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## REVIEW ARTICLE

## A Review: Phytochemistry, Ethanobotanical and Pharmacological activities of *Alstonia scholaris* R.Br (Apocynaceae)

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### Abstract

The plant *Alstonia scholaris* has been used in different system of traditional medication for the treatment of diseases and ailments of human beings. It is reported to contain various types of alkaloids, steroids, triterpenoids, flavonoids and phenolic acids. *Alstonia scholaris* has been reported as antimicrobial, anti-cancer, anti-inflammatory, analgesic, antioxidant, anti-fertility and wound healing activities. This plant is used in traditional, Ayurvedic, Unani and Homeopathy types of alternative medicinal systems against different ailments such as fever, diarrhea, asthma, lung cancer earaches, snakebite etc. In this review recorded the phytochemistry, ethanobotanical and pharmacological activities of *A. scholaris*

## INTRODUCTION

Plants have played a significant role in maintaining human health. In recent times, focus on plant research has increased all over the world. One such plant, *Alstonia scholaris*, invites attention of the researcher's world-wide for its pharmacological activities. It belongs to family Apocynaceae grows throughout in India. This plant is an evergreen and a common medicinal plant of India, the Asia-Pacific, Southern China and Queensland (Wiert, 2006) that can grow to a height of hundred meters, with white and strongly perfumed flowers. The wood has been used for school black boards, hence the name "scholaris". The important plants of genus *Alstonia* include *Alstonia scholaris*, *Alstonia boonei*, *Alstonia congensis* and *Alstonia macrophylla*.

The plant is a large evergreen tree up to 17 to 20 m in height about 110cm in diameter. Bark is grayish brown, rough, abounding in bitter, white milky latex; leaves 4-7 in a whorl, coriaceous, whitish beneath, obovate or elliptic or oblong, obtuse acuminate, 30-60 pairs of horizontal veins joining an intramarginal one; cymes peduncled or sessile, umbellately branched; flowers aromatic, greenish white, small greenish white numerous in umbellate panicles, corolla tube short, very strongly scented; fruit follicles, 30-60 cm long; seeds papillose with brownish hair at each end. (Kirtikar *et al* 1980 and Nadkarni *et al* (1976).

#### Vernacular name:-

**English:-** Dita bark, White cheese wood., **Hindi:-**Chatian, Satuin., **Sanskrit:-**Saptaparni., **Bengali:-** Chattin., **Tamil:-**Pala., **Gujarti:-**Saptaparni

