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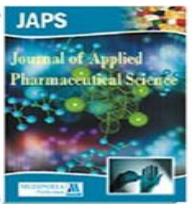

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Alstonia scholaris R.Br. (Apocynaceae): Phytochemistry and pharmacology: A concise review

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ABSTRACT

Alstonia scholaris is a traditionally important medicinal plant. This evergreen tree is native to the Indian subcontinent and Southeast Asian countries. The plant is used in 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. Among the phytochemicals, alkaloids are mostly reported. This review compiles reports on phytochemical and pharmacological aspects of *A. scholaris*.

Key words: *Alstonia scholaris*, Apocynaceae, Phytochemistry, Pharmacology, Alkaloids, Medicine.

INTRODUCTION

Alstonia scholaris R.Br. (Family: Apocynaceae) (also known as Devils tree, Dita Bark tree) has long being used as a traditional medicine to cure various human and livestock ailments. The plant is grown in the lowland and mountain rainforests of India, the Asia-Pacific, Southern China and Queensland (Wiart, 2006). The plant grows throughout the humid regions of India, especially in West Bengal and west-coast forests of south India. The plant is used in Ayurvedic, Unani and Sidhha/Tamil types of alternative medicinal systems (Khare, 2007).

SYSTEMATIC POSITION

Kingdom: Plantae
Order: Gentianales
Family: Apocynaceae
Tribe: Plumeriae
Subtribe: Alstoniinae
Genus: *Alstonia*
Species: *Alstonia scholaris*

ETHNOBOTANY

The plant is traditionally being used in debility (Rahmatullah et al., 2009), arthritis (Yusuf et al., 2006), impotence (Zashim Uddin et al., 2006), wounds and earache (Bharadwaj and Gakhar, 2005), asthma (Saikia, 2006; Vikneshwaran et al., 2008), leucorrhoea (Bhandary et al, 1995), 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),

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Fig 1: *Alstonia scholaris* habit

Fig 2: *A. scholaris*: arrangement of the leaves.

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 (Zashim Uddin et al., 2006), antidote to poison (Mollik et al., 2010), abortifacient (Ayyanar and Ignacimuthu, 2005), astringent, thermogenic, cardiotonic (Singh and Sangwan, 2011), stomachic and expectorant (Sen et al, 2011). Reports are available on its ethnoveterinary use such as fever in cattle (Harsha et al., 2005; Bharati and Sharma, 2010). Ayurvedic use is found in phosphaturia and as a blood purifier (Khare, 2007).

PHYTOCHEMISTRY

Analysis of phytochemical constituents (Chakravarti et al., 1955, 1956; Talapatra et al., 1967, 1968; Banerji and Banerji, 1975; Dhar et al., 1977; Banerji and Chakrabarti, 1984; Banerjee et al., 1984; Arambewela and Ratnayake, 1991; Varshney and Goyal, 1995; Mahajan and Badgujar, 2008; Deepthi et al., 2008; Khyade and Vaikos, 2009a; Thenmozhi et al., 2010; Dutta et al., 2010; Thankamani, 2011) and pharmacognosy (Datta and Datta, 1984; Upadhye et al., 2006; Ansari et al., 2006; Hemalatha et al., 2008; Dutta and Laskar, 2009; Khyade and Vaikos, 2009b) of the species have been reported by many authors.

Alkaloids are one of the major constituents of the species (Dutt, 1944; Boonchuay and Court, 1976a; Rahman and Alvi, 1987; Kam et al., 1997; 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; Manohar and Ramaseshan, 1961; Fritz and Fischer, 1964); Echitamine chloride (Kamarajan et al., 1991; Saraswathi et al., 1997,1998,1999); Rhazine (Chatterjee et al., 1969); Nareline (Morita et al., 1977); Pseudo Akuammigine (Banerji and Banerje, 1977); Scholarine (Banerji and Siddhanta, 1981); Scholaricine (Banerji, 1981; Rahman et al., 1985); Dihydrocondylocarpine, (Rahman et al., 1986); 19, 20-Z-Vallesamine and 19, 20-E-Vallesamine (Rahman et al., 1987); Picrinine (Ghosh et al., 1988); Alschomine and Isoalschomine, (Abe et al., 1989); Mataranine A and B (Hadi, 2009); monoterpenoid indole alkaloids (Cai et al., 2007; 2008a; Feng et al., 2009); Picralinal of picralima group (Rastogi et al., 1970); Picrinine-type alkaloids (Cai et al., 2008b); N^1-methoxymethyl Picrinine (Wang et al., 2009) etc. have been reported. 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).

Among the other constituents, Isookanin-7-o-alpha-l-rhamnopyranoside, a new flavanone glycoside (Chauhan et al., 1985) and Alstonoside, a secoiridoid glucoside (Thomas et al., 2008) have been recorded. Iridoids, coumarins, flavonoids, leucoanthocyanins, reducing sugars, simple phenolics, steroids, saponins and tannins were also found in the plant (Khyade and Vaikos, 2009a). Presence of agr-amyrin, bgr-amyrin, lupeol acetate, venenative, rhazine and yohimbine have been noted (Gupta et al., 2002), Linalool, cis- and trans-linalool oxides (furanoid and pyranoid), alpha-terpineol, 2-phenylethyl acetate and terpinen-4-ol (Dung et al., 2001) and steroids (Singh et al., 2010b) are among the other phytoconstituents of the species.

