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# *Alstonia scholaris*: It's Phytochemistry and pharmacology

## Abstract

Complementary therapies based on herbal medicines are the world's oldest form of medicine and recent reports suggest that such therapies still enjoy vast popularity, especially in developing countries where most of the population does not have easy access to modern medicine. *Alstonia scholaris* (L.) R.Br (Apocynaceae) is an evergreen tropical tree native to Indian sub-continent and South East Asia, having grayish rough bark and milky sap rich in poisonous alkaloid. It is reported to contain various iridoids, alkaloids, coumarins, flavonoids, leucoanthocyanins, reducing sugars, simple phenolics, steroids, saponins and tannins. It has been reported to possess antimicrobial, antiamebic, anti-diarrheal, antiplasmodial, hepatoprotective, immunomodulatory, anticancer, antiasthmatic, free radical scavenging, antioxidant, analgesic, anti-inflammatory, antiulcer, antifertility and wound healing activities. In other parts of the world, it is used as a source cure against bacterial infection, malarial fever, toothache, rheumatism, snakebite, dysentery, bowl disorder, etc. Reports on the pharmacological activities of many isolated constituents from *A. scholaris* (L.) R.Br are lacking, which warrants further pharmacological studies.

### Key words:

*Alstonia scholaris* (L.) R.Br, echitamine, pharmacology, phytochemistry, review

## Introduction

Complementary therapies based on herbal medicines are the world's oldest form of medicine and recent reports suggest that such therapies still enjoy vast popularity, especially in developing countries where most of the population does not have easy access to modern medicine.<sup>[1]</sup> The traditional Indian system of medicine, Ayurveda, which means the science of life, is one of the world's oldest systems of medicines. Ayurveda mainly uses plant-based formulas developed through the experimentation and experiences of doctors for centuries.<sup>[2]</sup>

*Alstonia scholaris* (L.) R.Br (Apocynaceae) is an evergreen tropical tree native to Indian sub-continent and South East Asia, having grayish rough bark and milky sap rich in poisonous alkaloid. This plant is a native of India, Sri Lanka, Pakistan, Nepal, Thailand, Burma, Malaysia, South East Asia, Africa, Northern Australia, Solomon Islands, and Southern China.<sup>[3-8]</sup> The plant is a large evergreen tree,

growing up to 17–20 m in height, with a straight often fluted and buttressed bole, about 110 cm in diameter. Bark is grayish brown, rough, lenticellate abounding, bitter in taste secreting white milky latex. Leaves are 4–7 in a whorl, coriaceous, elliptic-oblong. Flowers are small, greenish white, many in umbellate panicles, corolla tube is short, very strongly scented. Fruits have follicles, 30–60 cm long. Seeds are papillose with brownish hair at each end.<sup>[4(80-83),5(111-114)]</sup> The bark, also called dita bark, is traditionally used by many ethnic groups of North East India and other parts of the world as a source cure against bacterial infection, malarial fever, toothache, rheumatism, snakebite, dysentery, bowl disorder, etc. Also, the latex is used in treating coughs, sores and fever.<sup>[4,9,10]</sup> It is a beautiful foliage tree with a large canopy, and because of this, it has become a popular ornamental tree in the landscapes and gardens in the warm and temperate regions of Florida, Texas, and California in the United States.<sup>[3]</sup>

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**Table 1: Important chemical constituents from different parts of *Alstonia scholaris***