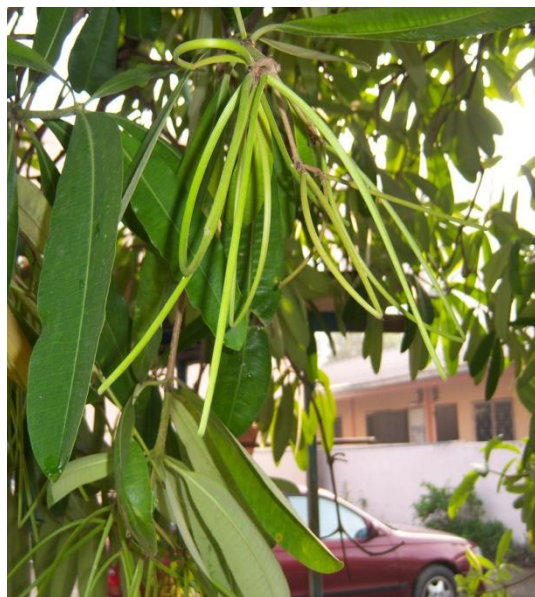
#### Systematic Position:-

Plantae  
Gentianales  
Apocynaceae  
Plumeriae

**Alstoniinae**  
***Alstonia***  
***Alstonia scholaris***



**Fig.1. *Alstonia* Plant**



**Fig.2. *Alstonia* Fruit**

**PHYTOCHEMISTRY**

*Alstonia scholaris* (Linn) is known to be a rich source of alkaloids (about 180 alkaloids) isolated, so far only few have been assessed for biological activities. (Versha *et.al* 2003) The bark of this plant contains alkaloid ditamine and echitamine, echitenine, echicaoutchin, an amorphous yellow mass, echicerin in acicular crystals, echitin in crystallized scales, echitein in rhombic prisms, resembling an alkaloid, a fatty acid and fatty resinous substance. Steve Thomas *et.al* (2007) reported the isolation of a new secoiridoid glucoside alstonoside, together with two known isoflavone apio-glucosides, formononetin 7- $\beta$ -D-apiofuranosyl(1-6)- $\beta$ -D-glucopyranoside and biochanin A 7- $\beta$ -D apiofuranosyl-(1-6)- $\beta$ -D-glucopyranoside are reported. Atta-ur-Rahman *et.al*(1985) reported the isolation of an anilinoacrylate alkaloid, scholaricine, from the leaves of *Alstonia scholaris* to which structure 2-(demethylschoarine) has been suggested. They also reported the isolation of 19, 20. dihydrocondylocarpinalkloid from the leaves of *Alstonia scholaris* (Atta-ur-Rahman *et.al* 1986). In 1987 they also isolated 19-20 -Z- Vallesamine and 19,20-E-Vallesamine from *Alstonia scholaris*. Yamauchi.*et.al* (1990). 17- $\beta$ - Acetylechitamine was isolated from the bark of the plant along with echitamine. In 1990 they also isolated several alkaloids from the leaves of *A. scholaris*. They reported that the leaves of plants from Taiwan and Thailand showed similar alkaloids patterns, with picrinine, nareline and alschomine as the major alkaloids. Alkaloids are one of the major constituents of the species (Dutt, 1944; Boonchuay and Court, 1976a; Rahman and Alvi,1987; Kam *et al.*, 1995; Hadi and Bremmer, 2001; Mahidol *et al.*,2002; Dai *et al*, 2008; Cai *et al.*, 2010; Jain *et al.*, 2009a,b). Among different alkaloids, Echitamine (Govindachari and Rajappa, 1961. Constituents have been reported from different parts of the plant such as bark (Manohar and Ramaseshan, 1961; Yamauchi *et al.*, 1990b; Gupta *et al.*, 2002; Salim *et al.*, 2004; Feng *et al.*,2009); leaves (Chatterjee *et al.*, 1965; Banerji and Banerje, 1977;Rahman *et al.*, 1986; Yamauchi *et al.*, 1990a,b; Zhou *et al.*, 2005;Macabeo *et al.*, 2005; Cai *et al.*, 2008b; Hirasawa *et al.*, 2009); roots (Boonchuay and Court, 1976b); flowers (Dutta *et al.*, 1976)and fruits (Wongseripipatana *et al.*, 2004).