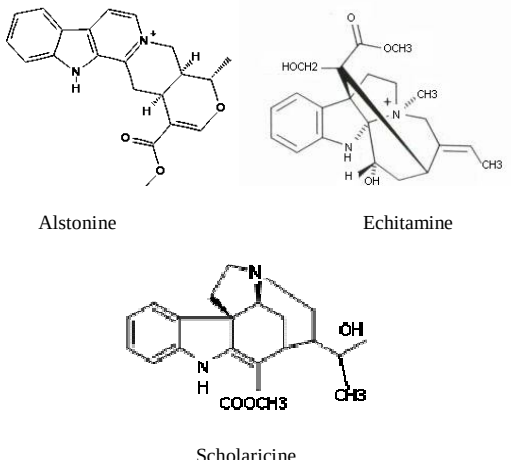

Fig. 3 Chemical constituents of *A. scholaris*

In another investigation, unusual 2,3-secofernane triterpenoids, Alstonic acids A and B were found (Wang et al., 2009). Three new triterpenoids, two of the ursane type, 3β -acetate-24-nor-urs-4,12-diene ester triterpene and 3β -hydroxy-24-nor-urs-

4,12,28-triene triterpene , and one of the oleanane type, 3,28-β -diacetoxy-5-olea-triterpene and two triterpenes, α-amyrin acetate and ursolic acid have also been recorded (Sultana and Saleem, 2010). Ursolic acid (pentacyclic triterpene acid) (Shetty et al., 2007), lupeol acetate (Gupta et al., 2005), flavonoids (Hui et al., 2009); monoterpene (Datta and Mathur, 1987), triterpene (Chakravarti et al., 1957, 1960; Wang et al., 2009; Singh et al., 2010b); iridoids (Feng et al., 2008) have been reported from the plant. Apart from those, two C13-norisoprenoids namely megastigmane-3β, 4α, 9-triol, 7-megastigmene-3,6,9-triol (Xu et al., 2009); C13-norisoprenoid (Xu et al., 2009) have been found.

The plant has been investigated as a source of biocrude and solid fuel (Sharma and Prasad, 1986), alternative energy (Augustus et al., 2003) and isoprene emission (Padhy and Varshney, 2005).

PHARMACOLOGY

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); antipsychotic (Campos et al., 1999, 2004a; de Moura Linck et al., 2008); anxiolytic (Costall and Naylor, 1995; Campos et al., 2004b; Arulmozhi et al., 2008); antioxidant and free radical scavenging (Arulmozhi et al., 2007a; 2010a; Ravi Shankar et al., 2008; Kumar et al., 2010); immunostimulating (Iwo et al., 2000); hepatoprotective (Lin et al., 1996); wound healing (Arulmozhi et al., 2007b); antinociceptive (Arulmozhi et al., 2007c); antidiabetic and antihyperlipidemic (Arulmozhi et al., 2010b; Bandawane et al., 2011); hypoglycaemic (Akhtar and Bano, 2002; Sonawane and Lohar, 2011); antiarthritic (Arulmozhi et al., 2011); antidiarrhoeal (Patil et al., 1999; Shah et al., 2010) and spasmolytic (Shah et al., 2010), anti-stress (adaptogenic) and nootropic (Kulkarni and Juvekar, 2009); antifertility (Choudhary et al., 1991; Gupta et al., 2002, 2005); broncho-vasodilatory (Channa et al., 2005); nitric oxide scavenging (Jagetia and Baliga, 2004); radioprotective (Gupta et al., 2008, 2010a,b; Jahan et al., 2009b; Jahan and Goyal, 2010); neuropharmacological (Bhattacharya et al., 1979); α-Glucosidase inhibitory (Jong-Anurakkun et al., 2007); antibacterial (Khan et al., 2003; Deepthi et al., 2008; Khyade and Vaikos, 2009a; Patel, 2010; Hussain et al., 2010; Dutta et al., 2010; Dash and Murthy, 2011; Gami and parabia, 2011a); antimycobacterial (Macabeo et al., 2008); antimicrobial (Versha et al., 2003; Sirohi et al., 2009; Thankamani, 2011; Singh and Sangwan, 2011); antifungal (Riaz et al., 2010); antiplasmodial (Keawpradub et al., 1999); antimalarial (Gandhi and Vinayak, 1990); larvicidal (Kaushik and Saini, 2009); schizonticidal (Patel et al., 2010; Gami and parabia, 2011b); antileishmanial (Singha et al., 1992); molluscicidal (Singh and Singh, 2003a,b; 2005; Singh et al., 2010; Chauhan and Singh, 2010); anti-cholinesterase (Singh et al., 2003b); antiparasitic (Monzon, 1995); phytotoxic (Javaid et al., 2010); piscicidal (Singh and Singh, 2010); anti hypertensive (Bhogayata et al., 2009); aphrodisiac (Dweck, 2007) activities. Alstonine, the alkaloid, (Elisabetsky and Campos, 2006) is reported to have anticancerous property (Beljanski and Beljanski, 1982, 1986).

The plant was also reported for some negative pharmacological aspects such as teratogenic (Jagetia and Baliga, 2003c); toxic (Baliga et al., 2004); irritant and allergenic (Pasricha and Agarwal, 1990) properties. Antimicrobial activity of endophytic fungi from the plant was reported (Mahapatra and Banerjee, 2010).

CONCLUSION

The plant has long being investigated for its phytochemicals and pharmacological activities supporting its vast ethnobotanical and alternative medicinal use. Traditional use of this plant has been validated by several pharmacological investigations. The plant has been reported extensively as anticancerous, antimicrobial, molluscicidal, anxiolytic and antipsychotic agent. However, many of the diseases treated indigenously using the plant have not been confirmed in the laboratory. This leaves an opportunity to explore the species both phytochemically and pharmacologically. Therefore, ethnopharmacology can bridge between the folklore use and actual pharmacological efficacy of the medicinal plant. In this way it may be used in novel drug discovery programs in the future.

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