agent, *Alstonia scholaris* presents a promising avenue for further research and development. By unraveling its mysteries, we hope to unlock a treasure trove of therapeutic possibilities that can benefit humanity. Let us embark on this journey together, leveraging the power of nature to enhance our well-being.

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