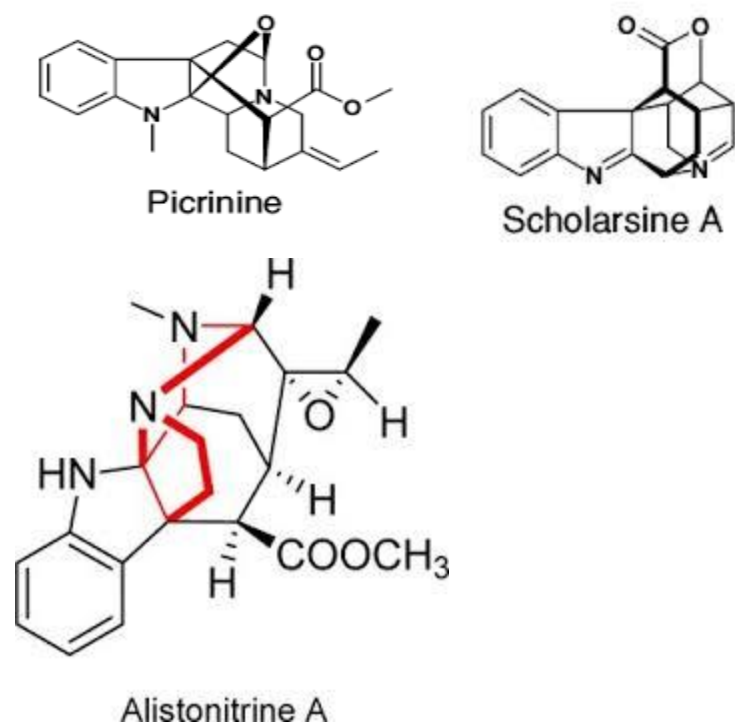


Fig. 3. Chemical constitute of *A. Scholaris*

### ETHNOBOTANY

The plant is traditionally being used in debility (Rahmatullah *et al.*, 2009), arthritis (Yusuf *et al.*, 2006) diabetes, ulcer (Nadkarni *et al.* 1976), stomachache, malarial fever, pimple, dental care (Singh *et. al* (2005) importance (Zashim Uddin *et al.*, 2006), wounds and earache (Bharadwaj and Gakhar, 2005), asthma (Saikia, 2006; Vikneshwaran *et al.*, 2008), dog bite (Prusti and Behera, 2007), fever (Rajakumar and Shivanna, 2010), cancer, tumour, jaundice, hepatitis, malaria, skin diseases (Mollik *et al.*, 2010), diarrhea (Dash and Padhy, 2006) leprosy, mental disorders, cardiopathy, helminthiasis, pruritus, agalactia (Singh and Sangwan, 2011), hypertension (Bhogayata *et al.*, 2009), dental or gum problem (Sen *et al.*, 2011), abdominal pain after delivery (Deb *et al.*, 2009; Sharma and Kumar, 2011) and swelling (Deb *et al.*, 2009). It is also used as aphrodisiac (ZashimUddin *et al.*, 2006), antidote to poison (Mollik *et al.*, 2010), abortifacient (Ayyanar and Ignacimuthu, 2005), astringent, thermogenic, cardiotoxic (Singh and Sangwan, 2011), stomachic and expectorant ( Sen *et al.*, 2011).

### PHARMACOLOGY

The bark, stem, roots and the leaves have been used traditionally as folk remedies for the treatment of many diseases. The bark is bitter, astringent, acrid, digestive, febrifuge, stomachic, cardiotoxic and tonic. It is useful in fever, malarial fever, diarrhoea, dysentery, skin diseases, ulcers, asthma, bronchitis, cardiopathy, agalactia and debility. The milky exudate is bitter and is good for ulcers. (Kirtikar *et al.* 1980 and Nadkarni *et al.* 1976). The ripe fruits are used to treat insanity due to syphilis and epilepsy. The most extensively used part of the plant is the bark which is a component of many compound herbal formulations. The bark extract of the powdered stem bark is a bitter tonic and febrifuge, useful for the treatment of malaria, diarrhea and dysentery. (Baliga *et al.* 2004). The plant has been reported for anticancerous (Kamarajan *et al.* 1991; Saraswathi *et al.* 1997,1998,1999; Keawpradub *et al.* 1997; Jagetia *et al.* 2003; 2005; Jagetia and Baliga, 2003a,b; 2004; 2005; 2006; Nersesyan *et al.* 2004; Baliga, 2010; Jahan *et al.* 2009a; Jain *et al.* 2009c); anti-tussive, anti-asthmatic and expectorant (Shang *et al.* 2010a); anti-inflammatory and analgesic (Karawya *et al.* 2010; Shang *et al.* 2010b; Arulmozhi *et al.* 2012); antipyretic (Surwase *et al.* 2009); anti-ulcerogenic (Arulmozhi *et al.* 2012); anti-diarrhoeal (Patil *et al.* 1999; Shah *et al.* 2010)