Part used	Extract/oil	Chemical constituent	Ref.	
Flower	Flower extract	3 $\beta$ -acetate-24-nor-urs-4,12-diene ester triterpene and 3 $\beta$ -hydroxy-24-nor-urs-4,12,28-triene triterpene and one of the oleanane types, 3,28- $\beta$ -diacetoxy-5-olea-triterpene together with two known triterpenes, $\alpha$ -amyirin acetate and ursolic acid	[14]	
	Volatile oil	Principal constituents were linalool (35.7%), <i>cis</i> - and <i>trans</i> -linalool oxides (furanoid and pyranoid) (14.7%), $\alpha$ -terpineol (12.3%), 2-phenylethyl acetate (6.3%) and terpinen-4-ol (5.6%). The volatile concentrate contained more than 90% of oxygenated compounds, which contributed to its fragrant odour	[15]	
	Column fraction	<i>n</i> -hexacosane, lupeol, palmitic acid, $\beta$ -amyirin and ursolic acid	[16]	
Bark	Column fraction	Picrinine and strictamine	[17]	
	Root bark	Two triterpenoids, $\alpha$ -amyirin acetate and lupeol, and a steroid, $\beta$ -sitosterol	[18]	
	Trunk bark	A new indole alkaloid, akuammiginone, and a new glycosidic indole alkaloid, echitamidine- <i>N</i> -oxide 19- <i>O</i> - $\beta$ -D-glucopyranoside, together with the five known alkaloids, echitamic acid, echitamidine <i>N</i> -oxide, <i>N</i> -demethylalstogustine <i>N</i> -oxide, akuammicine <i>N</i> -oxide, and <i>N</i> -demethylalstogustine	[19]	
	Alkaloidal extract	Six new monoterpenoid indole alkaloids, scholarisines B–G together with 15 known analogues, were isolated from the bark of <i>A. scholaris</i>	[20]	
	Bark	Triterpenoids $\alpha$ -amyirin acetate and lupeol	[21]	
	Ethanol extracts	Four new 11-noriridoids, namely, scholareins A–D, along with three known derivatives, isoboonein, alxialactone, and loganin	[22]	
	Alcoholic extracts	17- <i>O</i> -acetylechitamine and echitamine	[23]	
		Contain scholarisine I and scholarisine II	[24]	
	Leaves	Leaves extract	The eight elements, Cu, Zn, Fe, Mg, Ca, Cr, Mn and Cd, were extracted from the leaves of <i>A. scholaris</i> based on traditional analytical flowchart program and separated into water-soluble state and suspension state by microporous filtering film	[25]
		Column fraction	Iridoids, alkaloids, coumarins, flavonoids, leucoanthocyanins, reducing sugars, simple phenolics, steroids, saponins and tannins	[26]
Methanolic extract		A new indole alkaloid, akuammidine- <i>N</i> -oxide together with akuammidine	[27]	
Leaves extract		Eight flavonoids were isolated and identified: kaempferol, quercetin, isorhamnetin, kaempferol-3- <i>O</i> - $\beta$ -D-galactopyranoside, quercetin-3- <i>O</i> - $\beta$ -D-galactopyranoside, isorhamnetin-3- <i>O</i> - $\beta$ -D-galactopyranoside, kaempferol-3- <i>O</i> - $\beta$ -D-xylopyranosyl-(2-1)- <i>O</i> - $\beta$ -D-galactopyranoside, quercetin-3- <i>O</i> - $\beta$ -D-xylopyranosyl-(2-1)- <i>O</i> - $\beta$ -D-galactopyranoside	[28]	
Methanol percolate		Lagunamine (19-hydroxytubotaiwine), angustilobin B acid and losbanine (6,7-seco-6-nor-angustilobine B) together with tubotaiwine, its oxide and 6,7-seco-angustilobine B	[23]	
Leaves extract		19-episolaricine, <i>N</i> -methylscholaricine, <i>N</i> -methylburnamine and vallesamine <i>N</i> -oxide	[29]	
<i>n</i> -Hexane extract		The predominant <i>n</i> -alkanes were C <sub>31</sub> (46.43%) and C <sub>33</sub> (21.85%), while C <sub>29</sub> (6.16%), C <sub>32</sub> (4.28%), C <sub>25</sub> (3.74%) were moderately abundant. The C <sub>17</sub> (0.39%) and C <sub>22</sub> (0.44%) <i>n</i> -alkanes were present only in minor amounts	[30]	
Hydro-alcoholic extract		2,3-Secofernane triterpenoids, alstonic acids A and B, together with an indole alkaloid, <i>N</i> -methoxymethyl picrinine	[31]	
Column fraction		Megastigmane-3 $\beta$ , 4 $\alpha$ , 9-triol and 7-megastigmane-3,6,9-triol	[32]	
Ethanol extract		Unprecedented cage-like alkaloid, scholarisine A	[33]	
Ethanol extract		Four picrinine-type monoterpenoid indole alkaloids, 5 $\beta$ -methoxyaspidophylline, picrinine, picralinal and 5-methoxystrictamine	[34]	
Leaves extract		Fourteen compounds were obtained and the structures were elucidated as: cycloeucalenol, $\alpha$ -amyirin acetate, $\beta$ -amyirin-3-palmitate, lupen-3-ol, lupen-3-palmitate, $\beta$ -sitosterol, squalene, $\alpha$ -tocopherol, $\alpha$ -tocopherolquinone, bis(2-ethylhexyl) phthalate, dibutyl phthalate, 1-hydroxy-3,5-dimethoxyxanthone, 7,3',4'-trimethoxy-5-hydroxyflavone, 3,5,7,4'-tetrahydroxyflavone-3- <i>O</i> - $\beta$ -D-glucoside	[35]	
Ethanol extract		Monoterpenoid indole alkaloids with a skeleton rearrangement and two additional carbons, named <i>E</i> -alstoscholarine and <i>Z</i> -alstoscholarine	[36]	

Contd...

**Table 1: Contd/-**

Part used	Extract/oil	Chemical constituent	Ref.
	Leaves extract	The structures of these isolated compounds were found to be quercetin 3- <i>O</i> - $\beta$ - <i>D</i> -xylopyranosyl (1" $\rightarrow$ 2")- $\beta$ - <i>D</i> -galactopyranoside and (-)-lyoniresinol 3- <i>O</i> - $\beta$ - <i>D</i> -glucopyranoside	[37]
	Leaves extract	Ursolic acid determined by HPTLC	[38]
	Alcoholic extract	Three new akuamillan-type indole alkaloids, i.e. 5-methoxystrictamine (=methyl (5 $\beta$ ,16 <i>R</i> ,19 <i>E</i> )-5-methoxyakuaramilan-17-oate, methyl (16 <i>R</i> ,19 <i>E</i> )-1,2-dihydro-16-(hydroxymethyl)-5-oxoakuamillan-17-oate, and methyl (2 $\beta$ ,16 <i>R</i> ,19 <i>E</i> )-4,5-didehydro-1,2-dihydro-2-hydroxy-16-(hydroxymethyl)akuamillan-4-ium-17-oate chloride	[39]
	Methanolic extract	The first seco-uleine alkaloids, manilamine (18-hydroxy-19,20-dehydro-7,21-seco-uleine) and N4-methyl angustilobine B, together with the known indole alkaloids, ( <i>E</i> )-vallesamine, angustilobine B N4 oxide, ( <i>S</i> )-tubotaiwine, and 6,7-seco-angustilobine B	[40]
	Leaves extract	Three new indole alkaloids, nareline ethyl ether, 5-epi-nareline ethyl ether and scholarine- <i>M</i> (4)oxide, in addition to nareline methyl ether, picrinine and scholaricine	[41]
	Leaves extract	Picrinine and akuammidine	[42]
	Alcoholic extract	Picalinal	[43]
	Alcoholic extract	A new indole alkaloid, alstonamine, and a sitsirikine type indole alkaloid, rhazimanine	[44]
	Methanol extract	A new alkaloid, 19,20- <i>Z</i> -vallesamine, along with 19,20- <i>E</i> -vallesamine	[45]
	Leaves extract	19,20-Dihydrocondylocarpine	[46]
	Ethanol extract	A new alkaloid, scholaricine, has been isolated. It was elucidated as 2 (demethylscholarine)	[47]
	Ethanol percolate	A new alkaloid designated scholaricine. It was ( $\pm$ )12-methoxyechitamidine	[48]
	Leaves extract	A new indole alkaloid, alkaloid-a, together with echitamine and echitamidine	[49]
Fruit	Pod	A new indole alkaloid, <i>N</i> -formylscholarine, together with picrinine, strictamine and nareline Indole alkaloid picrinine, strictamine and nareline	[50]
	Methanolic extract	Alkaloids 19- <i>E</i> -picrinine, 19- <i>E</i> -akuammidine, 19- <i>E</i> -vallesamine and 19- <i>S</i> -scholaricine	[51]
Root	Bark	$\psi$ -akuammigine; akuammicine; akuammicine- <i>N</i> -methiodide; akuammicine- <i>N</i> -oxide; indole alkaloids; <i>N</i> -demethylechitamine, tubotaiwine	[52]
Stem	Hydro-alcoholic extract	A new secoiridoid glucoside, named alstonoside, together with two isoflavone apioglucoisides, formononetin 7- <i>O</i> - $\beta$ - <i>D</i> -apiofuranosyl-(1 $\rightarrow$ 6)- $\beta$ - <i>D</i> -glucopyranoside and biochanin A 7- <i>O</i> - $\beta$ - <i>D</i> -apiofuranosyl-(1 $\rightarrow$ 6)- $\beta$ - <i>D</i> -glucopyranoside	[53]
	Bark	0.200% total alkaloids, 0.07% steroids and 0.44% resins	[54]
Trunk	Bark	A new indole alkaloid akuammiginone and a new glycosidic indole alkaloid echitamidine- <i>N</i> -oxide 19- <i>O</i> - $\beta$ - <i>D</i> -glucopyranoside together with the five known alkaloids, echitaminic acid, echitamidine- <i>N</i> -oxide, <i>N</i> -demethylalstogustine <i>N</i> -oxide, akuammicine <i>N</i> -oxide and <i>N</i> -demethylalstogustine	[55]
Seed	<i>n</i> -Hexane extract	Oil of mature seed contains oleic acid (65.66%), linoleic acid (12.15%), palmitic acid (13.77%) and stearic acid (8.42%)	[56]