## FOLKLORIC USES

1. **Fevers:** The herb is a substitute for quinine and cinchona. It is used widely for treating the problem of intermittent and remittent fevers. The powder of the plant is taken in the dosage of 2-6 grams. An infusion created from the extracts from the bark of the tree is known to cure malarial fever.
2. **Diarrhea and dysentery:** The plant is effect in cases of chronic dysentery and diarrhea.
3. **Skin disorders:** the extract from the tree of *Alstonia scholaris* is helpful in treating acne, ringworm and eczema.
  - The paste made from the bark of the tree if applied on wounds can be benefiting
  - The bark powder is used to cure pain in the abdomen and lumps
  - The twigs of the tree are used as a toothbrush because of its bactericidal properties
  - The *Alstonia scholaris* is used to improve appetite of new mothers.
  - The plant increases lactation in new mothers
  - The paste of the bark of the evergreen tree is applied to cure chronic arthritis.
  - The powder of the flower of the *Alstonia scholaris* is used in case of headaches
  - The roasted leaves of the tree is made into a poultice and used as a stimulant on ulcers.
  - This herb is also prescribed for curing leprosy
  - The juice of the bark is used to cure sores, tooth pains, ulcers and rheumatism.
  - The fruits of the tree cure insanity as well as epilepsy.

## Antimicrobial activity

The leaf extract have antimicrobial properties(Versha *et.al* 2003; Sirohi *et.al* 2009; Thankamani 2011; Singh and Sangwan 2011) while the alcoholic extract from the stem bark showed anticancer activity in HSI human sarcoma in embryonated egg. (Baliga *et.al* 2004). The antimicrobial property of the plant constitutes of *A.scholaris* (alkanes, alkanols and sterols) (Goyal *et.al* 1995). Evaluated the antibacterial activity of the petrol, dichloromethane, ethyl acetate, butanol fractions of crude methanolic extracts of the leaves, stem and root barks of *Alstonia scholaris* and reported that butanol fractions exhibited broader spectrum of antibacterial activity. (Khan *et.al* 2003).

## AntiCancer activity

The plant has been reported for anticancerous (Kamarajan *et.al* 1991; Saraswathi *et. al* 1997, 1998, 1999; Keawpradub *et.al.*,1997; Jagetia *et.al.*, 2003; 2005; Jagetia and Baliga, 2003a,b; 2004;2005; 2006; Nersesyan *et.al* 2004; Baliga, 2010; Jahan *et.al.*,2009a; Jain *et. al* 2009c); An 85% ethanolic bark extract of *A. scholaris* showed antitumor and radiation sensitizing activity against a mouse transplantable tumor and is cytotoxic to human tumor cell lines . (Baliga *et.al* 2004). Methanol extracts of root barks of *Alstonia macrophylla* , *A .glaucescens* and *A. scholaris*, collected from Thailand have been assessed for cytotoxic activity against two human lung cancer cell lines, MOR-P ( adenocarcinoma) and COR-L23 ( large cell carcinoma), using the SRB assay. Pleiocarpamine, O-methylmacralstonine and macralstonine were all considerably less active than villalstonine.(Keawpradub *et.al* 1997).

## Antifertility activity

*A. scholaris* bark extract (200 mg/day for 60 days , orally ) showed significant antifertility effects in male rats as evidenced by marked reductions in the weights of testes, epididymides , seminal vesicle and ventral prostate .(Gupta *et.al* 2002). Step-19 spermatids production was reduced by 79.6% while the population of preleptotene and pachytene spermatocytes was decreased 61.9% and 60.1%, respectively. Spermatogonia, sertoli cell population and areas of the seminiferous tubule and Leydig cell nuclear, were significantly as were other indicators of male fertility. (Gupta *et.al* 2002.)