*A. scholaris* (L.) R.Br has been used in traditional systems of medicine for treating various ailments. The ripe fruits of the plant are used in syphilis and epilepsy. It is also used as a tonic, antiperiodic, and anthelmintic. The milky juice of *A. scholaris* (L.) R.Br has been applied to treat ulcers. The bark is the most intensively used part of the plant and is used in many compound herbal formulas.<sup>[4]</sup> It is a bitter tonic, alternative, and febrifuge and is reported to be useful in the treatment of malaria, diarrhea, and dysentery.<sup>[4,7,8,11]</sup> Recently, the leaf extract has also been found to own antimicrobial properties.<sup>[12]</sup> *A. scholaris* (L.) R.Br has also been reported to inhibit liver injuries induced by carbon tetrachloride, beta-*D*-galactosamine, acetaminophen, and ethanol as remarked by the reduced elevation of levels of serum transaminases and histopa-

thologic changes such as cell necrosis and inflammatory cell infiltration.<sup>[13]</sup>

Historically, the plant was scientifically named by Linnaeus as *Echites scholaris*. However, to commemorate the great botanist Professor C. Alston, the generic name was changed to *Alstonia*, whereas the species name *scholaris* was retained to signify its use in schools in South East Asia, where the wood is traditionally used to make blackboards and wooden slates. The other synonyms of the plant include *Tabernaemontana alternifolia* Burm, *Echites pala* Buch-Ham ex Spreng, and *Pala scholaris* (L.) Roberty.<sup>[3,4(pp1308-1315),5(pp337-346)-8]</sup> In Sanskrit, the plant is referred to as *phalagaruda*, *sapthaparna*, and *saptaparni* (*sapta* means 7 and *parna* or *parni* means leaves) because the leaves are found in whorls of 7 [Figure 1].

**Table 2: Pharmacological activities reported from *Alstonia scholaris***

Activity	Part/extract	Animal model/cell lines	Ref.
Antituberculosis	Methanol extract of leaf, stem bark and root bark of <i>A. scholaris</i>	<i>In vitro</i> antituberculosis activity (89% inhibition against <i>Mycobacterium tuberculosis</i> H37Rv at 50 µg/mL) using Microplate Alamar Blue Assay (MABA)	[57]
Antibacterial	The methanol and acetone extract of <i>A. scholaris</i>	Bacterial strain: the Gram-positive bacteria were <i>Staphylococcus aureus</i> (ATCC9144) (SA), <i>Micrococcus luteus</i> (ATCC4698) (ML), <i>Klebsiella pneumoniae</i> (ATCC15380) (KP), <i>Bacillus subtilis</i> (ATCC 6051) (BS), and <i>Pseudomonas aeruginosa</i> (ATCC25668) (PA); <i>Enterobacter aerogens</i> (ATCC13048) (EA), <i>Salmonella typhi</i> (NCTC 8394) (ST) and <i>Salmonella paratyphi</i> A (SPA) were Gram-negative bacteria	[58]
	The crude methanolic extracts of the leaves, stem and root barks of <i>A. scholaris</i>	The microorganisms used were <i>Aspergillus niger</i> , <i>Aspergillus rubrum</i> , <i>Aspergillus versicolor</i> , <i>Aspergillus vitis</i> , <i>Candida albicans</i> , <i>Candida trpicallis</i> , <i>Cladosporium cladosporioides</i> , <i>Penicillium notatum</i> , <i>Trichophyton mentagrophytes</i> , <i>Trichophyton tonsurans</i>	[59]
	<i>A. scholaris</i> leaf powder is extracted with petroleum ether, chloroform, ethyl acetate and methanol	The microorganisms used were <i>Escherichia coli</i> , <i>Salmonella typhi</i> , <i>Staphylococcus aureus</i> , <i>Klebsiella pneumoniae</i> , <i>Shigella dysenteriae</i> , <i>Aspergillus niger</i> and <i>Aspergillus flavus</i>	[26]
Radioprotective	Trunk bark	Two Gram-positive bacteria including <i>Bacillus subtilis</i> and <i>Streptococcus pyogenes</i> and four Gram-negative bacteria including <i>Escherichia coli</i> , <i>Klebsiella pneumoniae</i> , <i>Pseudomonas aeruginosa</i> and <i>Proteus mirabilis</i>	[60]
	Bark	Male Swiss albino mice were studied for cytogenetic alterations in the form of chromosomal aberrations and micronuclei induction in bone marrow by exposing them to 2.5 Gy gamma radiations	[61]
	Hydro-alcoholic extract of bark	Male Swiss albino mice were studied for radiation-induced hematological and biochemical alterations	[62]
Anticancer	<i>A. scholaris</i> extract (ASE) of bark	Dose tolerance of <i>Alstonia scholaris</i> extract (ASE), Dose reduction factor (DRF), Endogenous colonies in spleen, LPx and GSH were studied in Swiss albino mice	[63]
	Bark extract	Radiation-induced biochemical alteration in mice by ameliorated cholesterol and lipid peroxidation	[64]
	Alkaloid fraction	Skin carcinogenesis in Swiss albino mice	[65]
	Ethanollic leaves extract	Cultured human neoplastic cell lines (HeLa, HepG2, HL60, KB and MCF-7) and in Ehrlich ascites carcinoma (EAC) bearing mice	[66]
	Echitamine chloride, a plant alkaloid from <i>A. scholaris</i>	Human cell lines, i.e. lung cancer cells (A-549), oral cancer cells (K3), breast cancer lines (MCF-7), neuroblastoma cancer lines (SW-N-MC), colon cancer cells (SW-620)	[67]
	EAC bearing mice from bark of <i>A. scholaris</i>	Rats have been used to examine the anticancer effects on methylcholanthrene-induced fibrosarcoma	[68]
	Ethanollic extract of stem of <i>A. scholaris</i> (ASE)	EAC bearing mice	[69]
Cytotoxic	Different extracts from stem bark	HeLa cell lines	[70]
	Echitamine chloride	HeLa, HepG2, HL60, KB and MCF-7 cell lines <i>in vitro</i> and in mice bearing EAC	[72]
	Methanol extracts of root barks of <i>Alstonia macrophylla</i> , <i>Alstonia glaucescens</i> , and <i>A. scholaris</i> , collected from Thailand	Human lung cancer cell lines, MOR-P (adenocarcinoma) and COR-L23 (large cell carcinoma), using the SRB assay	[73]
Alteration in phosphatase activity	Bark extract	Exposed to gamma radiation at the source to surface distance (SSD) of 77.5 cm to deliver the dose rate of 1.32 Gy/min	[74]
Chemomodulatory activity	<i>A. scholaris</i> extract (ASE) was studied in combination with berberine hydrochloride (BCL)	EAC bearing mice	[75]
	Combination of 120 mg/kg of ASE with 25 mg/kg of CPA was most effective	Mice transplanted with EAC	[76]
	Hydro-alcoholic extract of <i>A. scholaris</i> (ASE)	Benzo(a)pyrene (BaP) induced forestomach carcinoma in female mice	[77]