## Broncho-Vasodilatory activity

The ethanolic extract of the leaves of *A. scholaris* showed broncho - vasodilatory activity. Administration of the plant extract (25,37 and 50 mg/kg , via the jugular vein) to anaesthetised rats at 5min before the administration of

carbachol (10 µm/kg) led to a transient decrease in the normal blood pressure by  $54 \pm 13\%$  and  $81 \pm 7\%$  at doses of 25 and 37 mg/kg respectively. In contrast the inspiratory pressure was increased by  $50 \pm 13\%$  and  $83 \pm 12\%$ , respectively while the expiratory pressure and heart rate remained unchanged. Isoprenaline and salbutamol were the positive controls for the effects of the leaf extract on the carbachol-induced changes. The highest dose of the leaf extract (50 mg/kg) caused a severe decrease in the blood pressure and disturbed the respiratory rhythm. (Channa *et.al* 2005).

### Teratogenic effects

The hydroalcoholic extract of *Alstonia scholaris* extract produced teratogenic effects in mice at doses greater than 240 mg/kg (>20% of the LD<sub>50</sub>) when exposure occurred at day 11 of gestation. The extract at doses of 60, 120, 180, and 240 mg/kg did not cause mortality, congenital malformations, or alter the normal growth patterns. Doses of 360 or 480 mg/kg caused a dose-dependent increase in mortality, growth retardation and congenital malformations, characterized mainly by bent tails and syndactyly. These doses also significantly delayed fur development, eye opening, pinna detachment and vaginal opening. Doses of 240-480 mg/kg also delayed incisor eruption and testes descent. (Jagetia *et.al* 2003.)

### Immunomodulatory activity

The immunostimulating effect of *Alstonia scholaris* bark extracts was studied in BALB/c mouse by (Iwo *et. al* 2000). 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. (Iwo *et.al* 2000).

### Wound healing activity

Wound healing activity of the ethanol and aqueous extracts of *Alstonia scholaris* was tested against excision, incision and dead space wound models (Arulmozhi *et.al.* 2007). The wound healing was assessed by the rate of wound contraction, period of epithelialisation, skin breaking strength, granulation strength, dry granulation tissue weight, hydroxyproline, collagen and histopathology of granulation tissue. Malondialdehyde level was also estimated to evaluate the extent of lipid peroxidation. The extracts promoted wound healing significantly in all the wound models studied. Increased rate of wound contraction, skin breaking strength, granulation strength, dry granulation tissue weight, hydroxyproline and collagen, decrease in the period for epithelialisation and increased collagenation in histopathological section were observed with extracts treated groups. The extracts also significantly decreased the levels of lipid peroxidation.

### Analgesic and anti-inflammatory activities

The effect of ethanolic extract of leaves of *Alstonia scholaris* was evaluated in experimental models of pain and inflammation (Arulmozhi *et.al* 2007). The leaf extract at 200 and 400 mg/kg showed significant decrease in acetic acid induced writhings in mice with a maximum of 65.76% at 400 mg/kg. In hot plate method, the percentage of pain inhibition was found to be 73.90% and 79.56% with 200, 400 mg/kg of extract. There was a significant inhibition in carrageenan induced paw edema with 200 and 400 mg/kg of the extract.

## CONCLUSION

The plant has long been investigated for its phytochemicals and pharmacological activities supporting its vast ethnobotanical and alternative medicinal use. The plant *Alstonia scholaris* has a wide range of pharmacological activities and many isolated compounds. Plants, which are used in traditional medicine, require detailed investigation with ethno pharmacological approach. The plant has been reported extensively as anticancerous, antimicrobial, antidiabetic, antibacterial, antifertility and antipsychotic agent. The recently developed isolation, characterization techniques and pharmacological testing have led to interest in plants as a source of new drugs. The pharmacological activity of *Alstonia scholaris*, which will substantiate the use of this plant over centuries for medicinal purposes. In this study Pharmacological activity we observed the *A. scholaris* is medicinally important plant and this study help the traditional knowledge of plants.

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