Contd...

Table 2: contd/-

Activity	Part/extract	Animal model/cell lines	Ref.
Radiosensitizing effect	Enhancement of the cytotoxic effects of echitamine chloride by vitamin A	EAC cell cultures	[78]
	Echitamine chloride	Modulation of the impaired drug metabolism in sarcoma-180 bearing mice	[79]
	Alkaloid fraction of <i>A. scholaris</i>	Evaluated in various neoplastic cell lines, namely, HeLa, HePG2, HL60, MCF-7, and KB exposed to 0, 0.5, 1, 2, 3, and 4 Gy of $\gamma$ -radiation	[80]
Anti-tussive, anti-asthmatic and expectorant activities	Echitamine chloride from bark of <i>A. scholaris</i>	Inhibition of glycolysis and respiration of sarcoma-180 cells	[81]
	Ethanol extract, fractions and main alkaloids of <i>A. scholaris</i> leaf	The anti-tussive activity was evaluated using three different models including ammonia or sulfur dioxide induced mice coughing and citric acid induced guinea pigs coughing. The anti-asthmatic activity was investigated on guinea pigs' bronchoconstriction induced by histamine. The expectorant activity was evaluated by the volume of phenol red in mice's tracheas	[82]
Broncho-vasodilatory activity	Ethanol extract of <i>A. scholaris</i> (Apocynaceae) leaves	Guinea pig trachea, ileum	[83]
Anti-inflammatory and analgesic	The leaf extract	The analgesic activities were investigated using acetic acid-induced writhing, hot-plate and formalin tests in mice. The anti-inflammatory activities were determined <i>in vivo</i> and <i>in vitro</i> , including xylene-induced ear edema and carrageenan-induced air pouch formation in mice, and COX-1, -2 and 5-LOX inhibition	[84]
Wound healing	Ethanol and aqueous extract of leaves	Excision, incision and dead space wound healing models	[85]
Antidiabetic and antihyperlipidemic	Ethanol extract of the leaves of <i>A. scholaris</i>	Stz induced diabetic rat	[86]
Antidiabetic	Leaf powder of <i>A. scholaris</i>	Powder of leaves of <i>A. scholaris</i> causes a significant decrease in blood glucose level in human volunteers with Non-insulin dependent diabetes mellitus	[87]
Antihypertension	Decoction of bark	In patients with essential hypertension	[88]
Antidiarrheal and spasmolytic activities	Methanol crude extract of <i>A. scholaris</i>	Method used was castor oil induced diarrhea for <i>in vivo</i> antidiarrheal activity and rabbit jejunum <i>in vitro</i> model for spasmolytic activity	[89]
	Antidiarrheal formulation	Charcoal suspension (10%) was used to study the effect of kutajarishta on percent intestinal transit, while its effect on electrolyte, mainly potassium secretion, was studied using glibenclamide in castor oil induced diarrhea	[90]
Immunostimulating <i>In vitro</i> antioxidant and free radical scavenging	Aqueous and the alcoholic bark extracts	Castor oil induced diarrhea. Parameters under study were number of diarrheal episodes and mean wt. of stools of mice	[91]
	Bark extracts	BALB/c mouse	[92]
	Fraction from ethanol extract of leaves of <i>A. scholaris</i>	1,1-diphenyl-2-picryl-hydrazil (DPPH) free radical scavenging, metal ion chelating, hydrogen peroxide scavenging, superoxide anion radical scavenging, and ferric thiocyanate reducing	[93]
Nitric oxide Scavenging Stress and cognition	Methanol extract of fruit and flower	Extract showed significant antioxidant activity by inhibition of DPPH and superoxide production. Free radical scavenging activity is due to the presence of flavonoid	[94]
	Methanol extract of leaves	DPPH assay and plasmid nicking assay	[95]
	Ethanol extract of bark	NO scavenging activity	[96]
	Methanol extract of bark of <i>A. scholaris</i>	Restraint stress model in mice, passive avoidance model and elevated plus maze model	[97]
Anti-anxiety activity	Ethanol extract of <i>A. scholaris</i> leaves (EEAS)	Elevated plus maze, open field, hole board, light dark, mirror chamber and foot shock induced aggression models	[98]
Antimalarial	Methanol extracts prepared from various parts of <i>A. scholaris</i> , <i>A. macrophylla</i> and <i>A. glaucescens</i>	Antiplasmodial activity against multidrug-resistant K1 strain of <i>Plasmodium falciparum</i> cultured in human erythrocytes	[99]
	The petroleum ether extract and methanol extract of the bark of <i>A. scholaris</i>	Antimalarial activity in mice infected with <i>Plasmodium berghei</i>	[100]
Antifertility	Lupeol acetate isolated from benzene extract of <i>A. scholaris</i>	Body weights, weight of reproductive organs, i.e. testes, epididymis, seminal vesicle and ventral prostate, were observed. Testicular sperm count, epididymal sperm count and motility were also evaluated using male albino rats	[101]
	$\alpha$ -Amyrin acetate isolated from the plant <i>A. scholaris</i>	Male albino rats	[102]

Contd...

**Table 2: contd/-**

Activity	Part/extract	Animal model/cell lines	Ref.
	<i>A. scholaris</i> bark extract	Drug showed significant antifertility effect in male rat at this dose level. The primary site of action may be meiotic germ cells	[103]
Antileishmanial	<i>A. scholaris</i> plant extract	Plants were evaluated for antileishmanial activity with <i>Leishmania donovani</i> infected hamsters	[104]
Hepatoprotective	<i>A. scholaris</i> plant extract	Liver injuries induced by carbon tetrachloride (CCl <sub>4</sub> ), β-d-galactosamine, acetaminophen and ethanol were investigated by means of serum biochemical and histopathologic examinations	[105]
Toxicological profile	Different doses up to 2000 mg/kg	The acute and sub-acute toxic effects of various doses of hydro-alcoholic extract of <i>A. scholaris</i> (ASE) were studied in mice and rats	[106]
Teratogenic effect	Hydro-alcoholic extract of <i>A. scholaris</i>	The teratogenic effect was studied in the pregnant Swiss albino mice on Day 11 of gestation	[107]

**Figure 1: *Alstonia scholaris* with fruit pods****Taxonomical classification of *A. scholaris* Linn.****R.Br**

Taxonomy	<i>Alstonia scholaris</i>
Kingdom	Plantae, Planta
Subkingdom	Tracheobionta, vascular plants;
Division	Magnoliophyta, Flowering plants
Class	Magnoliopsida, Dicotyledon
Subclass	Asteridae
Order	Gentianales

**Phytochemistry**

*A. scholaris* Linn. is known to be a rich source of alkaloids and there is interest among the scientists to use this for therapeutic purposes. Amongst the chemical classes present in medicinal plant species, alkaloids stand as a class of major importance in developing new drugs because alkaloids own a great variety of chemical structures and have been identified [Table 1] as being responsible for the pharmacological properties of medicinal plants. Almost all the parts of plant (bark, flower, root) are found to contain active principles [Table 1].

**Pharmacology**

Following are the pharmacological activities of the plant; it has been investigated scientifically in animal models to validate the potential of the plant in cure of variety of ailments as shown in [Table 2].

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